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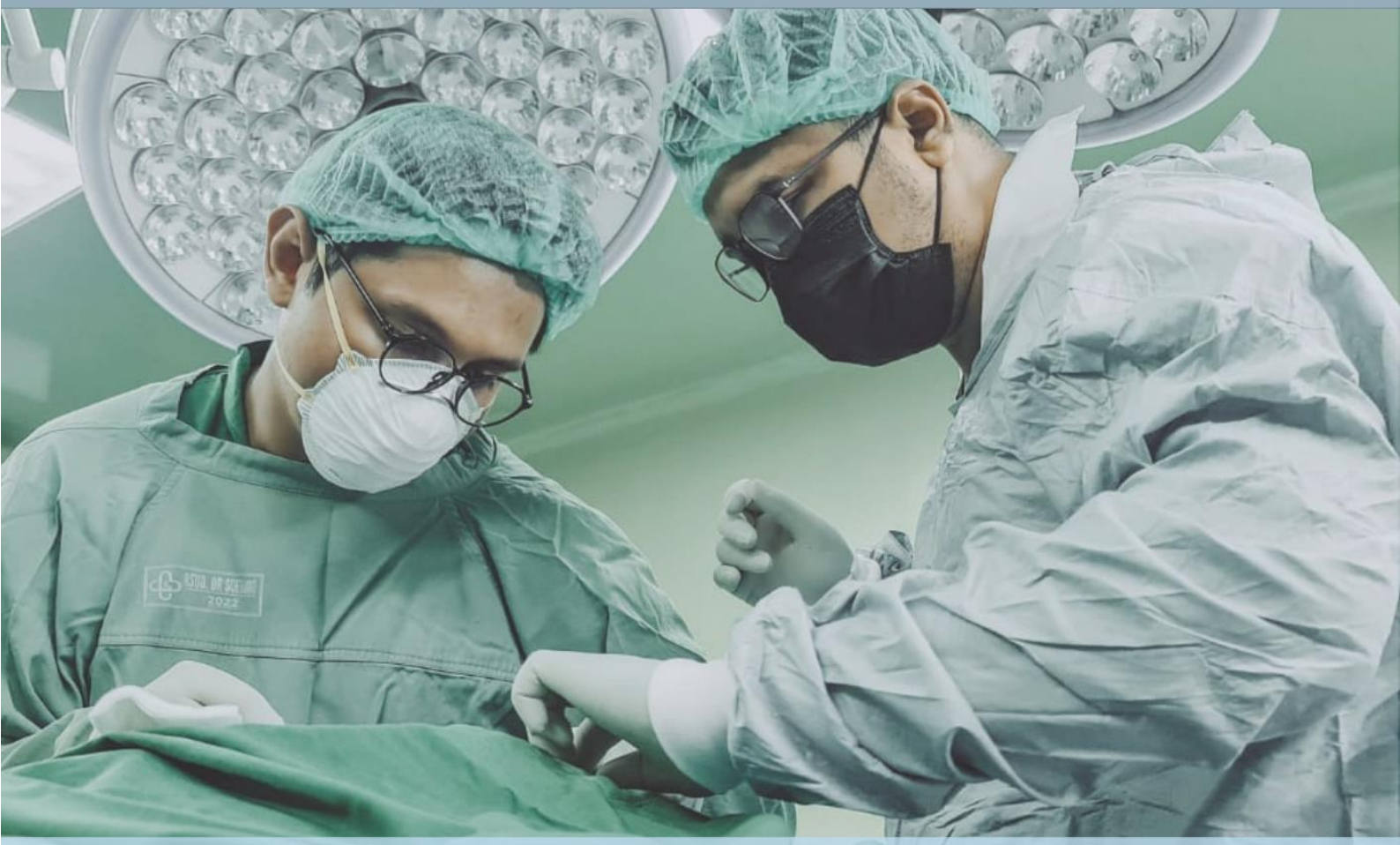

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Original Article

BLOOD TRANSFUSION PRACTICES AT THE INTENSIVE OBSERVATION UNIT (*RUANG OBSERVASI INTENSIF/ROI*) OF DR. SOETOMO GENERAL ACADEMIC HOSPITAL SURABAYA

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ABSTRACT

Introduction: Blood transfusion is the process of transferring blood or its components, such as red blood cells, plasma, and platelets, from donor to recipient. The major reason for blood transfusion is anemia and bleeding, frequently seen in critically ill trauma patients in Intensive Observation Unit (*Ruang Observasi Intensif/ROI*). One of the most prevalent causes of potentially preventable death in trauma patients is uncontrolled bleeding. In addition to controlling the bleeding by surgical or interventional procedures, blood transfusion is carried out to maintain oxygenation to tissue, preventing organ dysfunction due to hypoxia. **Objective:** This study aimed to determine the profile of blood transfusion carried out on the patients in the *ROI* of Dr. Soetomo General Academic Hospital. **Materials and Methods:** This retrospective descriptive study was conducted using medical records involving 258 patients who met the inclusion criteria. **Results:** The result showed that the majority of patients were female, aged 26-35 years, had blood type O, and Rhesus (Rh)-positive, accounting for 55.04%, 26.36%, 39.53%, and 100%, respectively. The most common indication for transfusion was anemia, with a percentage of 69.10%, particularly severe anemia, accounting for 48.45%. Furthermore, 57.36% of patients were from the surgery department, and 36.05% stayed in *ROI* for 2-3 days. The most common blood component and unit transfused was packed red blood cells (PRC), with a percentage of 57.50% and 439 units at 47.82%. Most of the transfusions, with a percentage of 37.80%, were carried out within 3-4 hours. Some patients were experiencing pruritus, febrile, urticaria, and chills, accounting for 0.39%, 0.39%, 0.39%, and 0.39%, respectively. **Conclusion:** Understanding transfusion practices, including blood type distribution, can prevent blood shortage, estimate the need for blood among *ROI* patients in Dr. Soetomo General Academic Hospital, and further ensure that all transfusions are ABO and Rh compatible.

Keywords: ABO Blood Type; Profile; Preventable Death; Rhesus; *Ruang Observasi Intensif* (*ROI*); Transfusion

ABSTRAK

Pendahuluan: Transfusi darah adalah suatu proses memberikan darah atau komponen darah seperti *red blood cells*, plasma, dan platelet dari donor ke resipien. Indikasi transfusi darah yang paling sering adalah anemia dan pendarahan. Pendarahan seringkali terjadi pada pasien trauma di Ruang Observasi Intensif (ROI). Pendarahan yang tidak terkontrol adalah salah satu penyebab paling umum dari kematian yang berpotensi dapat dicegah pada pasien trauma. Selain mengontrol pendarahan dengan pembedahan atau prosedur intervensi lainnya, transfusi darah dilakukan untuk mempertahankan oksigenasi ke jaringan sehingga mencegah disfungsi organ akibat hipoksia. **Tujuan:** Penelitian ini bertujuan untuk mengetahui profil transfusi darah pada pasien di ROI RSUD Dr. Soetomo. **Metode dan Bahan:** Penelitian ini merupakan penelitian deskriptif retrospektif yang menggunakan rekam medis. Didapatkan 258 pasien yang memenuhi kriteria inklusi. **Hasil:** Penelitian ini menunjukkan bahwa sebagian besar pasien adalah perempuan (55.04%), berumur 26-35 tahun (26.36%), golongan darah O (39.53%) dan rhesus positif (100%). Indikasi transfusi darah paling sering adalah anemia (69.10%) dengan derajat berat (48.45%). Sebagian besar pasien berasal dari departemen bedah (57.36%) dan tinggal di ROI selama 2-3 hari (36.05%). Komponen darah yang paling sering diberikan adalah *packed red blood cells* (PRC) (57.50%) sebanyak 439 kantong (47.82%). Sebagian besar transfusi diberikan dalam waktu 3-4 jam (37.80%). Beberapa resipien mengalami pruritus (0.39%), febris (0.39%), urticaria (0.39%), dan menggigil (0.39%). **Kesimpulan:** Pemahaman mengenai profil transfusi darah seperti distribusi golongan darah dapat mencegah kekurangan darah dan

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memperkirakan kebutuhan darah pada pasien ROI RSUD Dr. Soetomo, dan memastikan semua transfusi darah yang dilakukan kompatibel terhadap ABO dan rhesus pasien.

Kata kunci: Golongan Darah ABO; Profil; Kematian Yang Dapat Dicegah; Rhesus; Ruang Observasi Intensif (ROI); Transfusi

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INTRODUCTION

Blood transfusion is the process of transferring blood or its components, such as plasma, red blood cells, or platelets, from the donor to the recipient (1). It is a potentially life-saving procedure by replacing blood loss due to surgery, injury, and certain medical conditions (2). The need for blood transfusion in this world is increasing, and it is required by approximately 1 out of 7 patients who are admitted to the hospital (3). The transfusion of red blood cells or other products is a common intervention in intensive care unit (ICU) patients. Furthermore, about 40%-50% of critically ill patients in the ICU received a blood transfusion during their period of hospitalization (4). It has also been estimated that 1 out of 4 critically ill patients in ICU receives red blood cell transfusion (5).

These practices include planning as well as providing and distributing blood, which is facilitated by the transfusion unit. It also includes giving blood to the patients, which is facilitated by the hospital blood bank. The transfusion unit will provide the blood or its component to the hospital blood bank according to the requests. Furthermore, the blood and its component screened in advance for ABO and Rhesus (Rh) group, as well as transfusion-transmitted diseases. The blood units will only be delivered to the hospital when the screening for transfusion-transmitted disease is non-reactive. Meanwhile, pre-transfusion testing is carried out to confirm the presence of antibodies in the recipient that will react to the donor's red cells when transfused (6).

This study focuses on assessing blood transfusion practices in Intensive Observation Unit (*Ruang Observasi Intensif/ROI*) as it is a common intervention in treating patients, specifically with trauma. Patients in severe condition or with life-threatening organ insufficiency are treated and monitored in the Emergency Care Unit (Instalasi Rawat Darurat/IRD) of Dr. Soetomo General Academic Hospital. The critically ill patients in *ROI*, which are in the postoperative period, frequently need a blood transfusion, a common intervention for most experiencing anemia and bleeding.

Uncontrolled bleeding in trauma patients is the most prevalent cause of potentially preventable death (7). It is treated by first identifying the potential source of bleeding and controlling it through surgical or interventional procedures (8). One of the steps includes hemostatic resuscitation to maintain oxygenation to tissue and prevent death caused by bleeding (9). The management may include fluid replacement using crystalloids and transfusion of RBC, which is a blood product. RBC transfusion generally aims to correct hemoglobin (Hb) levels. Inadequate correction of low Hb levels will result in organ failure due to low oxygenation to tissue and hypoxia, hence, blood transfusion is required to prevent dysfunction (10). Previous studies showed that early resuscitation and transfusion of blood products are likely to reduce mortality rates in trauma patients (9).

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This study aims to assess the clinical profile of blood transfusion practices in *ROI*, including the pre-transfusion procedure. It will help identify the reasons and triggers for blood transfusion in hospitals and reduce unnecessary and unsafe practices to prevent reactions in the future. It also evaluates the profile of the transfusion recipients, such as age, gender, ABO, and Rh blood types.

MATERIAL AND METHOD

This descriptive retrospective study was conducted using secondary data based on the medical records of patients who experienced blood transfusion in *ROI* from January 1 to December 31, 2020. The total sampling technique was adopted where the inclusion criteria were adult patients (>17 years old) who experienced blood transfusion in *ROI* Dr. Soetomo General Academic Hospital Surabaya from January to December 2020. Meanwhile, patients with incomplete medical records were excluded from this study.

The data consisted of the clinical profile, including age, gender, blood type, laboratory examination, length of stay, department, indication, blood or its components, units transfused, duration, reaction, and pre-transfusion testing, such as ABO and Rh blood types. It was then processed using Microsoft Excel and presented as distribution frequency tables.

RESULT AND DISCUSSION

A total of 1046 patients were admitted to *ROI* during the study period, and 300 received a blood transfusion. However, only 258 samples were included because the remaining 42 were less than 17 years old.

Most blood transfusion encounters occurred in the 26-35 age group, followed by the 36-45, accounting for 26.36% and 22.87%, respectively. Approximately 6.20% of the transfusion recipients were at least 65 years old while those aged 26-35 years mainly received transfusions for pregnancy and childbirth-related conditions. This result was consistent with the previous study by Okoroiwu and Okafor (2018), where the majority of the transfusion recipients are in the reproductive age group, which is 15-49 years (11). In contrast, other studies showed that the elderly received more transfusions due to the presence of co-morbidities and low cardiac reserve (12).

Table 1. Distribution of Patients' Clinical Profiles

Clinical Profiles	N (%)
Age (Years)	
17-25	54 (20.93)
26-35	68 (26.36)
36-45	59 (22.87)
46-55	32 (12.40)
56-65	29 (11.24)
>65	16 (6.20)
Gender	
Male	116 (44.96)
Female	142 (55.04)
ABO Blood Type	
A	58 (22.48)
B	78 (30.23)
AB	20 (7.75)
O	102 (39.53)
Length of Stay (days)	
1	37 (14.34)
2-3	93 (36.05)
4-7	86 (33.33)
>7	42 (16.28)

A total of 142 recipients were female, while the rest were male, with percentages of 55.04% and 44.96%, respectively. The considerable number of females indicated the prevalence of pregnancy and birth-related cases. Based on previous studies, the majority of blood transfusions in females were associated with complications related to pregnancy, such as intrapartum and postpartum haemorrhage (13). Understanding the management and complications of pregnancy in pregnancy might be useful in reducing the risks and the need for blood transfusion.

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The distribution of ABO blood type among the samples was also assessed since it plays an important role in blood transfusion practices. Understanding the distribution is important to prevent a shortage of blood and estimate the need among *ROI* patients in the future. This helps to ensure that the patients receive blood compatible with their ABO blood type. Furthermore, the most common and the least blood types observed in this study were O and AB, accounting for 39.53% and 7.75%, respectively. Blood type B was more frequent than A among the transfusion recipients. Within the study population, the frequency of blood type O is more prevalent in both genders. The distribution of ABO among the transfusion recipients is also consistent with the reported donor population in which the proportion of blood type O was the largest (14). This result was consistent with the report of a previous study that the most common blood type in Indonesia was O (15).

This study observed that the incidence of blood transfusion was more common in patients with a length of stay of 2-3 days, accounting for 36.05%. A total of 42 patients who received a blood transfusion stayed in *ROI* for at least 8 days. In addition, those who stayed more than 7 days experienced major surgery or had complications such as excessive bleeding. Approximately 14.34% of patients in this study stayed in *ROI* for 1 day in preparation for elective surgery. A similar result was previously reported where more than half of patients admitted to the hospital received a transfusion within the first 2 days (16). However, another study showed that the incidence of blood transfusion was more common in patients with ICU length of stay of ≥7 to ≥15 days. This is due to the longer exposure to the risk of transfusion, such as blood loss from gastrointestinal bleeding, decreased erythrocyte life span caused by hemolysis and DIC, decreased erythrocyte production, or ineffective erythropoiesis secondary to an increased inflammatory state. Consequently, the incidence of anemia experiences a rapid increase (17).

Table 2. Distribution of ABO Blood Type According to Gender

Blood Type	Recipients N (%)	Male N (%)	Female N (%)
A	58 (22.48)	20 (17.24)	38 (26.76)
B	78 (30.23)	34 (29.31)	44 (30.99)
AB	20 (7.75)	11 (9.48)	9 (6.34)
O	102 (39.53)	51 (43.97)	51 (35.92)

The majority of blood group among the transfused patients was type O, accounting for 39.53%, with the same amount in both males and females, which is 51 each. Meanwhile, the least blood type in both genders was AB at 7.75%. AB was more frequent in males than females, with percentages of 9.48% and 6.34%, respectively. In this study, blood types A and B were more frequent in females than males. This is due to the higher number of female transfusion recipients during this study.

Table 3. Distribution of Laboratory Examination According to The Severity of Anemia

Severity	N (%)
Mild anemia	9 (3.49)
Moderate anemia	119 (46.12)
Severe anemia	125 (48.45)
Non-anemia	4 (1.94)

The laboratory examination of patients is classified according to the severity of anemia using the criteria set by the World Health Organization (WHO). According to WHO, anemia can be classified into mild (Hb 11-12.9 g/dl in males and Hb 11-11.9 g/dl in females), moderate (Hb 8-10.9 g/dl), severe (Hb <8 g/dl), and non-anemia (Hb ≥13 g/dl in males and Hb ≥12 g/dl in females). The majority of transfused

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patients in this study were experiencing severe anemia with a Hb level below 8 g/dl before the transfusion. However, 5 non-anemia patients (1.94%) were indicated for blood component transfusions, such as platelet concentrate and fresh frozen plasma. The data on the Hb levels of the patient were taken prior to the transfusion. This result was consistent with a European observational study where one-third of critically ill patients were experiencing anemia with Hb concentrations of <10 g/dl (12). However, several non-anemia patients with a Hb concentration of at least 13 g/dl had other indications for transfusion, such as thrombocytopenia and coagulation defect. Thrombocytopenia patients were given platelet concentrate transfusion, and those with coagulation defects were indicated for fresh frozen plasma transfusion.

Table 4. Distribution of Clinical Department

Department	N (%)
Surgery	148 (57.36)
Obstetrics and Gynecology	85 (32.95)
Internal Medicine	12 (4.65)
Others	13 (5.04)

Distribution of blood transfusion recipients based on the three broad categories of the department showed that most patients, at 57.36%, were from the surgery department. The other patients were from obstetrics and gynecology, accounting for 32.95%, and internal medicine at 4.65%. Approximately 5.04% of the rest were from the neurology, urology, ENT, and pulmonology department.

This study showed that the surgery department had the most patients receiving blood transfusions. Patients needing surgical intervention were frequently given transfusions due to blood loss during surgery. Following the surgery department, obstetrics and gynecology departments also constituted a large number of *ROI* patients who received blood transfusions. This is due to the high prevalence of transfusion in females with pregnancy and childbirth-related complications. A previous study also reported that more blood requests were made in the surgery department (13). However, another study reported that most recipients were obstetrics and traumatic brain injured patients in their third and fourth decade of life (18). In this study, traumatic brain-injured patients were not specified and were included in the surgery department.

Table 5. Distribution of ABO and Rh Blood Group

Blood Group	Recipients N (%)	Male N (%)	Female N (%)
A^+	58 (22.48)	20 (17.24)	38 (26.76)
A^-	0 (0)	0 (0)	0 (0)
B^+	78 (30.23)	34 (29.31)	44 (30.99)
B^-	0 (0)	0 (0)	0 (0)
AB^+	20 (7.75)	11 (9.48)	9 (6.34)
AB^-	0 (0)	0 (0)	0 (0)
O^+	102 (39.53)	51 (43.97)	51 (35.92)
O^-	0 (0)	0 (0)	0 (0)

This study also evaluated the technique for transfusion, including pre-transfusion tests such as ABO and Rh grouping, in addition to the recipients' demographics. The majority of blood groups were O Rh-positive in both males and females, accounting for 43.97% and 35.92%, respectively. The result indicated that all transfusion recipients were Rh-positive. This was consistent with a previous study that approximately 85% of the population is Rh-positive, and the rest is negative. The importance of knowing the distribution of the Rh blood group among the population is to prevent hemolysis since most Rh-negative recipients produce anti-D when they receive Rh-positive (19).

The most common blood group type observed in the blood transfusion recipients in both genders was O Rh-positive, accounting for

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33.72%. This result is consistent with a previous study that the frequency of blood group O Rh-positive was the highest (20). Furthermore, the knowledge of the prevalence and distribution of ABO and Rh blood groups plays an important role in blood transfusion practices. ABO and Rh incompatible transfusion can be potentially fatal to health.

Table 6. Distribution of Indication

Indication	N (%)
Anemia	237 (69.10)
Hemorrhage	46 (13.41)
Thrombocytopenia	31 (9.04)
Coagulation defect	8 (2.33)
Therapy	8 (2.33)
Major burn	7 (2.04)
Surgery preparation	6 (1.75)

There are several reasons for blood transfusion, and the majority in this study was anemia, accounting for 69.10%. This result was similar to a previous study where anemia was the most common reason for blood transfusion (21). The high incidence of anemia is due to the excessive use of packed red blood cells (PRC) to correct anemia among *ROI* patients, as shown in Table 7. Meanwhile, some of the transfusion recipients had more than one reason for blood transfusion. Anemia often coexists in the same patients with primary blood losses, including hemorrhage, and loss due to surgery and trauma.

Other causes recorded in this study are thrombocytopenia and coagulation effect, accounting for 9.04% and 2.33%, respectively. Patients with thrombocytopenia are indicated for platelet concentrate transfusion (22). Another blood component transfusion was in patients with coagulation defects in which the prothrombin time (PT) or activated partial thromboplastin time (aPTT) was prolonged. In general, patients with abnormal clotting factors should be transfused with fresh frozen plasma (FFP) (23). Approximately 1.75% of patients admitted to *ROI* for surgery preparation was also indicated for blood transfusion. A study assessing blood transfusion in patients with major elective surgery showed that 25.8% received at least 1 unit of a blood component transfusion. The most common reason for transfusion among these patients is Hb triggers (24). Furthermore, plasma transfusion is recommended in several conditions, including active bleeding with multiple coagulation factors deficiencies, which is commonly seen in burn patients. In this study, some patients had major burn injuries and were given fresh frozen plasma transfusion for resuscitation.

Table 7. Distribution of Blood Component

Blood Component	Amount N (%)	Unit N (%)
PRC	207 (57.50)	439 (47.82)
Whole Blood (WB)	115 (31.94)	182 (19.83)
PC	19 (5.28)	208 (22.66)
FFP	19 (5.28)	89 (9.69)

The majority of blood components transfused to *ROI* patients were PRC, accounting for 57.50%. This result was attributable to the observation of indications among ROI patients, in which the majority exhibited anemia and active bleeding. A previous study in a blood transfusion service unit in Cipto Mangunkusumo Hospital, Jakarta, also reported that PRC was the predominant blood product transfused to the subjects (25).

From a total of 918 units of blood component transfused during the study, PRC had the largest number of units, accounting for 47.82%. This result is consistent with the previous report that most transfused units were red blood cells (26). However, a study regarding the demographics of blood and its component found that the majority of units issued was whole blood. This was attributed to the lack of facility for blood component

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separation, thereby making it harder to get red cell and platelet concentrates, as well as fresh frozen plasma (11).

Table 8. Distribution of Transfusion Duration

Blood Component	Unit N (%)	<0.5 hours N (%)	0.5-2 hours N (%)	3-4 hours N (%)	Not Available N (%)
PRC	439 (47.82)	0 (0)	84 (42.86)	236 (68.01)	119 (34.00)
WB	182 (19.83)	0 (0)	14 (7.14)	111 (31.99)	57 (16.29)
PC	208 (22.66)	25 (100)	59 (30.10)	0 (0)	124 (35.43)
FFP	89 (9.69)	0 (0)	39 (19.90)	0 (0)	50 (14.29)

Each duration in the blood transfusion practices was also evaluated. The result showed that the majority of blood transfusions were within 3-4 hours, accounting for 37.80%. PRC and whole blood transfusion should be administered within 3-4 hours. However, several units of PRC were given within 0.5-2 hours due to the small volume in one unit. Platelet concentrate and fresh frozen plasma transfusion in this study were mostly administered within 0.5-2 hours. The duration of the remaining transfused units was not available in the medical record.

The duration of each transfusion varies depending on the blood products being used. Products, such as whole and PRC, should be completed in less than 4 hours (27). The transfusion of the majority of blood and its component was carried out within 3-4 hours. The most common blood component transfused in 3-4 hours was PRC (68.01%). However, a study at London Thalassemia Center implied that transfusions can be administered at one unit per hour in selected patients without cardiac disease and not receiving large volumes (28). The duration of about 38.13% of the total units transfused was not recorded. It may be necessary to enhance blood transfusion monitoring to minimize responses, lowering related morbidity and mortality.

Table 9. Distribution of Transfusion Reaction

Transfusion Reaction		N (%)
Acute reaction	Pruritus	1 (0.39)
	Febrile	1 (0.39)
	Urticaria	1 (0.39)
	Chills	1 (0.39)
Delayed reaction		0 (0)
No reaction		254 (98.45)

The majority of the transfused *ROI* patients in this study were not experiencing any reactions, accounting for 98.45%. However, some were experiencing acute reactions, such as pruritus, febrile, urticaria, and chills, with a percentage of 0.39% each, but they are no delayed reactions among the transfusion recipients.

It is also necessary to monitor patients for each unit of blood transfused in order to anticipate any reaction as soon as possible. In this study, 4 *ROI* patients experienced acute transfusion reactions. In the case of a transfusion reaction, the process should be stopped immediately. Transfusion-related acute lung injury (TRALI), a serious consequence of blood transfusion, was reported in a patient after a PRBC at Dr. Soetomo General Academic Hospital (29). Another study in Jakarta reported acute transfusion reactions in 288 subjects (0.5%), out of which 57.227 received a blood transfusion. In this study, the most common acute transfusion reaction was pruritus/itch. In a previous study, delayed transfusion reaction was not included (25).

CONCLUSION

This study showed that the most common blood type found was O Rh-positive in both genders. Furthermore, the knowledge of the prevalence and distribution of ABO and Rh

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blood groups plays an important role in blood transfusion practices. It can prevent a shortage of blood, estimate the need among *ROI* patients in Dr. Soetomo General Academic Hospital, and further ensure that ABO and Rh incompatible transfusions will not occur in the future. In addition, understanding the practices will help identify the indications and triggers in hospitals and reduce unnecessary and unsafe transfusions to prevent reactions. In this study, the majority of the reason for transfusion was anemia, which is due to the high usage of PRC among *ROI* patients.

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Conflict of Interest
The authors declared that there is no conflict of interest in this study.

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Nil.

Authors' Contributions
ASS, M, BAT & EK made substantial contributions to the conception, design of the study, the acquisition, analysis, and interpretation of data, as well as the creation of new software used. All authors have drafted the work or substantively revised it.

REFERENCES

1. Sutjahjo A. Dasar-dasar ilmu penyakit dalam. Surabaya: Airlangga University Press (AUP); 2015.
2. Okello CD, Shih AW, Angucia B, Kiwanuka N, Heddle N., et al., mortality and its associated factors in transfused patients at a tertiary hospital in Uganda. PLoS ONE. 2022;17(9). [WebPage] [PubMed]
3. Wardati, Nur'aini, Hadi AJ. Faktor Yang Mempengaruhi Perilaku Donor Darah di Unit Transfusi Darah Rs Dr. Fauziah Bireuen. MPPKI. 2019;2(3):181–185. [WebPage]
4. Bruin S, Eggermont D, Bruggen R, Korte D, Scheeren TWL. et al., Transfusion practice in the bleeding critically ill: An international online survey-The TRACE-2 survey. Transfusion. 2022;62(2):324-335. [WebPage] [PubMed]
5. Manen L, Hezel M, Boshuizen M, Straat M, Man AME. et al., Effect of red blood cell transfusion on inflammation, endothelial cell activation and coagulation in the critically ill. Vox Sanguinis. 2022;117(1):64-70. [PubMed]
6. Regulation of the Minister of Health of the Republic of Indonesia No. 91 of 2015 on Standar of Blood Transfusion Services. Jakarta. (December 31, 2015). [WebPage]
7. Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz, JV. et al., What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. J. Crit. Care 2017;37:270–276. [PubMed] [ScienceDirect]
8. Wong H, Curry N, Stanworth SJ. Blood products and procoagulants in traumatic bleeding. *Current Opinion in Critical Care*. 2016;22(6):598–606. [PubMed] [WebPage]
9. Ruiz C, Andresen M. Resuscitation with fluids and blood products in trauma. *Revista médica de Chile*. 2014;142(6):758–766. [PubMed] [WebPage]
10. Yuliarto S, Kadafi KT, Azizah LN, Susanto WP, Khalasha T. Impact of restrictive versus liberal transfusion and clinical outcomes in critically ill children: A retrospective observational study.

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.1-10

Health Science Reports. 2022;5(6). [PubMed]
11. Okoroiwu HU, Okafor IM. Demographic characteristics of blood and blood components transfusion recipients and pattern of blood utilization in a tertiary health institution in southern Nigeria. BMC Hematol. 2018;18(16). [WebPage] [PubMed]
12. Al-Faris L, Al-Fares AR, Abdul Malek K, Omran A, Al-Humood S. Blood transfusion practice in critically ill patients: a single institutional experience. Med. Princ. Pract. 2012;21(6):560–565. [PubMed]
13. Raghuwanshi B, Pehlajani NK, Sinha MK, Tripathy S. A retrospective study of transfusion practices in a tertiary care institute. Indian J. Anaesth. 2017;61(1):24-28. [WebPage] [PubMed]
14. Kementerian Kesehatan Republik Indonesia. INFODATIN Pusat Data dan Informasi Kementerian Kesehatan RI Pelayanan Darah Di Indonesia. 2018.
15. Directorate General of Population and Civil Registration Ministry of Internal Afffairs. *Indonesia miliki bank data 37,9 juta golongan darah*. Jakarta:2021. [cited 2022 Dec 16]. Available from https://dukcapil.kemendagri.go.id/berita/baca/725/dirjen-dukcapil-indonesia-miliki-bank-data-379-juta-golongan-darah [WebPage]
16. Sharma A, Singh V, Alavi A. Epidemiology and predictors of blood transfusion in hospitalizations for sickle cell disease. Blood. 2021;138(1):3103. [ScienceDirect]
17. Akbas T. Long length of stay in the ICU associated with a high erythrocyte transfusion rate in critically ill patients. J. Int. Med. Res. 2019;47(5):1948–1957. [WebPage] [PubMed]
18. Tobi KU, Imarengiaye CO. Blood transfusion in critically ill patients in an intensive care unit of a tertiary hospital in Nigeria. East Afr. Med. J. 2014;91(12):1-7. [PubMed]
19. Kaushansky K, Lichtman MA, Prchal JT, Levi MM, Press OW, Burns LJ. et al., Williams Hematology. 9th ed. New York: McGraw-Hill Education; 2016. [WebPage]
20. Doku, George N, Agbozo WK, Annor RA, Mawudzro PE, Agbeli EE. et al., Frequencies and ethnic distribution of ABO and RhD blood groups in the Volta region of Ghana, towards effective blood bank services. Afr. Health Sci. 2022;22(1):641–7. [PubMed]
21. Kipkulei JC, Buziba N, Mining S, Jepngetich H. Demographic and Clinical Profiles of Blood Transfusion Recipients at a Teaching and Referral Hospital in Kenya. Open J. Blood Dis. 2019;9(1):30–40. [WebPage]
22. Squires JE. Indications for platelet transfusion in patients with thrombocytopenia. Blood Transfusion. 2015;13(2):221-226. [PubMed]
23. Klein AA, Arnold P, Bingham RM, Brohi K, Clark R., et al., AAGBI guidelines: the use of blood components and their alternatives 2016. Anaesthesia. 2016;71(7):829-842.[WebPage][PubMed]
24. Unal D, Senayli Y, Polat R, Spahn DR, Toraman F, Alkis N., et al., Peri-operative blood transfusion in elective major surgery: incidence, indications, and outcome – a multicentre observational study. Blood Transfus. 2020;4(18):261-279. [PubMed] [WebPage]
25. Wahidiyat PA, Marpaung E, Iskandar SD. Characteristics of Acute Transfusion Reactions and its related factors in Cipto Mangunkusumo Hospital Jakarta,

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.1-10

Indonesia. Heal. Sci. J. Indones. 2019;10(1):15–20. [WebPage]
26. Mafirakureva N, Khoza S, Hassall O, Faragher BE, Kajja I, Mvere DA. et al., Profiles of blood and blood component transfusion recipients in Zimbabwe. Blood Transfus. 2015;4(13):600–609. [PubMed]
27. Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee. Transfusion Handbook. 2014. [cited 2022 December 16]. Available from https://www.transfusionguidelines.org/transfusion-handbook/4-safe-transfusion-right-blood-right-patient-right-time-and-right-place/4-13-transfusion-of-blood-components [WebPage]
28. Trompeter S, Cohen A, Porter J. Guidelines for the Management of Transfusion Dependent Thalassaemia (TDT). 3rd ed. Nicosia: Thalassemia International Federation; 2014. [E-Book]
29. Maulydia M, Airlangga PS, Siregar MI, Hendriana DR. Transfusion-related acute lung injury (TRALI) in postpartum bleeding patient: A case report. Bali J Anaesthesiol 2022;6:119-122. [WebPage]

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.1-10

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Original Article

PEDIATRIC SHOCK PROFILE IN THE PEDIATRIC INTENSIVE CARE UNIT (PICU) OF DR. SOETOMO GENERAL ACADEMIC HOSPITAL

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ABSTRACT

Introduction: Shock is a life-threatening condition caused by circulatory failure which increases morbidity and mortality rate. According to the western literature, about 2% of children are admitted to hospitals worldwide due to shock. **Objective:** This study aimed to describe the pediatric shock profile of patients in the Pediatric Intensive Care Unit (PICU) of Dr. Soetomo General Academic Hospital between 1 January to 1 December 2019. **Materials and Methods:** A total of 60 patients were selected as the participants using a descriptive method. Data collection was carried out by recording the exact time the participants first entered the PICU. Furthermore, data were collected based on gender, age, physical and laboratory examination, diagnosis of shock, patients' outcomes, as well as PRISM III score. **Results:** The results of this study that the males and children are 51.7% and 53.3%, respectively. At an infant age, the distribution of the highest average pulse and breathing frequency was 135 and 32.2, respectively. The highest average body temperature at the age of adolescents was 37.19°C. Furthermore, the patients' diagnoses were dominated by distributive shock with the highest PRISM III score ≥8 and deaths recorded of 76.6%, 60%, and 61.7%, respectively. The diagnosis results showed that distributive shock leads to the highest mortality with a PRISM III score of 51.7% and 53.3%. **Conclusion**: Distributive shock contributes to the patient's diagnoses and mortality rate with the highest score of PRISM III being ≥8. From this conclusion, the PICU needs to be more responsive to detect distributive shock in children.

Keywords: Demographics of Pediatric Shock; Distributive Shock; Pediatric Intensive Care Unit; Pediatric Shock Profile

ABSTRAK

Pendahuluan: Syok merupakan kondisi gagal sirkulasi yang mengancam jiwa yang meningkatkan morbiditas dan mortalitas. Syok menyumbang tingkat 2% dari anak-anak yang dirawat di seluruh dunia menurut sebagian besar literatur barat. **Tujuan:** Untuk menentukan dan mendeskripsikan profil pasien syok pediatri di PICU RSUD Dr. Soetomo tahun periode 1 Januari – 1 Desember 2019. **Bahan dan Metode:** Penelitian dilakukan secara retrospektif menggunakan metode deskriptif dengan jumlah sampel 60 pasien. Pengumpulan data dilakukan dengan pencatatan saat pasien pertama kali masuk PICU dengan kondisi stabil. Data mencangkupi jenis kelamin, usia, pemeriksaan fisik, pemeriksaan laboratorium, diagnosis syok, luaran pasien, dan skor PRISM III. **Hasil:** Hasil penelitian ini didominasi oleh laki-laki (51,7%) dan anak-anak (53,3%). Distribusi rata-rata frekuensi nadi dan frekuensi pernapasan tertinggi pada usia bayi (135) (32,2) dan rata-rata suhu tubuh tertinggi pada usia remaja (37,19). Diagnosis syok pasien didominasi oleh syok distributif (76,6%) dengan skor PRISM III tertinggi ≥8 (60%) dan persentase tertinggi adalah pasien meninggal (61,7%). Distribusi luaran pasien berdasarkan hasil diagnosis syok menunjukkan bahwa syok distributif memiliki mortalitas tertinggi (51,7%) dengan skor PRISM III ≥8 (53,3%). **Kesimpulan:** Hasil diagnosis syok dan mortalitas pasien tertinggi didominasi oleh syok distributif dengan skor mortalitas tertinggi pada PRISM III adalah ≥8. Dari kesimpulan tersebut, PICU harus lebih tanggap dalam mendeteksi syok distributif pada anak.

Kata Kunci : Demografi Syok Pediatrik; Syok Distributif; Unit Perawatan Intensif Anak; Profil Syok Pediatrik

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INTRODUCTION

Shock is a life-threatening condition caused by circulatory failure that increases morbidity and mortality rates (1). Therefore, pediatric shock is a general emergency that highly contributes to morbidity and mortality. About 400,000–500,000 reported cases of the septic life-threatening condition occur yearly. In 2000, there was an improvement in childhood shock from 50% to 20% (2).

Several studies reported that the mortality rate is between 40% to 80% in the case of septic, while it is 60% in cardiogenic shock. However, delays in recognizing and treating the clinical symptoms can lead to high mortality rates. The rate of spreading this life-threatening condition at Dr. Soetomo General Academic Hospital Surabaya is 14.58% (3).

Shock occurs in various forms including hypovolemic, cardiogenic, distributed, and obstructive. Hypovolemic is a condition with inadequate organ perfusion caused by loss of intravascular volume (4). Meanwhile, cardiogenic often occurs due to acute myocardial infarction and disorders of adequate cardiac filling such as pericardial tamponade or valve stenosis (5). Distributive shock is also caused by sepsis, vasoplegia, or anaphylaxis (6).

Fluid resuscitation is considered the cornerstone of management while implementing immediate care to identify pediatrics with shock (7). Furthermore, hemodynamic monitoring is one of the pillars of establishing shock diagnosis and determining its treatment. Early identification through physical examination, vital signs, urine output, central venous pressure, and transthoracic echocardiography is often used to evaluate preload and afterload status as well as cardiac function in response to fluid resuscitation (8).

It is only a few studies that examined the clinical and demographic profiles in the Pediatric Intensive Care Unit of Dr. Soetomo General Academic Hospital. Therefore, this study becomes a pilot and helps in establishing the essential clinical and demographic profile of the shock patients.

MATERIALS AND METHODS

This descriptive study examines the patient's medical records using a retrospective method. Data were collected by recording the exact time the participants first entered the PICU. Also, it was analyzed using consecutive sampling with inclusion criteria being pediatric patients aged 1 month – 18 years. The inclusion criteria were pediatric patients listed in the medical records at the PICU of Dr. Soetomo General Academic Hospital, while those with a diagnosis of shock were excluded. This study obtained ethical feasibility from the Health Research Ethics Committee of Dr. Soetomo General Academic Hospital.

The data extracted from the medical records included gender, age, physical examination in the form of heart rate, respiratory rate, body temperature, laboratory tests in the form of hemoglobin, white blood cells, platelets, shock diagnosis results, patients' outcomes from the PICU, and PRISM III score. Furthermore, the data were proceeded into the statistical program for social science software program and presented in tables.

RESULT AND DISCUSSION

Demographics of Pediatric Shock Patients

From January to December 2019, about 60 patients diagnosed with shock were treated in the PICU of Dr. Soetomo General Academic Hospital. A total of 31 or 51.7% out of the 60 participants were male and the remaining were female. In the case of age, about 53.3% were children between the age of 2-10 years. The

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following table shows the percentages of gender and ages of the patients.

Table 1. Demographics of Pediatric Shock Patients

Variable	Frequency (n=100)	Percentage (n=100)
Gender		
Male	31	51.7%
Female	29	48.3%
Age Categories		
Infant (<1 year)	10	16.7%
Children	32	53.3%
Adolescents	18	30%

Patients' Clinical Profile Based on Age with Physical Examination Results

In the HR, RR, and temperature categories, the chi-square p-value was 0.025, 0.181, and 0.043, respectively, which are less than the alpha of 5% or 0.05. Table 2 below shows the demographic data on the patients' age with the results of the physical examination.

Table 2. The relation of Age Categories and Patients' Physical Examination Results

Physical Examination	Infant (x̄±SD)	Children (x̄±SD)	Adolescents (x̄±SD)	p-value
HR	133.142± 10.558	119.823± 21.153	119.526± 24.132	0.025
RR	30± 8.082	28.352± 8.337	28.210± 9.997	0.181
Temperature	36.942± 0.427	36.785± 0.494	37.152± 0.968	0.043

Shock Patients' Profile Based on Laboratory Examination (Hemoglobin, Leukocyte Count, and Platelet)

In the PICU, the lowest, highest, and average levels of hemoglobin are 3.3 g/dL, 18.5 g/dL, and 10.46 g/dL, respectively. The lowest, highest, and average leukocyte count was 1280/µL, 580000/µL, and 47632.68/µL, respectively. Furthermore, the lowest and the highest platelet count was 4550/µL and 744000/µL with an average of 158153.83 ± 168353.15. Table 3 below shows the patients' hemoglobin levels, leukocyte counts, and platelet counts.

Table 3. Shock Patients' Profile Based on Laboratory Examination

Indicator	Mean
Hb (g/dL)	10.46
WBC (/µL)	47632.68
PLT (/µL)	158153.83 ± 168353.15

Patients' Profile Based on Shock Diagnosis Results, PRISM III Score, and Patients' Outcomes

Based on the diagnosis results in the PICU, distributive shock, particularly septic, has the highest medical records of 76.6%, followed by hypovolemic, cardiogenic, and obstructive with 20%, 3.3%, and 0%, respectively. The results on the PRISM III showed that the score ≥ 8 and < 8 are 60% and 40%, respectively. In this study, the condition of shock patients was divided into two where 61.7% and 38.3% of them died and lived, respectively. Table 4 below shows the percentage of shock diagnosis results, PRISM III score, and patients' outcomes.

Table 4. Profile of Shock Diagnosis Results, PRISM III Score, and Patients' Outcomes

Variable	Frequency	Percentage (n=100)
Diagnosis Results of Shock		
Hypovolemic Shock	12	20%
Cardiogenic Shock	2	3.3%
Distributive Shock	46	76.6%
Obstructive Shock	0	0%
PRISM III Score		
≥8	36	60%
<8	24	40%
Patients' Outcomes		
Survived	23	38.3%
Died	37	61.7%

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Profile of Patients' Outcomes Distribution based on Shock Diagnosis Results and PRISM III Score

Based on the diagnosis results, the record of patients that died through distributive, hypovolemic, cardiogenic, and obstructive shock is 51.7%, 8.3%, 1.7%, and 0% with about 25%, 11.7%, 1.7%, and 0% of them that were alive. The distribution of patients' outcomes showed that the mortality rate for PRISM III ≥8 and < 8 are 53.3% and 8.3% with about 6.7% and 31.7% that survive. Furthermore, the p-value was 0.027 and 0.001 which is less than alpha 5% or 0.05. Table 5 below shows the profile of patients' outcomes and PRISM III score.

Table 5. Profile of Patients' Outcomes Distribution Based on Shock Diagnosis Results and PRISM III Score

Variable	Output%		Total	p-value
	Life	Died		
Diagnosis Results of Shock				
Hypovolemic Shock	5 (8.3%)	7(11.7%)	12(20%)	0.027
Cardiogenic Shock	1(1.7%)	1(1.7%)	2(3.3%)	
Distributive Shock	31(51.7%)	15(25%)	46(76.6%)	
Obstructive Shock	0(0%)	0(0%)	0(0%)	
PRISM III Score				
≥ 8	32(53.3%)	4(6.7%)	36(60%)	0.001
< 8	5(8.3%)	19(31.7)	26(40%)	

Based on the demographic profile, patients experiencing shock in the PICU at Dr. Soetomo General Academic Hospital Surabaya were dominated by males with a total of 51.7% compared to females with 43.3%. This was in line with the data of Gadappa and Behera (2019) (11), where male pediatric patients were more susceptible to shock.

The prevalence is high in males due to decreased humoral and cellular immune responses to infection. However, the increase in an age not only causes the immune system to be mature but also gender differences underlying the formation of immunity in early life. There is a gradual spike in sex steroid hormones during infancy and this is known as "mini puberty". Additionally, sex steroid hormones affect the immune system (9). Male is at higher risk of contracting infection because the antibodies genetically and hormonally in female are better for producing immunoglobulins (10).

Moreover, the number of patients with age differed since children had the highest score with a total of 53.3%. The result is in line with Gadappa & Behera (2019) (11) that children critically affected by shock also have several co-morbidities such as leukocytosis, anemia, positive CRP, and hyponatremia. This is because they are susceptible to infection and have a higher incidence of anemia.

At the age of baby and adolescence, the highest average pulse is 135 and 37 with a breathing frequency of 32.2 and 19, respectively. The p-value in the HR, RR, and temperature categories are 0.025, 0.181, and 0.043, respectively, indicating less than the alpha of 5% or 0.05. This showed that there is a relationship between age and the patients' examination results. The results are also in line with Paary *et al*. (2016) (12) because the patients have a history of hypertension, type II diabetes mellitus, and chronic kidney disease.

Several studies showed that comorbid conditions including diabetes mellitus, hypertension, and chronic kidney disease are risk factors for infant mortality (13). The lowest, highest, and average level of the patients' hemoglobin was 3.3 g/dL, 18.5 g/dL, and 10.46 g/dL, respectively. These data were in line with Biban *et al*, (2021) (13) that the

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average hemoglobin level in septic shock is 10.5 g/dL. In this study, patients experiencing shock in the PICU suffer from leukocytosis. The majority of them experience an increase in leukocytes due to infectious conditions (14).

These results were in line with Jeevan *et al*. (2017) (15) that the average mortality of leukocyte levels is 47632.68/µL. Also, the average number of platelet was still at normal levels with an average value of 158153.83 ± 168353.15/µL. This is because data collection was carried out by recording the exact time the patients' first entered the PICU.

Distributive shock is the most common diagnosis in medical records with 46 patients or 76.6%. This is caused by complications from ventilator-related pneumonia, atelectasis, pneumothorax, laryngeal edema, and extubating events (16).

Based on the patients' outcomes, the rate of mortality and the patients who are alive are 61.7% and 38.3%, respectively. The high death rate can be caused by patients who have immature immune systems. Additionally, the participants' condition tends to worsen septic shock which increases the mortality rate (17).

Based on the diagnosis result, about 51.7% and 25% of patients with distributive shock, particularly septic, died and lived respectively. This is caused by the respiratory tract being the most common site of infection (9).

The distribution of patients' outcomes showed that the mortality rate for PRISM III ≥8 is 53.3%, while those that were alive with a PRISM III score <8 is 31.7%. This high death is caused by the patients' who died before reaching the PICU (18). The p-value is 0.027 and this is less than the alpha of 5% or 0.05. This indicates that there is a relationship between the shock diagnosis and patients' outcomes. Also, the p-value is 0.001 and this is less than the alpha of 5% or 0.05. This shows that there is a relationship between the PRISM III score and patients' outcomes.

CONCLUSION

The majority of the shock patients were dominated by males and children aged 2-10 years. In the demographic distribution of age, the average value of the highest pulse frequency of 135 was from 1 month to 1 year. The highest average respiratory frequency and body temperature were at the age of infants and adolescents, respectively. Moreover, the diagnosis results showed that distributive shock had the highest mortality with the PRISM III score ≥8.

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Conflict of Interest

There is no conflict expressed by all the authors.

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Authors' Contributor

All authors have contributed to several processes in this study.

REFERENCES

1. Holler JG, Jensen HK, Henriksen DP, Rasmussen LM, Mikkelsen S, Pedersen C, & Lassen AT. Etiology of Shock in the Emergency Departement : A 12-Year Population-Based Cohort Study. *Shock*. 2019;*51*(1): 60. [PubMed] [WebPage]
2. Nteziyaremye J, Paasi G, Burgoine K,

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.11-17

Balyejjusa JS, Tegu C, Olupot-Olupot P. Perspectives on Aetiology, Pathophysiology and Management of Shock in African Children. *African Journal of Emergency Medicine*. 2017; *7*: 20. [PubMed] [ScienceDirect]

3. Tambajong RN, Lalenoh DC, Kumaat L. Profil Penderita Sepsis di ICU RSUP Prof. Dr. RD Kandou Manadoperiode Desember 2014–November 2015. *E-CliniC*. 2017;*4(1)*. [WebPage]
4. Standl T, Annecke T, Cascorbi I, Heller AR, Sabashnikov A, Teske W. The Nomenclature, Definition and Distinction of Types of Shock. *Deutsches Ärzteblatt International*. 2018;*115*(45):758-766. [PubMed] [WebPage]
5. Kislitsina ON, Rich JD, Wilcox JE, Pham DT, Churyla A, Vorovich EB, Ghafourian K, Yancy CW. Shock–Classification and Pathophysiological Principles of Therapeutics. *Current Cardiology Reviews*. 2019;*15*(2):112–113. [PubMed] [WebPage]
6. Fox SE, Akmatbekov A, Harbert JL, Li G, Brown JQ, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. The Lancet Respiratory Medicine.2020; 8(7): 681–686. [PubMed] [WebPage]
7. Houston KA, George EC, Maitland K. Implications for paediatric shock management in resource-limited settings: a perspective from the FEAST trial. *Critical Care*. 2018; *22*(1) :1–9. [PubMed] [WebPage]
8. Lee EP, Hsia SH, Lin JJ, Chan OW, Lee J, Lin CY, Wu HP. Hemodynamic Analysis of Pediatric Septic Shock and Cardiogenic Shock Using Transpulmonary Thermodilution. *BioMed Research International*. *2017*;2:1.[PubMed]
9. Kharisma PL, Muhyi A, Rachmi E. Relationship between Nutritional Status, Age, Gender and Degree of Dengue Infection in Children at Abdul Wahab Sjahranie Hospital Samarinda. *Jurnal Sains dan Kesehatan*. 2021;*3(3)*: 381. [WebPage]
10. Hermawan B, Afrizal AR. Hubungan antara Jenis Kelamin dan Usia dengan Kejadian Dengue Syok Sindrom Padanak di Ponorogo. Proceeding Book Call for Paper Thalamus: Medical Research For Better Health. 2020. [WebPage]
11. Gadappa SM, Behera MK. Clinical profile and outcome of shock in mechanically ventilated patients in pediatric intensive care unit of tertiary care centre. Int J Res Med Sci. 2019 Dec. 26;7(1):71-6. [WebPage]
12. Paary TTS, Kalaiselvan MS, Renuka MK, Arunkumar AS. Clinical Profile and Outcome of Patients with Severe Sepsis Treated in an Intensive Care Unit in India. *Ceylon Medical Journal*. 2016; *61*(4): 182. [PubMed]
13. Amâncio FF, Heringer TP, Oliveira C da CHB de, Fassy LB, Carvalho FB de, Oliveira DP, de Oliveira CD, Botoni F O, Magalhães F do C, Lambertucci JR. Clinical Profiles and Factors Associated with Death in Adults with Dengue Admitted to Intensive Care Units, Minas Gerais, Brazil. *PloS One*. 2015; *10*(6): 16. [WebPage] [PubMed]
14. Biban P, Teggi M, Gaffuri M, Santuz P, Onorato D, Carpenè G, Gregori D, Lippi G. Cell Population Data (CPD) for Early Recognition of Sepsis and Septic Shock in Children: A Pilot Study. *Frontiers in Pediatrics*. 2021; *9*: 145. [WebPage] [PubMed]

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.11-17

15. Jeevan GJ, Chandra GF, Bahadur TS. Clinical, Demographic Profile and Outcome of Children Admitted in PICU with a Diagnosis of Severe Sepsis and Septic Shock. *Age (Months)*. 2017; 23: 815. [WebPage]
16. Sutadi K, Pudjiastuti, Martuti S. Faktor Risiko Mortalitas pada Anak dengan Syok di Ruang Perawatan Intensif Rumah Sakit dr. Moewardi Surakarta. *Sari Pediatri*. 2020; *22*(1): 9-10. [WebPage]
17. Kurade A, Dhanawade S. Clinical Profile and Outcome of Septic Shock in Children Admitted to a Tertiary Care Referral Hospital. *Int J Pediatr Res*. 2016; 3: 225–230. [WebPage]
18. Popli V, Kumar A. Validation of PRISM III (Pediatric Risk of Mortality) Scoring System in Predicting Risk of Mortality in a Pediatric Intensive Care Unit. *Children*. Journal of Dental and Medical Sciences. 2018; 17(3). [WebPage]

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Original Article

BASIC LIFE SUPPORT TRAINING: THE EFFECTIVENESS AND RETENTION OF THE DISTANCE-LEARNING METHOD

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ABSTRACT

Introduction: Basic Life Support (BLS) training during the COVID-19 pandemic needed to be effective as well as prevent disease transmission between trainers and participants. The distance-learning method is one of the recommended modified training methods. However, there is still limited research that evaluates the effectiveness of the distance-learning method for BLS training for laypersons during the COVID-19 pandemic. **Objective:** To evaluate the effectiveness and retention of the distance-learning method for BLS training in improving the participant's knowledge and skills. **Materials and Methods:** This is a non-randomized quasi-experimental study (one group pre-test and post-test design). A total of 64 *TAGANA* (*Taruna Siaga Bencana*/disaster volunteer) members of Sleman Regency who had undergone the distance learning method for BLS training were the participants of this study. A knowledge questionnaire and observation checklist were prepared and tested for context validity by an expert group. Data on the participant's knowledge were collected before and after the training session, and data on the participant's skills were recorded after the training session. After the training, a social media group was created to provide a periodical refresher of the BLS materials and facilitate discussions between the speakers and the study's samples. Data on knowledge retention and skills were recorded six months post-training. **Results:** The distance-learning method for BLS training effectively increased the participants' knowledge of BLS, indicated by a significantly higher final knowledge score than before the training (Z=-6.904, p <0.001). The method also provided sufficient BLS skills, indicated by most of the samples (93.7%) passing the skill observation test even though no participant had attended a similar training before. Moreover, the participant's knowledge and skills scores were significantly lower six months after the training session than immediately after training (Z=-5.157, p <0.001; Z=-4.219, p <0.001). **Conclusion:** The distance-learning method for BLS training effectively increased the participant's BLS knowledge and skills. However, their knowledge and skills decreased at six months post-training. Overall, the distance-learning method has been proven as a promising alternative to BLS training during and after the COVID-19 pandemic.

Keywords: Basic Life Support training; Cardiovascular Disease; COVID-19; Distance Learning; Education

ABSTRAK

Pendahuluan: Pelatihan Bantuan Hidup Dasar (BHD) selama pandemi COVID-19 dituntut untuk tetap berjalan efektif sekaligus dapat mencegah transmisi penyakit antara pelatih dan peserta pelatihan. Salah satu modifikasi metode pelatihan yang direkomendasikan adalah metode *distance-learning*. Saat ini masih terbatas penelitian yang menilai efektivitas pelatihan BHD metode *distance-learning* untuk masyarakat awam di tengah pandemi COVID-19. **Tujuan:** Untuk menilai efektivitas dan retensi pembelajaran pelatihan BHD metode *distance-learning* dalam meningkatkan pengetahuan dan keterampilan peserta pelatihan. **Bahan dan Metode:** Penelitian dengan rancangan *non-randomized quasi-experimental (one group pre-test and post-test design).* Sampel penelitian adalah 64 anggota TAGANA Kabupaten Sleman yang mengikuti pelatihan BHD metode *distance-learning*. Peneliti menyiapkan kuisioner pengetahuan dan daftar tilik observasi keterampilan sekaligus melakukan tes validitas isi untuk kedua instrumen penelitian ini bersama kelompok ahli. Data pengetahuan BHD diambil sebelum dan setelah pelatihan. Data keterampilan BHD diambil setelah pelatihan. Setelah pelatihan selesai, dibuat sebuah kelompok sosial media yang memberikan penyegaran materi BHD secara periodik dan memungkinkan diskusi antara pemateri dan peserta pelatihan. Enam bulan pascapelatihan, diambil data retensi pembelajaran. **Hasil dan Pembahasan:** Pelatihan BHD metode *distance-learning* efektif meningkatkan pengetahuan peserta ditunjukkan oleh nilai pengetahuan setelah pelatihan lebih tinggi secara bermakna dibandingkan sebelum pelatihan (Z=-6,904, p<0,001). Metode *distance-learning* juga dapat memberikan keterampilan BHD yang cukup, ditunjukkan

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dengan 60 sampel (93,7%) lulus evaluasi keterampilan setelah pelatihan meskipun peserta belum pernah mengikuti pelatihan sejenis sebelumnya. Nilai pengetahuan dan keterampilan enam bulan pascapelatihan lebih rendah secara bermakna dibandingkan segera setelah pelatihan (Z=-5,157, p<0,001; Z=-4.219, p<0,001). **Kesimpulan:** Pelatihan BHD metode *distance-learning* efektif meningkatkan pengetahuan dan keterampilan peserta. Namun demikian pengetahuan dan keterampilan ini menurun 6 bulan pascapelatihan. Metode *distance-learning* terbukti dapat menjadi alternatif untuk pelatihan BHD selama dan di luar pandemi COVID-19.

Kata kunci: Pelatihan Bantuan Hidup Dasar; Penyakit Kardiovaskular; COVID-19; *Distance Learning*; Pendidikan

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INTRODUCTION

The COVID-19 pandemic has increased the incidence of Out-of-Hospital Cardiac Arrests (OHCA) (1). Research in the United States, France, and Italy showed a significant increase in the incidence of OHCA during the pandemic compared to the same period a year before the pandemic. There has also been an increase in the morbidity and mortality of OHCA patients. Moreover, there was a reduction in survival rate at hospital admission, lower survival at hospital discharge, a decline in Return Of Spontaneous Circulation (ROSC), and a decrease in the number of sustained ROSC (2–4).

An important component in increasing the survival rate of OHCA patients is the provision of Basic Life Support by laypersons (5,6). Basic Life Support training prepares laypersons with the skills required to resuscitate OHCA patients. Effective training methods have been proven to increase the knowledge and skills of rescuers, improve the implementation of guidelines in daily practice, form a culture of helping, improve the quality of resuscitation, and potentially increase the survival rate of OHCA victims (7–9).

Various Basic Life Support (BLS) training methods for laypersons have been developed. Despite the limited data to determine the single most effective method, better outcomes are seen from an instructor-led training method accompanied by *hands-on* sessions and feedback (10).

The COVID-19 pandemic has affected the ideal BLS training method. BLS training must be effective while preventing disease transmission between trainers and participants (11). To overcome this challenge, the European Resuscitation Council (ERC) provided general guidelines for conducting BLS training for laypersons during the COVID-19 pandemic. The distance-learning method is a recommended modified training method to cope with the COVID-19 pandemic (12).

Various literature has shown the effectiveness of this method in increasing the participants' knowledge of BLS, their willingness to help, and motivating them to further study this topic (13–18). Unfortunately, most past literature used health workers as their samples and was conducted under normal non-pandemic conditions. There is still limited research that evaluates the effectiveness of the distance-learning method for BLS training for laypersons during the COVID-19 pandemic.

MATERIALS AND METHODS

Study Design

This study used a non-randomized quasi-experimental design (with one pre-test group and post-test group) to evaluate the effectiveness and learning retention of the distance-learning method for BLS training in improving the participant's knowledge and skills. The study was conducted at the Department of Anesthesiology and Intensive

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Therapy, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, between April and October 2021.

Sample Size and Study Participants

This study's participants are *TAGANA* members (*Taruna Siaga Bencana*/Disaster Volunteer) of Sleman Regency who had undergone Basic Life Support training with the distance-learning method. The inclusion criteria included being 15-40 years old, having gadgets, and being accustomed to using gadgets for online activities. The exclusion criteria were participants who had previously attended similar training. The participants were excluded from the sample if they withdrew from the study or did not attend the full training.

The minimum sample size was calculated using the G*Power® software (v.3.1.9.4). Based on the estimated effect size (d) of 0.5, α = 0.05, and power of 0.95, the minimum number of samples for the paired t-test was 54 people. If it is estimated that 10% of the subjects would drop out, the minimum sample size is 60 people.

Ethics

This study received a recommendation from the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada. The study's objectives and procedures were explained to all participants. We then asked for their consent to participate in the study and collected their informed consent through an electronic Google Form®.

Data Collection

The researchers prepared a knowledge questionnaire and observation checklist that refer to the 2020 AHA guidelines (19). The content validity of both instruments was tested by an expert group consisting of three specialists in Anesthesiology and Intensive Therapy and two final-stage Anesthesiology and Intensive Therapy resident doctors. They used a content validity index. Each expert assessed the instruments' items using four rating scales ranging from 1 (very unimportant) to 4 (very important). Ratings 1 and 2 were considered as disagree, and ratings 3 and 4 were counted as agree. The results of the Average Congruency Percentage/ACP of the knowledge questionnaire were 95%, and the skill observation checklist was 96%. Therefore, both instruments were valid.

As the assessment of BLS skills was conducted by many raters, to avoid bias, an inter-rater reliability test was conducted on the observation checklist instrument by using the intra-class correlation coefficient (ICC) in a preliminary study with 10 participants. The ICC score was 0.932, indicating no significant difference in BLS skills assessment results between raters.

The BLS knowledge questionnaire consists of 20 multiple-choice questions about the integrated emergency response system and BLS theory. The correct answer was given a score of 5, and the wrong answer was given a score of 0. The minimum score for the knowledge questionnaire was 0, and the maximum score was 100.

The observation checklist consists of 9 Basic Life Support steps. Each step comprises of four assessment categories. The lowest category was 'did not do it' with a score of 0, and the highest category was 'did it right' with a score of 3. Each step and question were weighted according to the complexity of the steps. The score for each step was the multiplication of the category score with the question's weight. The minimum score of the observation checklist was 0, and the maximum

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score was 78. A minimum score of 50 indicates a pass.

Procedure

This study's procedure is shown in Figure 1. Individuals who agreed to participate in the study and met the inclusion criteria were included in this study's sample. All participants were given an electronic training module to study two days before participating in the training. The module describes the integrated emergency response system and BLS theory according to the 2020 AHA guidelines (19).

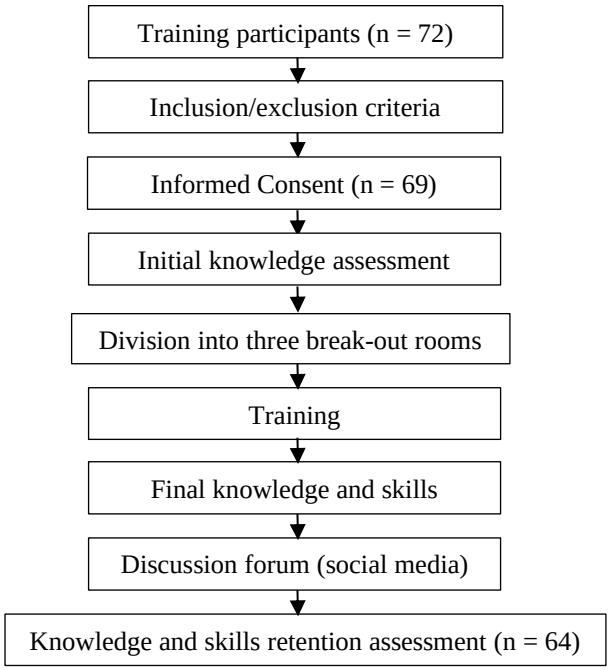

Figure 1. This study's procedure

Initial Knowledge Assessment

Researchers assessed the participant's initial knowledge using a knowledge questionnaire through the Quizizz® application. The participants answered these questions directly from their respective devices.

Training Implementation

All participants received an online BLS training session through the Zoom® application. The participants were divided into three classes using the breakout rooms feature in the Zoom® application. Each class consisted of 21-22 participants. The speakers were specialists in Anesthesiology and Intensive Therapy who are certified BLS training instructors. The training consisted of 4 sessions: a 40-minute lecture session, a 20-minute video simulation session, a 20-minute live simulation session, and a 40-minute discussion session.

Final Knowledge Assessment

The researchers assessed the participant's final knowledge using a knowledge questionnaire through the Quizizz® application. The participants answered these questions directly from their respective devices.

Final Skill Assessment

The researcher assessed the participant's final skills offline one day after the training session. The assessment process follows the health protocols recommended by the *European Resuscitation Council* and government policies. The participants were divided into five groups, and each consisting of 12-13 people. Each group was assessed by one rater. The participants practiced BLS on a ResusciAnne Laerdal® torso mannequin and were assessed using an observation checklist.

Social Media Discussion Forum

After the training, a WhatsApp® group was created for the presenter and participants. The presenter provided a periodic refresher of BLS materials and facilitated a discussion with all participants in the group.

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Knowledge-skills Retention Assessment

Six months after the training, researchers assessed the participant's knowledge retention using a knowledge questionnaire and skills retention test by using an observation checklist.

Statistical Analysis

The data was analyzed using a Paired-Samples t-test if the data distribution was normal or a Wilcoxon signed-rank test if the data distribution was not normal. The difference was considered statistically significant if the *p*-value <0.05. Data analysis was performed using the IBM SPSS Statistics® version 25 (IBM Corp., Armonk, NY) software.

RESULTS AND DISCUSSION

Results

Personal Characteristics

A total of 72 people agreed to join the study, but three were excluded because they were not used to using gadgets and had attended similar training before. In total, 64 out of the 69 participants attended the entire training session and were included in the data collection.

The average age of the participants was 30.52 years, with more males than females (65.6% vs 34.4%). All participants had their own devices, with the majority (92.75%) being mobile phones (Table 1).

All of the assessment data are shown in Table 2. The normality test showed that all of the scores had a non-normal distribution.

Table 1. Sample Characteristics (N = 64)

Characteristics		n	%
Gender	Man	42	65.6%
	Woman	22	34.4%
Age (years)		30.52 ± 6.90	
Type of gadget	Smartphone	60	92.75%
	Laptop	4	6.25%

Table 2. Assessment Data for All Assessments

	Mean	SD	Med	Min	Max
Initial knowledge	61.56	9.34	60	40	80
Final knowledge	89.45	10.32	90	50	100
Final skills	63.14	8.92	62	42	78
Knowledge retention	79.92	7.26	80	55	95
Skill retention	55.70	9.42	54	39	73

Basic Life Support knowledge and skills

The Wilcoxon signed-rank test analysis showed that there was a significant difference between the participant's initial knowledge and final knowledge scores. The median of final knowledge scores (Me = 90) was significantly higher than the median score of initial knowledge (Me = 60), Z=-6.904, $p < 0.001$. As many as 60 (93.7%) participants passed the final skills assessment.

Learning Retention

Table 3. Score Comparison of Each Basic Life Support Step's Skill Scores

BLS Step's Skill Scores		Final Skills	Skills Retention	p-value
		x̄ (%)	x̄ (%)	
1	Ensure a safe environment	2.69 (89.58)	2.16 (71.88)	0.005
2	Check for a response	2.61 (86.98)	2.42 (80.73)	0.192
3	Open the airway	4.89 (81.51)	4.38 (72.92)	0.058
4	Check for breathing	4.72 (78.65)	4.00 (66.67)	0.011
5	Alert emergency services	6.47 (71.88)	5.53 (61.46)	0.054
6	Chest compression	11.95 (79.69)	11.02 (73.44)	0.003
7	Rescue breathing	11.25 (75.00)	9.06 (60.42)	0.000
8	Continuity of CPR	6.94 (77.08)	6.70 (74.48)	0.157
9	Post-CPR management	9.84 (82.03)	10.44 (86.98)	0.618

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The median knowledge retention score (Me = 80) was significantly lower than the final knowledge score (Me = 90), Z = -5.157, $p < 0.001$, as analyzed by the Wilcoxon signed-rank test. However, it was still significantly higher than the score of initial knowledge (Me = 60), Z = -6.642, $p < 0.001$. The analysis also showed a significant decrease in the skills retention (Me = 54) score compared with the final skills score (Me = 62) Z=-4.219, $p < 0.001$. Table 3 shows that almost all steps had decreased scores, except for the 9th step. A significant decrease was found in steps 1st, 4th, 6th, and 7th. However, the score increase on the 9th step was not significant.

Table 4. Basic Life Support Skills Assessment Results

Skills	Pass	Fail
Final skills	60 (93.7%)	4 (6.3%)
Skill retention	51 (79.7%)	13 (20.3%)

Table 4 indicates that 44 (68.7%) participants passed the skills retention assessment. There was no significant difference in the number of participants who passed the final skills assessment and those who passed the skills retention test.

Discussion

During the pandemic, the European Resuscitation Council did not recommend holding face-to-face Basic Life Support (BLS) training or mass training for laypersons. Some recommended modified training methods include self-directed learning and distance-learning because they reduce the risk of infection for participants and trainers (12).

This study showed that the distance-learning method of BLS training for laypersons effectively increases the participants' knowledge of BLS. The increase in knowledge is indicated by a significantly higher final knowledge score (Me = 90) than the initial knowledge score (Me = 60). This increase is comparable to the traditional face-to-face learning method as studied by Castillo *et al.*, which reported that face-to-face BLS training led to a significant increase in knowledge scores from 6.27 (1.65) at the start to 8.36 (1.23) at the end of the training (20).

These results are also consistent with previous research by Tobase *et al.*, who found that online training methods are an effective teaching-learning method for increasing the BLS knowledge of nursing students (13). Therefore, extensive applications of this method can increase the coverage of people exposed to BLS theory and increase the community's competence and motivation to resuscitate OHCA victims (21).

In addition to increasing knowledge, this study also proved that distance-learning method training could provide participants with sufficient BLS skills. This is indicated by the fact that most of the participants (93.7%) passed the skill observation test, despite never attending similar training.

Furthermore, Ali *et al.'s* meta-analysis concluded that the online training method provides participants with better skills in recognizing environmental safety, asking for help, and response time in resuscitation (17). These results make the online training method an effective alternative to BLS training for laypersons during the COVID-19 pandemic (17,22).

This study also assessed BLS knowledge and skills retention after learning through the distance-learning method. A statistical test showed a decrease in knowledge six months post-training (Me = 80) compared to knowledge at the end of training (Me = 90). However, retention of this knowledge was still significantly higher than initial knowledge

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before training (Me = 60). Moreover, the statistical test showed a decrease in skills six months after training (Me = 59) compared to skills at the end of training (Me = 64). The percentage of passing skills observation also decreased from 93.7% at the end of the training to 68.7% six months after the training.

Interestingly, a similar decrease also occurred in the conventional face-to-face learning method, as reported by Srivilaithon *et al.* They found that BLS knowledge decreased 1.29 times six months after BLS training was given to medical students. Moreover, Sufiyah *et al.* reported a decrease in BLS skills after the conventional learning method. They found that a year post-training, only 26% of medical students could complete all BLS steps, and less than 50% of the participants successfully did 3 out of 10 assessment points (23,24).

According to Anderson *et al.,* to maintain learning retention, short but routine training once a month using mannequins and visual feedback is required (25).

Overall, this study has demonstrated the effectiveness of the distance learning method for BLS training for laypersons, which is comparable to the level 3 evaluation stage based on Kirkpatrick's evaluation criteria. Thus, it is hoped that participants will also experience changes in their behavior, not just their knowledge and skills in Basic Life Support (26).

CONCLUSION

The distance-learning method for BLS training effectively increased the participant's knowledge and skills of Basic Life Support. However, their knowledge and skills decreased six months post-training. The distance-learning method has been proven to be a promising alternative to BLS training during and after the COVID-19 pandemic. Further studies with larger sample sizes, longer observation periods, and qualitative perceptions of training participants should be performed to obtain a wider perspective on the effectiveness of distance-learning on BLS training.

Acknowledgment

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Conflict of Interest

The authors declared no conflict of interest in this study.

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Authors' Contribution

All authors have contributed to all processes in this study.

REFERENCES

1. Singh S, Fong HK, Mercedes BR, Serwat A, Malik FA, Desai R. COVID-19 and out-of-hospital cardiac arrest: A systematic review and meta-analysis. Resuscitation. 2020 Nov;156:164–6. [PubMed]
2. Lai PH, Lancet EA, Weiden MD, Webber MP, Zeig-Owens R, Hall CB, et al. Characteristics Associated With Out-of-Hospital Cardiac Arrests and Resuscitations During the Novel Coronavirus Disease 2019 Pandemic in New York City. JAMA Cardiol. 2020 Oct 1;5(10):1154. [PubMed]
3. Marijon E, Karam N, Jost D, Perrot D, Frattini B, Derkenne C, et al. Out-of-hospital cardiac arrest during the COVID-19 pandemic in Paris, France: a population-

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.18-26

based, observational study. Lancet Public Health. 2020 Aug;5(8):e437–43. [PubMed] [ScienceDirect]
4. Baldi E, Sechi GM, Mare C, Canevari F, Brancaglione A, Primi R, et al. COVID-19 kills at home: the close relationship between the epidemic and the increase of out-of-hospital cardiac arrests. Eur Heart J. 2020 Aug 21;41(32):3045–54. [PubMed] [WebPage]
5. Han H, Zaw S, Djukiadmodjo F, Teh A, O'Donnell D, Hare D, et al. Predictors of Survival in Patients With Out-of-Hospital Cardiac Arrests: Differences Between Shockable and Non-Shockable Rhythms. Heart Lung Circ. 2018;27:S337. [WebPage]
6. Blewer AL, Ho AFW, Shahidah N, White AE, Pek PP, Ng YY, et al. Impact of bystander-focused public health interventions on cardiopulmonary resuscitation and survival: a cohort study. Lancet Public Health. 2020 Aug;5(8):e428–36. [PubMed] [WebPage]
7. Cheng A, Nadkarni VM, Mancini MB, Hunt EA, Sinz EH, Merchant RM, et al. Resuscitation Education Science: Educational Strategies to Improve Outcomes From Cardiac Arrest: A Scientific Statement From the American Heart Association. Circulation. 2018 Aug 7;138(6):e82–122. [WebPage] [PubMed]
8. Cheng A, Magid DJ, Auerbach M, Bhanji F, Bigham BL, Blewer AL, et al. Part 6: Resuscitation Education Science: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation [Internet]. 2020 Oct 20 [cited 2021 Nov 8];142(16_suppl_2). Available from: https://www.ahajournals.org/doi/10.1161/CIR.0000000000000903 [WebPage]
9. Pivač S, Gradišek P, Skela-Savič B. The impact of cardiopulmonary resuscitation (CPR) training on schoolchildren and their CPR knowledge, attitudes toward CPR, and willingness to help others and to perform CPR: mixed methods research design. BMC Public Health. 2020 Dec;20(1):915. [PubMed] [WebPage]
10. González-Salvado V, Rodríguez-Ruiz E, Abelairas-Gómez C, Ruano-Raviña A, Peña-Gil C, González-Juanatey JR, et al. Training adult laypeople in basic life support. A systematic review. Rev Esp Cardiol Engl Ed. 2020 Jan;73(1):53–68. [PubMed]
11. Baldi E, Contri E, Savastano S, Cortegiani A. The challenge of laypeople cardio-pulmonary resuscitation training during and after COVID-19 pandemic. Resuscitation. 2020 Jul;152:3–4. [PubMed]
12. Nolan JP, Monsieurs KG, Bossaert L, Böttiger BW, Greif R, Lott C, et al. European Resuscitation Council COVID-19 guidelines executive summary. Resuscitation. 2020 Aug;153:45–55. [PubMed] [ScienceDirect]
13. Tobase L, Peres HHC, Gianotto-Oliveira R, Smith N, Polastri TF, Timerman S. The effects of an online basic life support course on undergraduate nursing students' learning. Int J Med Educ. 2017 Aug 25;8:309–13. [PubMed]
14. Birkun A. Distant learning of BLS amid the COVID-19 pandemic: Influence of the outbreak on lay trainees' willingness to attempt CPR, and the motivating effect of the training. Resuscitation. 2020 Jul;152:105–6. [PubMed]
15. Naylor K, Torres K. Transitioning to Web-Based Learning in Basic Life Support Training During the COVID-19 Pandemic to Battle the Fear of Out-of-Hospital Cardiac Arrest: Presentation of Novel

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.18-26

Methods. J Med Internet Res. 2021 May 25;23(5):e27108. [PubMed] [WebPage]
16. Moon H, Hyun HS. Nursing students' knowledge, attitude, self-efficacy in blended learning of cardiopulmonary resuscitation: a randomized controlled trial. BMC Med Educ. 2019 Dec;19(1):414. [WebPage] [PubMed]
17. Ali DM, Hisam B, Shaukat N, Baig N, Ong MEH, Epstein JL, et al. Cardiopulmonary resuscitation (CPR) training strategies in the times of COVID-19: a systematic literature review comparing different training methodologies. Scand J Trauma Resusc Emerg Med. 2021 Dec;29(1):53. [PubMed] [WebPage]
18. Han S, Park HJ, Nah S, Lee EH, Lee HJ, Park JO, et al. Instructor-led distance learning for training students in cardiopulmonary resuscitation: A randomized controlled study. Lin S, editor. PLOS ONE. 2021 May 6;16(5):e0251277. [WebPage] [PubMed]
19. Panchal AR, Bartos JA, Cabañas JG, Donnino MW, Drennan IR, Hirsch KG, et al. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation [Internet]. 2020 Oct 20 [cited 2021 Dec 11];142(16_suppl_2). Available from: https://www.ahajournals.org/doi/10.1161/CIR.0000000000000916 [WebPage]
20. Castillo J, Gallart A, Rodríguez E, Castillo J, Gomar C. Basic life support and external defibrillation competences after instruction and at 6 months comparing face-to-face and blended training. Randomised trial. Nurse Educ Today. 2018 Jun;65:232–8. [PubMed] [WebPage]
21. Birkun AA, Dantanarayana VR. Open Online Course on Basic Cardiopulmonary Resuscitation: Investigation of an Audience and the Effects of Distant Training. Gen Reanimatol. 2020 Apr 24;16(2):52–63. [WebPage] [PubMed]
22. Lactona ID, Suryanto S. Efficacy and knowledge of conducting CPR through online learning during the COVID-19 pandemic: A literature review. J Public Health Res [Internet]. 2021 Apr 14 [cited 2021 Oct 28];10(2). Available from: https://www.jphres.org/index.php/jphres/article/view/2208 [WebPage]
23. Srivilaithon W, Amnuaypatanapon K, Limjindapron C, Diskumpon N, Dasanadeba I, Daorattanachai K. Retention of Basic-Life-Support Knowledge and Skills in Second-Year Medical Students. Open Access Emerg Med. 2020 Sep;Volume 12:211–7. [WebPage] [PubMed]
24. Sufiyah IM, Semedi BP, Wiyasihati SI. Retention of basic life support in medical students of Airlangga University. J Kedokt Dan Kesehat Indones. 2018 Aug 30;9(2):115–9. [WebPage]
25. Anderson R, Sebaldt A, Lin Y, Cheng A. Optimal training frequency for acquisition and retention of high-quality CPR skills: A randomized trial. Resuscitation. 2019 Feb;135:153–61. [PubMed] [WebPage]
26. Dorri S, Akbari M, Dorri Sedeh M. Kirkpatrick evaluation model for in-service training on cardiopulmonary resuscitation. Iran J Nurs Midwifery Res. 2016 Oct;21(5):493–7. [PubMed] [WebPage]

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.18-26

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Original Article

ASSOCIATION BETWEEN SHOCK INDEX AND POST-EMERGENCY INTUBATION HYPOTENSION IN PATIENTS WHO CALLED THE RAPID RESPONSE TEAM AT DR. CIPTO MANGUNKUSUMO HOSPITAL

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ABSTRACT

Introduction: Hypotension is an acute complication following Emergency Endotracheal Intubation (ETI) in populations who called the Rapid Response Team (RRT). Thus, a fast and simple tool is needed to identify the risk of Post-emergency Intubation Hypotension (PIH). Shock Index (SI) pre-intubation is one of the potential factors to predict PIH. **Objective:** To measure the association between shock index with post-emergency intubation hypotension after calling for the RRT. **Materials and Methods:** This research is a cohort retrospective study that analyzed 171 patients aged ≥18 years who have called RRT and underwent an emergency ETI. The cut-off point for SI was determined using the ROC curve to predict PIH. The modification effect was evaluated using stratification analysis. Data were analyzed using cox regression to determine the likelihood of SI in the cause of hypotension. **Result**: A total of 92 patients (53.8%) underwent post-emergency intubation hypotension. The SI cut-off point of 0.9 had a sensitivity of 82.6% and a specificity of 67.1% for predicting PIH (Area Under Curve (AUC) 0.81; 95% CI 0.754–0.882, p <0.05). The increased risk of PIH associated with high SI score was an aRR of 1.9; 95% CI 1.03–3.57, a p-value of 0.040 among those with sepsis, and an aRR of 7.9, 95% CI 2.36–26.38, a p-value of 0.001 among those without sepsis. **Conclusion:** This study showed that a high SI score was associated with PIH after being controlled with other PIH risk variables. The risk of PIH associated with SI score modestly increased (2-fold increase) in those with sepsis and significantly increased (8-fold increase) in those without sepsis.

Keywords: Critical Illness; Emergency Intubation; Post-Intubation Hypotension; Rapid Response Team; Shock Index

ABSTRAK

Pendahuluan: Hipotensi merupakan komplikasi akut yang rentan dialami pasca dilakukan intubasi emergensi pada populasi yang diaktivasi tim respons cepat, maka diperlukan alat untuk identifikasi risiko hipotensi pasca emergensi endotrakeal intubasi dengan cepat dan mudah dilakukan. Indeks syok (IS) sebelum intubasi adalah salah satu faktor yang potensial dalam memprediksi kejadian Hipotensi Pasca-Intubasi Emergensi (HPI). **Tujuan:** Untuk mengetahui hubungan indeks syok sebelum intubasi dengan kejadian hipotensi pasca intubasi. **Bahan dan Metode:** Penelitian ini studi kohort retrospektif yang terdiri 171 pasien berumur ≥18 tahun yang diaktivasi tim respons cepat dan dilakukan intubasi emergensi. Penentuan titik potong syok indeks yang dapat memprediksi hipotensi dengan kurva ROC. Analisis stratifikasi dilakukan untuk mengetahui efek modifikasi. Untuk mengetahui besar risiko SI terhadap hipotensi maka data dianalisis menggunakan cox regresi. **Hasil:** Terdapat 92 pasien (53,8%) yang mengalami hipotensi pasca intubasi emergensi. Nilai titik potong IS yang diambil untuk meprediksi hipotensi adalah 0,9 dengan sensitivitas 82,6% dan spesifisitas 67,1% (area under curve (AUC) 0,81; 95%CI 0,754–0,882, p<0,05). Peningkatan risiko HPI berhubungan dengan skor IS yang tinggi sebesar aRR 1,9 95%CI 1,03–3,57; p-value 0,040 pada yang sepsis dan aRR 7,9; 95%CI 2,36–26,38; p-value 0.001 pada pasien yang tidak sepsis. **Kesimpulan**: Studi ini menunjukkan bahwa skor SI yang tinggi meningkatkan risiko HPI setelah dikontrol dengan variabel lain yang berisiko terhadap HPI. Peningkatan risiko HPI berhubungan dengan skor SI yaitu pada mereka yang sepsis meningkat 2 kali, dan pada yang tidak sepsis sebesar 8 kali.

Kata kunci: Penyakit Kritis; Intubasi Emergensi; Hipotensi Pasca-Intubasi; Tim Respons Cepat; Indeks Syok

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INTRODUCTION

Any patient from all hospital units can worsen and become critically ill (1). Therefore, critical care management should be provided and accessible in the hospital environment. To do so, the implementation of a Rapid Response Team (RRT) has been proposed to identify and provide initial care for critically ill patients (2,3). A common emergency procedure provided by the RTT is Emergency Endotracheal Intubation (ETI). It is generally performed on critically ill patients to improve oxygenation and ventilation (4).

Endotracheal Intubation is more challenging for doctors to perform in emergency situations. It is associated with an increased risk of adverse events compared to elective intubation in the operating room (4,5). These risks include the critically ill patient's susceptibility to developing hypoxia and hypotension after this life-saving procedure. Post-Intubation Hypotension (PIH) is significantly associated with poor outcomes such as increasing the risk of mortality, kidney injury, myocardial injury, and Intensive Care Unit (ICU) length of stay (6,7). Therefore, to prevent these outcomes, it is vital to identify susceptible patients, especially in emergency settings.

Measurement of vital signs by calculating the Shock Index (SI) before intubation is a simple bedside and effective tool for predicting early shock than using a single parameter. SI can be defined as the ratio of Heart Rate (HR) to Systolic Blood Pressure (SBP), with a normal range of 0.5-0.7 (7–9). The prevalence of PIH in the SI of <0.7 group (23%) was lower than those in the SI of ≥0.7 (37.5%) group of patients who underwent intubation in the emergency department (8). The study presented that subjects who had a pre-intubation SI of ≥0.8 were more susceptible to experiencing PIH (OR 2.28; 95% CI 1.18-4.43) (10). Another study of 140 patients admitted to the ICU showed that a SI of ≥0.9 was a predictor for PIH (P=.01; OR 3.17; 95% CI 1.58–26.48) (5).

SI has been used commonly in the emergency room and ICU to assess disease severity and initiate therapy to optimize perfusion (9). The usefulness of SI for predicting PIH has been previously studied. However, no studies have focused on evaluating SI for predicting PIH outside the ER or ICU. There were also various cut-off points of SI for predicting PIH.

One of the RRT actions during resuscitation, which is quite often done, is emergency intubation. However, the RRT still lacks data on this topic. Thus, this study's samples were patients who called the RRT. This study aims to measure the association between SI and post-ETI hypotension after RRT activation.

MATERIALS AND METHODS

Study setting and population

We conducted a retrospective cohort study of patients admitted to Dr. Cipto Mangunkusumo Hospital, a national referral center and teaching hospital. The subjects included in this study were patients ≥18 years and required an ETI to be performed by RRT doctors in all in-hospital units except the ICU, emergency room, and operating room.

The RRT consists of intensivists, anesthesiologists, anesthesia residents, and general practitioners trained in critical care. The team provides immediate assistance to all emergency calls from hospital units except the ICU, emergency, and operating room. Emergency endotracheal intubation is typically performed by anesthesia residents or general practitioners and supervised by anesthesiologists.

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The exclusion criteria in this study were patients with an SBP less than 90 mmHg or Mean Arterial Pressure (MAP) less than 65 mmHg, have undergone cardiac arrest, or missing blood pressure and heart data rate pre- and or post-emergency endotracheal intubation.

Study protocol and measurements

The ethics commissions approved the KET.143/UN2.F1/ETIK/PPM.00.02/2022. Data were retrieved through electronic medical records and RRT documentation after sorting for all potential subjects with a code for endotracheal intubation. Furthermore, the shock index was calculated by dividing HR with SBP and assessing whether PIH occurred post-ETI. PIH was defined as any recorded SBP less than 90 mmHg, as when SBP decreases more than 20% from the baseline, an MAP less than 65 mmHg, or initiating or increasing the vasopressor dose in 30 minutes post-intubation (7).

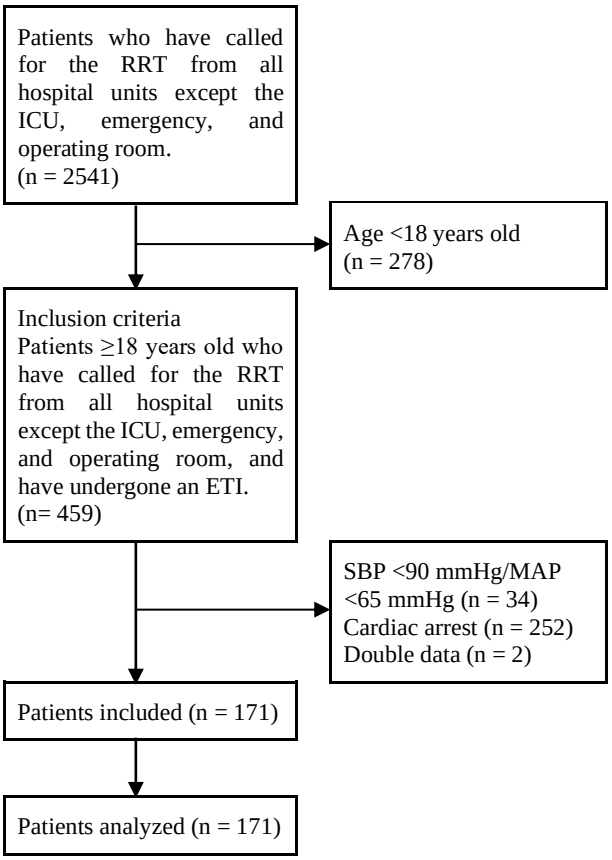

Figure 1. Study Flow Chart

Sampling was conducted from January 2020 to December 2021 (Figure 1). The demographic data used were age, sex, and length of hospitalization. Clinical features included comorbidities, hemodynamic data pre- and post-intubation, and medication for intubation.

Statistical analysis

Continuous variables were presented by mean ±SD or median (interquartile range/IQR) depending on the data distribution. Meanwhile, categorical variables were mentioned as frequency (percentage).

The cut-off point of the shock index was determined using the ROC curve to predict the PIH, which was then calculated by the Youden index. The results were then divided into two categories for further analysis.

Stratification analysis was performed to evaluate the modification effect. Since PIH is considered a common outcome (6,11), using a logistic regression would result in an overestimated relative risk (12). To overcome this issue, the Cox regression analysis calculates the RR (Risk Ratio) by assigning the same survival time for all observations (13). Analysis was done by Stata/SE 16.1, and the significance is indicated by a level of less than 0.05.

RESULTS AND DISCUSSION

The demographic and clinical data are presented in Table 1. Regarding outcomes, 92 patients (53.8%) experienced PIH, and 79 patients (46.2%) did not. The median age of patients was 51.9 (IQR, 18.5 – 89.3), and 53.8% were male. This finding is similar to a previous study which found that 52% of their subjects who experienced PIH were aged 56 years (14). The rate of PIH in this study is higher than in previous studies, which reported 46% (4) and 29.6% incidence (8). Another study revealed

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PIH rates of 19.6%, which excluded patients who used vasopressor pre-intubation (10). These varying results may be due to differences in the definitions of PIH because there is no consensus on its definition. The most significant relationship to mortality was using the vasopressor post-intubation (14).

Table 1. Demographic and Clinical Data

Variable	Value
Post-intubation hypotension	
Yes, n (%)	92 (53.8)
No, n (%)	79 (46.2)
Sex	
Male, n (%)	92 (53.8)
Female, n (%)	79 (46.2)
Age, median (range)	51.9 (18.5 – 89.3)
Intubation reason	
Respiratory failure, n (%)	113 (66.1)
Airway protection, n (%)	12 (7)
Loss of consciousness, n (%)	46 (26.9)
Hemodynamic assessment (pre-intubation)	
Heart rate, median (range)	121 (60 – 188)
SBP (mmHg), median (range)	131 (90 – 217)
MAP, median (range)	96.7 (66 – 185.7)
Time to call RRT from admission, median (range)	7 (0 – 53)
SI (pre-intubation), median (range)	0.9 (0.3 – 1.9)
Comorbidities	
Malignancy, n (%)	56 (32.7)
CHF, n (%)	16 (9.4)
CKD, n (%)	44 (25.7)
COPD, n (%)	4 (2.3)
Diabetes Mellitus, n (%)	47 (27.5)
Hypertension, n (%)	47 (27.5)
Hepatic cirrhosis, n (%)	4 (2.3)
Sepsis, n (%)	104 (60.8)
Intubation medication	
Fentanyl, n (%)	165 (96.5)
Midazolam, n (%)	65 (38)
Ketamine, n (%)	95 (55.6)
Propofol, n (%)	120 (70.2)
Rocuronium, n (%)	47 (27.5)

SBP, Systolic blood pressure; MAP, mean arterial pressure; RRT, Rapid Response Team; SI, Shock index; CHF, Congestive heart failure; CKD, Chronic kidney disease; COPD, Chronic obstructive pulmonary disease

To some extent, the incidence of PIH may be influenced by factors such as study design, hospital setting, and geographic location (15). Table 1 shows that more than 65% of intubation cases were due to respiratory failure. Regarding the patient's hemodynamic status pre-intubation, the results showed that the median heart rate, SBP, and MAP were 113 x/minutes, 131 mmHg, and 96.7 mmHg, respectively. The median time to call RRT from admission was 7 days (IQR, 0 – 53). These results are in line with a previous study that found adult patients who called the RRT 7 days after admission did not survive, and those who called after 5 days survived (16). Furthermore, the prolonged length of stay (LOS) may be due to the increased complications experienced by the patients (17).

An ROC analysis of the SI score calculated that the SI cut-off point of 0.9 had a sensitivity of 82.6% and a specificity of 67.1% for predicting PIH (Area Under Curve (AUC) 0.81, 95% CI 0.754–0.882, p <0.05, Fig. 2). Based on an SI threshold of 0.9, table 2 showed that patients with a high SI score (SI score ≥0.9) were significantly likely to experience PIH than those with a low SI score (SI score <0.9) (RR 3.2 95%CI 2.06–5.01; p-value <0.001).

The results of this study are similar to a study done by Trivedi et al. (5), which showed that a SI score greater than or equal to 0.9 had a significant association with PIH (OR 3.17, 95%CI 1.36–7.73, p-value 0.01) and higher ICU mortality (OR 5.75; 95%CI 1.58–26.48, p-value 0.01). Conversely, a study by Koby A et al. (10) found that PIH was associated with SI scores greater than or equal to 0.8 (OR 2.28; 95% CI 1.18–4.43). The likely reason for these differences may be caused by the influence of the patient's characteristics and the intubation methods performed. However, these results revealed that increasing the SI score may be useful for predicting PIH. Thus, using the SI score is a more effective tool for assessing acute critical illness than conventional vital signs (5).

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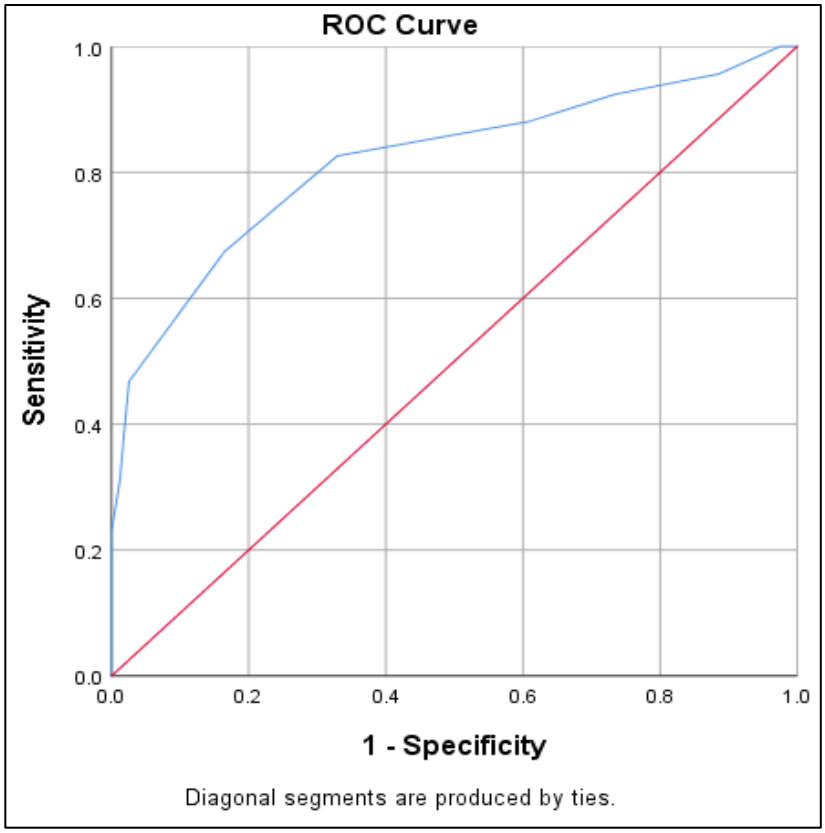

Figure 2. ROC curve for SI score for predicting post-emergency endotracheal intubation

Regarding comorbidities, malignancy occurred in about 69.6% of patients who developed PIH (RR 1.5, 95%CI 1.16–1.96; p = 0.004). The bivariate analysis showed that the association between chronic kidney disease (RR 0.7 95%CI 0.44–0.98; p = 0.019), diabetes mellitus type 2 (RR 0.7 95%CI 0.47–1.00; p = 0.031), and hypertension (RR 0.7 95% CI 0.47–1.00; p = 0.031) were statistically significant with PIH (Table 2).

Furthermore, patients who experienced PIH had a higher prevalence of sepsis than those without PIH (60.6% vs. 39.4%, p = 0.027). We also discovered that all pre-medications before intubation did not differ between the two groups for the risk of PIH.

Moreover, Table 3 shows that sepsis modified the effect of the shock index on the development of PIH. The significance of the homogeneity test was 0.01. The risk ratio of experiencing PIH due to shock index was 1.7 (95% CI 1.20–2.44) among those with sepsis and 4.9 (95% CI 2.46–9.61) among those without sepsis.

Next, multivariable analysis was done using the Cox regression to assess the association between SI score and PIH. In this analysis, potential confounders were controlled, and the interaction terms were tested. The interaction between SI score and sepsis was found to be statistically significant. The adjusted RR (aRR) was 1.9 (95%CI 1.03–3.57, p-value 0.040) among those with sepsis and 7.9 (95%CI 2.36–26.38, p-value 0.001) among those without sepsis after controlling for age, sex, malignancy, and propofol (Table 4).

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Table 2. Association between the SI and Covariate Variables with PIH

Variable	PIH		RR (95% CI)	p-value
	Yes N = 92	No N = 79		
SI score				
High (≥0.9)	76 (74.5)	26 (25.5)	3.2 (2.06–5.01)	<0.001*
Low (<0.9)	16 (23.2)	53 (76.8)		
Age				
≥65 years old	18 (42.9)	24 (57.1)	0.7 (0.51–1.09)	0.101
<65 years old	74 (57.4)	55 (42.6)		
Sex				
Male	41 (44.6)	51 (55.4)	1.4 (1.09–1.92)	0.009*
Female	51 (64.6)	28 (35.4)		
Malignancy				
Yes	39 (69.6)	17 (30.4)	1.5 (1.16–1.96)	0.004*
No	53 (46.1)	62 (53.9)		
CHF				
Yes	6 (37.5)	10 (62.5)	0.7 (0.35–1.29)	0.169
No	86 (55.5)	69 (44.5)		
CKD				
Yes	17 (38.6)	27 (61.4)	0.7 (0.44–0.98)	0.019*
No	75 (59.1)	52 (40.9)		
COPD				
Yes	2 (50)	2 (50)	0.9 (0.34–2.49)	0.877
No	90 (53.9)	77 (46.1)		
T2DM				
Yes	19 (40.4)	28 (59.6)	0.7 (0.47–1.00)	0.031*
No	73 (58.9)	51 (41.1)		
Hypertension				
Yes	19 (40.4)	28 (59.6)	0.7 (0.47–1.00)	0.031*
No	73 (58.9)	51 (41.1)		
Hepatic cirrhosis				
Yes	2 (50)	2 (50)	0.9 (0.34–2.49)	0.877
No	90 (53.9)	77 (46.1)		
Sepsis				
Yes	63 (60.6)	41 (39.4)	1.4 (1.02–1.92)	0.027*
No	29 (43.3)	38 (56.7)		
Fentanyl				
Yes	87 (52.7)	78 (47.3)	0.6 (0.43–0.93)	0.139
No	5 (83.3)	1 (16.7)		
Midazolam				
Yes	36 (55.4)	29 (44.6)	1.0 (0.79–1.39)	0.745
No	56 (52.8)	50 (47.2)		
Ketamine				
Yes	54 (56.8)	41 (43.2)	1.1 (0.85–1.51)	0.372
No	38 (50)	38 (50)		
Propofol				
Yes	63 (52.5)	57 (47.5)	0.9 (0.69–1.24)	0.601
No	29 (56.9)	22 (43.1)		
Rocuronium				
Yes	27 (57.4)	20 (42.6)	1.1 (0.81–1.47)	0.556
No	65 (52.4)	59 (47.6)		

*) Significance test if p-value <0.05; RR=Risk Ratio; PIH=Post-Intubation hypotension; SI=Shock index; CHF=Congestive heart failure; CKD=Chronic kidney disease; COPD=Chronic obstructive pulmonary disease; T2DM=Type 2 Diabetes Mellitus

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Table 3. Stratification Analysis Results of the Association of SI with PIH based on Covariate Variables

Covariate variable	RR strata	95% CI	RR MH (95%CI)	ΔRR (%)	p-value homogeneity test
Age					
<65 years old	2.6	1.76–3.84	2.49 (1.78–3.48)	0.8	0.63
≥65 years old	2.2	1.15–4.08			
Sex					
Male	2.7	1.79–4.16	2.49 (1.79–3.47)	0.8	0.58
Female	2.3	1.34–3.77			
Malignancy					
Yes	3.6	1.51–8.56	2.57 (1.82–3.63)	2.4	0.32
No	2.3	1.59–3.28			
CHF					
Yes	1.3	0.41–3.77	2.51 (1.79–3.51)	0	0.20
No	2.6	1.86–3.80			
CKD					
Yes	2.6	1.36–4.89	2.46 (1.77–3.43)	2.0	0.87
No	2.4	1.65–3.57			
COPD					
Yes	2.0	0.50 –7.99	2.51 (1.81–3.49)	0	0.74
No	2.5	1.81–3.54			
T2DM					
Yes	3.9	1.88–8.19	2.41 (1.75–3.32)	3.9	0.13
No	2.1	1.46–2.99			
Hypertension					
Yes	2.6	1.35–4.91	2.45 (1.76–3.40)	2.4	0.86
No	2.4	1.64–3.53			
Hepatic cirrhosis					
Yes	1.0	0.14–7.09	2.51 (1.80–3.49)	0	0.35
No	2.6	1.83–3.59			
Sepsis					
Yes	1.7	1.20–2.44	-	-	0.01*
No	4.9	2.46–9.61			
Fentanyl					
Yes	2.5	1.79–3.45	2.53 (1.82–3.53)	-	-
No	-	-			
Midazolam					
Yes	2.3	1.38–3.96	2.51 (1.81–3.48)	0	0.73
No	2.6	1.72–3.99			
Ketamine					
Yes	2.1	1.47–3.12	2.45 (1.78–3.83)	2.4	0.29
No	3.1	1.70–5.68			
Propofol					
Yes	2.7	1.86–3.95	2.52 (1.82–3.50)	0.4	0.48
No	2.1	1.06–4.01			
Rocuronium					
Yes	3.4	1.57–7.39	2.52 (1.81–3.51)	0.4	0.36
No	2.3	1.59–3.29			

*) Significance test if p-value <0.05; OR Crude 2.51 (95% CI 1.81–3.49); RR=Risk Ratio; MH=Mantel-Haenszel; PIH=Post-emergency Intubation Hypotension; SI=Shock index; CHF=Congestive Heart Failure; CKD=Chronic Kidney Disease; COPD=Chronic Obstructive Pulmonary Disease; T2DM=Type 2 Diabetes Mellitus

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Table 4. High vs. Low SI Score Associated with PIH by Sepsis

Variable	aRR (95% CI)	p-value
Sepsis		
Yes	1.9 (1.03–3.57)	0.040*
No	7.9 (2.36–26.38)	0.001*

*) Significance test if p-value <0.05
High (≥0.9) vs Low (<0.9); SI=Shock index; PIH=Post-emergency Intubation Hypotension
OR adjusted by age, sex, malignancy, propofol.

Malignancy may cause the patients to become immunocompromised. Therefore, patients with cancer tend to be susceptible to mortality-related factors such as acute respiratory failure or sepsis (18).

According to a previous study, propofol was the most significant factor associated with PIH (aOR 2.16, 95% CI 1.43–3.25, p-value <0.001) (11). It has a short duration of action and rarely results in allergies. However, propofol has the disadvantage of causing hemodynamic instability (11,19).

Next, Wira et al. (20) reported that a SI elevation greater than 0.8 might be a convenient modality to identify patients with severe sepsis. Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection (21). A common complication of sepsis is cardiovascular dysfunction (22). Therefore, sepsis may be given a modification effect for its association between SI and hypotension.

These results could be warning signs for hospitals to modify pre-intubation or peri-intubation management to avoid hemodynamic collapse. High-risk patients, especially those with SI scores of 0.9 or higher, must receive hemodynamic optimization to balance their respiratory and cardiovascular status. Thus, the interventions that the RRT needs to perform during pre-intubations are administering intravenous fluid bolus, using a vasopressor, and choosing an induction agent that fits the patient's hemodynamic needs.

To the best of our knowledge, this is the first study that evaluates the SI in patient populations who have called for the RRT. These results may be the basis for future research regarding the potential of the SI factor to predict PIH in RRT populations.

However, there are several limitations to our study. First, it is a retrospective observational study. Thus, gaps still exist due to missing data. Second, our results may not be generalizable to other populations or centers.

CONCLUSION

Our study showed that the high SI score group was associated with PIH after being controlled with other PIH risk variables. The risk of PIH associated with SI score was modestly increased (2-fold increase) in those who had sepsis and very high (8-fold increase) in those who did not.

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Conflict of Interest

The authors have no conflict of interest to declare.

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None to declare.

Authors' Contributions

All authors have contributed to all processes in this research.

REFERENCES

1. Higgs A, Cook TM, McGrath BA. Airway management in the critically ill: The same, but different. Br J Anaesth. 2016;117:i5–9. [PubMed] [WebPage]

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.27-36

2. Rocha HAL, De Castro Alcântara AC, Rocha SGMO, Toscano CM. Effectiveness of rapid response teams in reducing intrahospital cardiac arrests and deaths: A systematic review and meta-analysis. Rev Bras Ter Intensiva. 2018;30(3):366–75. [PubMed] [WebPage]
3. Ko BS, Lim TH, Oh J, Lee Y, Yun IA, Yang MS, et al. The effectiveness of a focused rapid response team on reducing the incidence of cardiac arrest in the general ward. Medicine (Baltimore). 2020;99(10):e19032. [PubMed] [WebPage]
4. Green RS, Turgeon AF, McIntyre LA, Fox-Robichaud AE, Fergusson DA, Doucette S, et al. Postintubation hypotension in intensive care unit patients: A multicenter cohort study. J Crit Care [Internet]. 2015;30(5):1055–60. Available from: http://dx.doi.org/10.1016/j.jcrc.2015.06.007 [PubMed] [ScienceDirect]
5. Trivedi S, Demirci O, Arteaga G, Kashyap R, Smischney NJ. Evaluation of preintubation shock index and modified shock index as predictors of postintubation hypotension and other short-term outcomes. J Crit Care [Internet]. 2015;30(4):861.e1. Available from: http://dx.doi.org/10.1016/j.jcrc.2015.04.013 [PubMed] [ScienceDirect]
6. Smischney NJ, Kashyap R, Khanna AK, Brauer E, Morrow LE, Seisa MO, et al. Risk factors for and prediction of postintubation hypotension in critically ill adults: A multicenter prospective cohort study. PLoS One [Internet]. 2020;15(8 August):1–16. Available from: http://dx.doi.org/10.1371/journal.pone.0233852 [PubMed] [WebPage]
7. M Althunayyan S. Shock Index as a Predictor of Post-Intubation Hypotension and Cardiac Arrest; A Review of the Current Evidence. Bull Emerg Trauma. 2019;7(1):21–7. [PubMed]
8. Lee K, Jang JS, Kim J, Suh YJ. Age shock index, shock index, and modified shock index for predicting postintubation hypotension in the emergency department. Am J Emerg Med [Internet]. 2020;38(5):911–5. Available from: https://doi.org/10.1016/j.ajem.2019.07.011 [PubMed] [ScienceDirect]
9. Maheshwari K, Nathanson BH, Munson SH, Hwang S, Yapici HO, Stevens M, et al. Abnormal shock index exposure and clinical outcomes among critically ill patients: A retrospective cohort analysis. J Crit Care [Internet]. 2020;57:5–12. Available from: https://doi.org/10.1016/j.jcrc.2020.01.024 [PubMed] [ScienceDirect]
10. Banapoor B, Beattie LK, Koby A, Nwokolo J, Horn A, Marchick M. Using pre-Rapid Sequence Intubation Shock Index as a predictor of post-intubation hypotension, mortality, and duration of intubation. 2016;(August 2015). Available from: https://www.researchgate.net/publication/292157568
11. Nakornchai T, Limphan-Udom P, Monsomboon A, Surabenjawong U, Praphruetkit N, Chaisirin W, et al. Factors associated with post-intubation hypotension in an emergency department: A retrospective observational study. J Med Assoc Thail. 2017;100(8):864–71. [WebPage]
12. Knol MJ, Le Cessie S, Algra A, Vandenbroucke JP, Groenwold RHH. Overestimation of risk ratios by odds ratios in trials and cohort studies: Alternatives to logistic regression. C Can Med Assoc J. 2012;184(8):895–9. [PubMed] [WebPage]
13. Xie W, Zheng F. Robust Cox Regression as an Alternative Method to Estimate Adjusted Relative Risk in Prospective

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.27-36

Studies with Common Outcomes. Int J Stat Med Res. 2016;5(4):231–9. [WebPage]
14. Smischney NJ, Seisa MO, Cambest J, Wiegand RA, Busack KD, Loftsgard TO, et al. The Incidence of and Risk Factors for Postintubation Hypotension in the Immunocompromised Critically Ill Adult. J Intensive Care Med. 2019;34(7):578–86. [PubMed] [WebPage]
15. Green R, Hutton B, Lorette J, Bleskie D, Mcintyre L, Fergusson D. Incidence of postintubation hemodynamic instability associated with emergent intubations performed outside the operating room: A systematic review. Can J Emerg Med. 2014;16(1):69–79. [PubMed] [WebPage]
16. Ahn JH, Jung YK, Lee JR, Oh YN, Oh DK, Huh JW, et al. Predictive powers of the Modified Early Warning Score and the National Early Warning Score in general ward patients who activated the medical emergency team. PLoS One [Internet]. 2020;15(5):1–12. Available from: http://dx.doi.org/10.1371/journal.pone.0233078 [WebPage]
17. Siddique SM, Tipton K, Leas B, Greysen SR, Mull NK, Lane-Fall M, et al. Interventions to Reduce Hospital Length of Stay in High-risk Populations: A Systematic Review. JAMA Netw Open. 2021;4(9):1–13. [PubMed] [WebPage]
18. Martos-Benítez FD, Soto-García A, Gutiérrez-Noyola A. Clinical characteristics and outcomes of cancer patients requiring intensive care unit admission: a prospective study. J Cancer Res Clin Oncol [Internet]. 2018;144(4):717–23. Available from: http://dx.doi.org/10.1007/s00432-018-2581-0 [PubMed] [WebPage]
19. Koenig SJ, Lakticova V, Narasimhan M, Doelken P, Mayo PH. Safety of Propofol as an Induction Agent for Urgent Endotracheal Intubation in the Medical Intensive Care Unit. J Intensive Care Med. 2015;30(8):499–504.[PubMed][WebPage]
20. Wira C, Francis MW, Bhat S, Ehrman R, Conner D, Siegel M. The shock index as a predictor of vasopressor use in emergency department patients with severe sepsis. West J Emerg Med. 2014;15(1):60–6. [PubMed] [WebPage]
21. Singer M, Deutschman CS, Seymour C, Shankar-Hari M, Annane D, Bauer M, et al. The third international consensus definitions for sepsis and septic shock (sepsis-3). JAMA - J Am Med Assoc. 2016;315(8):801–10. [PubMed]
22. Greer JR. Pathophysiology of cardiovascular dysfunction in sepsis. BJA Educ. 2015;15(6):316–21. [WebPage]

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Case Report

USING MULTIMODAL ANALGESIA FOR BREAKTHROUGH PAIN IN STAGE IV BREAST CANCER PATIENT

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ABSTRACT

Introduction: Breakthrough Pain (BTP) is experienced as mild to moderate-severe pain, from only a few seconds to hours. It causes a decrease in the quality of life and functional capacities. Furthermore, BPT must be recognizable, assessed, and controlled to prevent its relapse and severity. **Case report:** A woman, 45 years old, having breast cancer along with pulmonary, femur, and cervical metastases, came with the main complaint of pain. The patient had a pain score of NRS 9, which was felt intermittently for the last 3 months. Treatment has been carried out with MST 10 mg/8 hours and a Durogesic® patch (fentanyl 50 mcg/h) but the pain did not subside. Moreover, the patient was unable to identify any precipitating factors or pain relievers, while the diagnosis confirmed BTP. The rescue dose was administered in a range of 10 – 20% of the total daily dose in the last 24 hours equivalent to 11 – 22 mg intravenous Morphine or equianalgesic with 110 – 220 mcg of fentanyl. For immediate effect, transmucosal fentanyl was recommended, but this preparation is currently unavailable. Moreover, therapy was carried out with the continuous administration of Morphine, and the pain reduced to NRS 0 – 3 on the second day. **Conclusion:** Transmucosal fentanyl, either buccal, sublingual, oral, or nasal mucosa, was proven to be effective in treating BTP. However, when transmucosal fentanyl is not available, multimodal analgesia is an effective alternative.

Keywords: Breakthrough Pain; Breakthrough Pain Assessment; Cancer Pain; Multimodal Analgesia

ABSTRAK

Pendahuluan: Renjatan nyeri (*breakthrough pain*) dirasakan sebagai nyeri ringan hingga sedang-berat, dari hanya hitungan detik hingga jam. Renjatan nyeri (*breakthrough pain*) menyebabkan penurunan kualitas hidup dan kapasitas fungsional. Renjatan nyeri (*breakthrough pain*) diharapkan dapat dikenali, dinilai dari awal, dan dapat diprediksi untuk dikontrol dengan cepat serta mencegah kekambuhan dan keparahannya. **Laporan kasus:** Seorang wanita, 45 tahun, dengan kanker payudara kanan dan kiri stadium IV metastase pulmonal, os femur, cervical datang dengan keluhan utama nyeri, dengan skala nyeri NRS 9, yang dirasakan hilang kambuh sejak 3 bulan terakhir dan telah mendapat MST 10 mg/8 jam dan Durogesic patch (fentanil 50 mcg/jam) namun nyeri bertambah berat dan tidak membaik dengan analgetik yang sehari – hari dikonsumsi. Pasien tidak dapat mengidentifikasi faktor pencetus maupun pereda nyeri. Pasien didiagnosis renjatan nyeri (*breakthrough pain*). *Rescue dose* menggunakan 10 – 20% dari total dosis harian (atau total dosis dalam 24 jam terakhir) yaitu 11 – 22 mg Morphine intravena atau ekuinalgesik dengan 110 – 220 mcg fentanyl intravena. Untuk efek yang cepat, direkomendasikan fentanyl transmukosal, namun sediaan ini belum tersedia. Pain service mensubtitusi terapi menjadi pemberian Morphine kotinu dan terpantau renjatan nyeri Ny. L berkurang menjadi NRS 0 – 3 pada hari kedua terapi. **Kesimpulan:** Fentanyl transmucosal dikatakan efektif mengatasi renjatan nyeri. Namun, jika fentanyl transmucosal tidak tersedia, analgesia multimodal dapat menjadi subtitusi dalam mengurangi renjatan nyeri.

Kata kunci: Renjatan Nyeri; Asesmen Renjatan Nyeri, Nyeri Kanker; Analgesia Multimodal

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INTRODUCTION

Breakthrough Pain (BTP) is an acute and transient exacerbation that occurs in pain previously controlled by routine opioids. In BTP, an additional dose of the routine opioids might be needed when the pain cannot be controlled (1,2). The prevalence of this condition in cancer patients (Breakthrough Cancer Pain/BTcP) is fairly higher at 33-95% compared to the non-cancer chronic disease patients with an average of 59.2%. According to the American Pain Foundation, BTP is experienced by 50%–90% of all hospitalized cancer patients, 89% of home care-terminal-patients, and 35% of all ambulatory care cancer patients, where 30% of these cases are moderate to severe pain (2–4).

BTP is experienced as mild to moderate-severe pain which occurs up to 4 times a day on average. The duration varies, from only a few seconds to hours with an average of 30 minutes. The reported pain types also vary, from somatic (33%), visceral (20%), and neuropathic pain (27%), to the combinations of them (1).

Furthermore, BTP causes a decrease in the quality of life and functional capacities. According to previous studies, patients reported either physical or psychological effects, which limits their daily routines, including mood swings, sleep disturbances, psycho-emotive deficits, increased anxiety, and depression levels. BTP also affects interpersonal relationships with one another, including a perception of being a burden to their caregivers (5). BTP should be recognizable and predictable to prevent its relapse as well as reduce the severity. Various guideline recommends the use of rapid-onset and short-duration opioids which are not always available in some hospitals. Therefore, this study presents a case of BTP that occurred in a cancer patient. The hospital did not have the recommended medication preparation and multimodal analgesia was used to control the pain.

CASE REPORT

Mrs. L, 45 years old, came into the hospital with chief complaints of pain, supported by the NRS of 9, and did not become better after using the routinely-consumed analgetic. Early diagnoses suggested stage IV right and left breasts as well as pulmonary and cervical metastases. The patient had also undergone a radical mastectomy on the right and left breasts, while the history of chemotherapy and radiotherapy numbers could not be remembered.

The patient complained of pain in the neck and back area 3 months before the hospital admission. When the first pain was felt, morphine sulfate (MST continuous) 10 mg/12 hours was initially administered and then the dose was increased to 10 mg/8 hours, with further addition of a Durogesic ® patch (fentanyl 50 mcg/hour). With this therapy, it was confirmed that the pain was relieved completely, while adequate sleeping and eating were restored. The patient continued to take the medication regularly but 1 month before the hospital admission, the pain sometimes become worsened and the severity increased from NRS 6 – 9. The pain was described as “tense, tight, heavy” and sometimes could only be described as “uncomfortable”. The patient also felt discomfort in the abdominal area, along with bloating, and constipation. Both the patient and families did not pay attention to the factors/activities which might trigger the pain. More specifically, pain usually occurs when the patient is asleep or not moving. Although the patient often tried to change the position of the body, the pain still did not reduce.

The blood pressure was 130/80 mmHg, heart rate 82 bpm, peripheral oxygen saturation

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98% room air, and body temperature was 36,5 ^{o}C. Based on the chest x-ray results, pneumonia-type metastasis, massive pleural effusion, left breast and pleural-type pulmonary metastasis were found, while no visible skeletal metastasis was observed in the visualized bone system. Laboratory examination showed anemia with Hb 9,5 g/dL, and other components within the normal range.

Pain service used the algorithm in Diagram 1 to assess the pain and the patient answered "yes" to all questions. The intermittent pain might go in minutes, but also might last for hours. Therefore, the pain service diagnosed the patient with cancer or BTP with stage IV skeletal and pulmonary metastases.

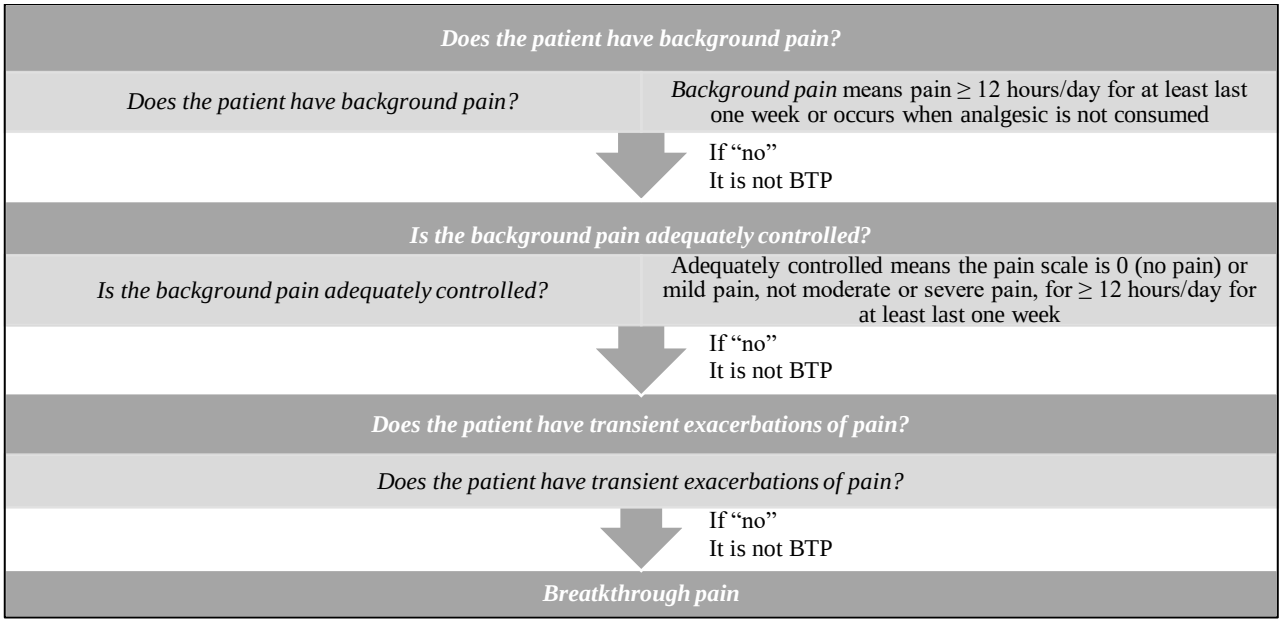

Diagram 1. Breakthrough Pain Diagnosis Algorithm(6)

The pain characteristics was analyzed by using the Breakthrough Pain Assessment Tool (BAT), wherein a pain diary was filled by the patient for 2 x24 hours with the assistance of the relatives, and the data are presented in Table 1. On the first day in inpatient care, the patient complained of pains at 08.30 a.m., 10.22 p.m., 10.35 p.m., and 11.24 p.m, while on the second day, pains were felt at 02.15 a.m. 3.15 p.m., and 8.15 p.m. The entire pains were at NRS level of 6-9 with the description of being "tense, heavy, uncomfortable, and restless". Most of the pain durations were around 10-30 minutes, while some were more than 30 minutes. Further consultation culminated in neurosurgery for pathological fracture of the 7th cervical spine and thoracic cardiovascular surgeon for massive pleura effusion thoracentesis procedure. The rescue dose needed was calculated as in the Diagram 2.

The initial treatment given was Morphine 2 mg iv bolus in a single dose and 10 mg in 50 cc of normal saline at a rate of 3 ml/hour (titration dose), Ketamine 6 mg iv bolus (single dose), Midazolam 2 mg iv bolus (single dose), Paracetamol 1 gr iv (extra), as well as Amitriptyline 25 mcg/24 hours orally. These administrations were still below the recommended doses of morphine at 14.4 mg/day compared to calculations of 43 mg/day. It was observed that the BPT decreased

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immediately to NRS 1 – 2 after the second day of therapy.

Step 1. Current therapy
- MST 10 mg/8 hours (per oral)
- Durogesic® patch (fentanyl 50 mcg/hour)

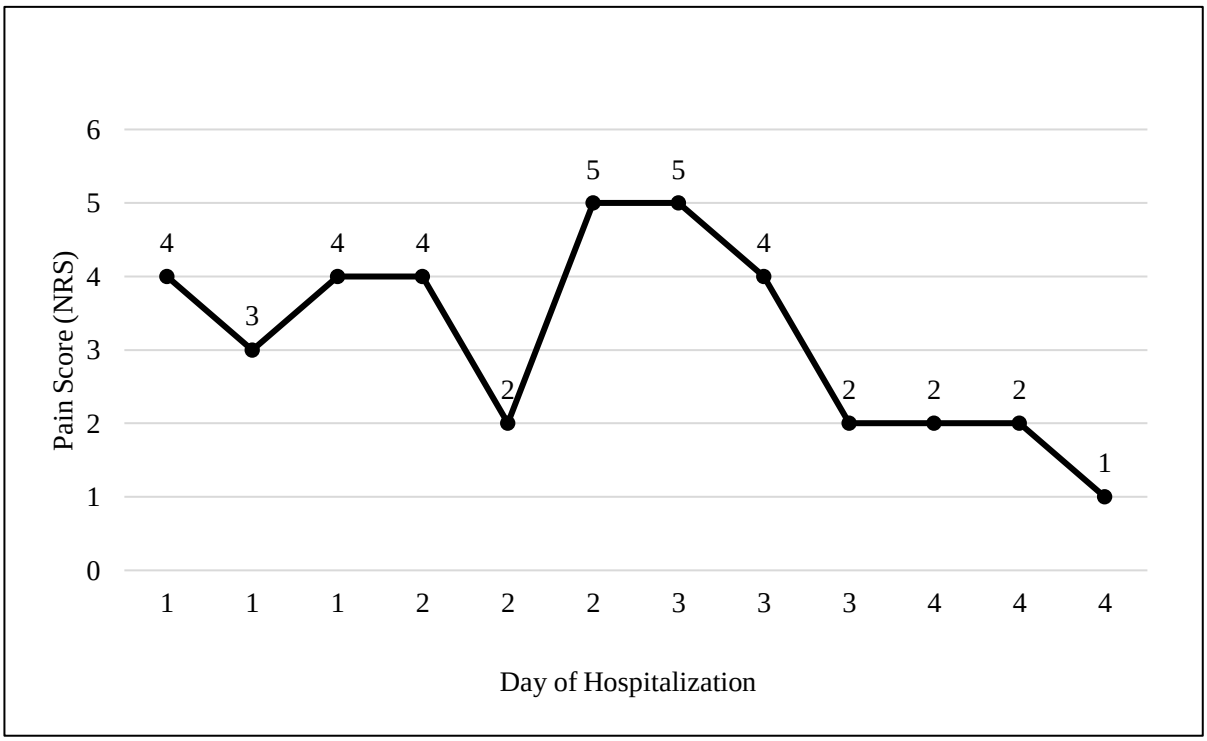
Step 2. Equianalgesic with
- MST 10 mg/8 hours (peroral) = Total Morphine 30 mg/day peroral
- Durogesic® patch (fentanyl 50 mcg/hour) → equivalent to Morphine 100 mg/day per oral

Step 3. Total daily dose Morphine = 130 mg/day peroral → equivalent to intravenous Morphine 43 mg/day

Step 4. Rescue dose uses is 10 – 20% of the total daily dose (or total dose in the last 24 hours)
- which is 4,3 – 8,6 mg of intravenous Morphine
- This dose is equianalgesic with 43 – 86 mcg intravenous fentanyl

Diagram 2. Rescue Dose Calculation for Mrs. L's BTP

Due to the condition, the pain diary filling was assisted by relatives and several assessment items were asked verbally. Some questions were also not filled by the relatives, for example, "what was the analgesic consumed to relieve the pain?". They did not fill it because the patient's medicines were given directly by the nurse, either peroral or through injection. Despite the weaknesses, the pain occurrence documentation in the pain diary provided enough overview of the pain which was experienced 3-4 times a day from moderate with NRS 4-6 to mild intensity of NRS 1-2. The following chart is Mrs. L pain monitoring by the room nurse (Graphic 1).



Graphic 1. Mrs. L Pain Monitoring

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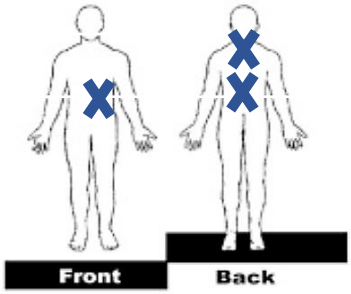
Table 1. Breakthrough Pain Assessment Tool (BAT) of Mrs. L/45 years old (5)

Breakthrough Pain Assessment Tool (BAT) **Mrs. L/45 years old**	
Guideline: These questions are related to BTP you experienced for a recent week. BTP refers to the cancer pain you experience for a short time.	
Questions	**The patient's Answer**
Which body parts feel BTP? Give an "X" mark on the picture!	
How often do you feel BTP? a. < 1 time a day b. 1 – 2 times a day c. 3 – 4 times a day d. > 4 times a day	3 – 4 times a day
Is there any trigger for the occurrence of BTP? If there are any, please write them down!	"No idea, because there is no specific trigger that causes the pain. The pain may occur when sleeping."
Is there anything to relieve BTP you experience (analgesic or another)? If there are any, please write them down!	"No. All of the body positions feel the same. Sometimes, I feel comfortable leaning to either left or right, but sometimes it is better when the bed is lightly elevated, sometimes the pain still feels tense despite the change in the position."
How long does it take for you to feel BTP whenever it relapses? a. < 5 minutes b. 5 – 15 minutes c. 15 – 30 minutes d. 30 – 60 minutes e. > 60 minutes	"I do not precisely count how long, sometimes it is only in a matter of minutes, sometimes it occurs all night that I cannot sleep."
How heavy/how painful is BTP at its heaviest? Starting from 0 means no pain at all and 10 which means the pain is the heaviest you could imagine.	0 1 2 3 4 5 6 7 8 **9** 10
How heavy/how painful is BTP you usually experience? Starting from 0 means no pain at all and 10 which means the pain is the heaviest you could imagine.	0 1 2 3 4 5 **6** 7 8 9 10
How troublesome is your BTP? Starting from 0 means not troublesome at all and 10 means the pain is highly troublesome.	0 1 2 3 4 5 6 7 8 9 **10**
How much is BTP preventing you from living a normal life? Starting from 0 means no problem at all and 10 means the pain is entirely preventing you from living a normal life.	0 1 2 3 4 5 6 7 8 **9** 10
What analgesic do you take to relieve BTP? If there is any, please write the type and dose.	"Usually I do not take medication, except the ones given by the doctor. Once, I took the MST earlier because the pain was unbearable."
How effective is the analgesic you consume to relieve the pain? Starting from 0 means not effective at all and 10 meaning highly effective.	0 1 2 **3** 4 5 6 7 8 9 10
How long it takes for the analgesic to be in effect? a. No effect b. 0 – 10 minutes c. 10 – 20 minutes d. 20 – 30 minutes e. > 30 minutes	"Often no effect."

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Questions	The patient's Answer
Is there any side effect from the analgesic you take to relieve BTP? If there is any, please write what is the side effect!	"No."
If there is any side effect, how disturbing was the side effect you experienced earlier? Starting from 0 means not disturbing and 10 means highly disturbing.	"No Side Effects." 0 1 2 3 4 5 6 7 8 9 10

DISCUSSION

Case discussion focuses on pain management and the underlying diseases treated by the neurosurgeon as well as the thoracic cardiovascular surgeon. Furthermore, pain management starts with a proper assessment which involves diagnosing BTP. To decide the appropriate therapy, BTP has to be evaluated and categorized into the following (1):

a. Incident pain: pain related to specific activities or certain accidents, could be treated by short-acting opioids to anticipate any occurrence of pain caused by its trigger factors
b. End-of-dose failure pain: the pain relapses at the end of the scheduled daily opioids duration, and can be treated by increasing the dose or frequency of daily opioids administration. This condition occurs when the interval for the schedule of analgesia administration exceeds the duration of the opioids given, or when the duration of opioids action is insufficient from an average of 4 hours to 2 – 3 hours. This is due to the differences of opioids' metabolism rates per dose for every individual(2).
c. Uncontrolled persistent pain: pain that is uncontrolled by scheduled daily opioids which have been consumed for the whole time, and could be treated by adjusting the dose.

In Mrs. L case, BTP was not related to certain activities or positions, and the interval of morphine administrated was already in accordance with the usage instruction along with Durogesic® (fentanyl) patch which provided a continuous analgesic effect. Therefore, the BTP experienced could be categorized as uncontrolled and persistent (1).

A pain diary was used to observe the BTP fluctuation and relapse time. The pain service used the diary developed by America Pain Foundation with several weaknesses. Due to language issues, the pain diary which is written in a foreign language was independently translated into Bahasa Indonesia.

National Comprehensive Cancer Network (NCCN) released a recommendation for BPT management, namely the administration of rescue doses to relieve the pain rapidly and adequately. The rescue dose should be an analgesic bolus, and increasing the titrated dose may take hours to take effect (7). Rescue dose is equivalent to 10 – 20% of the total daily dose in the last 24 hours. Furthermore, re-administration of rescue doses every hour was allowed while also monitoring the side effects of pain reduction. Repetitive rescue dose administration indicates the necessity of the re-adjustment of the therapy which has been given. Rapid onset and short-duration opioids are the options for rescue doses, for example, fentanyl. Transmucosal fentanyl, either buccal, sublingual, oral, or nasal mucosa, has been proven to be effective in treating BPT. Fentanyl administration starts with the lowest dose followed by slow titration (7–9). The occurrence of BPT has to be monitored within 1 day to determine whether a change in analgesic dose is required on the next day (10).

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Oral Transmucosal Fentanyl Citrate (OTFC) is the recommended therapy to rapidly and adequately relieve BPT. Aside from being user-friendly for patients compared to intravenous preparations, it is available in stick-shaped packages of lozenges. The recommended dose is 5 – 20 to achieve peak plasma concentration in 15-30 minutes after its administration (11). However, the preparations are currently not yet available in the hospital. Pain service substituted the therapy by using multimodal analgesia.

Multimodal analgesia involves using 2 or more combinations of an analgesic, each with a different mechanism of action. Aside from opioids, drugs with distinct mechanisms of action target the pain pathways culminating in additive and synergistic effects. The multimodal analgesic approach is commonly recommended to treat acute or postoperative pain, as it can potentially reduce side effects and provide the benefit of treating pain through different cellular pathways. This raises the possibility of the approach being significantly relevant in BTP management (12). One of the main concerns is the need for rapid onset of analgesia, and multimodal analgesia has been shown to meet these needs.

In this case, pain service also used ketamine, an NMDA-receptor antagonist (N-methyl-D-aspartate receptor), that blocks glutamate. At low doses (subanesthetic), ketamine provides analgesia and limits/modulates central sensitization, hyperalgesia, and tolerance of opioids or other analgesics, although evidence is still limited (8).

Predicting the occurrence of BTP is expected to accelerate the administration of analgesics to help relieve pain severity, either in terms of its peak time or the pain duration itself. Patients with predictable BTP have a shorter time to experience peak pain at less than 10 minutes, and a shorter duration of pain namely 30 minutes vs 40 minutes with p = 0.02 (13). Predicting BTP requires the recognition of the precipitating factors. Movement in patients' bed is the most common trigger while coughing, sitting, standing, walking, defecation and urination also function similarly although not very often. However, patients are not always able to recognize these precipitating factors, to be precise, 23% responded that there is no specific precipitating factor and the pain might appear suddenly (13). In this case, the patient and relatives also reported the same occurrence, wherein there were no precipitating or mitigating factors for the BTP. The patient's condition might be caused by the short time monitoring carried out only on the 2nd day.

CONCLUSION

BTP might occur as a transient, acute, mild to moderate-severe intensity pain that can decrease the quality of life and functional capacity of the patient. It can be predicted by recognizing precipitating factors and administrating a rescue dose for rapid and adequate pain relief. Furthermore, Transmucosal fentanyl, either buccal, sublingual, oral, or nasal mucosa, has been proven to be effective in treating BPT. However, when transmucosal fentanyl is not available, multimodal analgesia can be used as an alternative to overcome BTP.

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Conflict of Interest
All authors declared there are no conflicts of interest regarding this case report.

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Author Contribution

All authors read and approved the final manuscript.

REFERENCES

1. Swarm RA, Paice JA, Anghelescu DL, Are M, Bruce JY, Buga S, et al. Adult cancer pain, version 3.2019. JNCCN J Natl Compr Cancer Netw. 2019;17(8):977–1007. [PubMed] [WebPage]
2. SB M, Editor. Wall and Melzack's textbook of pain. 6th ed. Philadelphia: Elsevier Saunders; 2013. 1153 p.
3. Løhre ET, Thronæs M, Klepstad P. Breakthrough cancer pain in 2020. Curr Opin Support Palliat Care. 2020;14(2):94–9. [PubMed] [WebPage]
4. Margarit C, Juliá J, López R, Anton A, Escobar Y, Casas A, et al. Breakthrough cancer pain - Still a challenge. J Pain Res. 2012;5:559–66. [PubMed] [WebPage]
5. Vellucci R, Fanelli G, Pannuti R, Peruselli C, Adamo S, Alongi G, et al. What to Do, and What Not to Do, When Diagnosing and Treating Breakthrough Cancer Pain (BTcP): Expert Opinion. Drugs. 2016;76(3):315–30. [PubMed] [WebPage]
6. Caraceni A, Davies A, Poulain P, Cortés-Funes H, Panchal S, Fanelli G. Guidelines for the management of breakthrough pain in patients with cancer. JNCCN J Natl Compr Cancer Netw. 2013;11(SUPPL.1):S29–36. [PubMed]
7. Hadzic A, Anesthesia NYS of R, Editors. Hadzic's textbook of regional anesthesia and acute pain management. Second. New York: McGraw-Hill Education; 2017. 1506 p.
8. Swarm R, Janjan N, Putnam A. NCCN Guidelines Index Adult Cancer Pain TOC Discussion. NCCN Guidel. 2016;91.
9. Rahmadi M, Madina U, Sulianto I, Padolo E, Ardianto C, Ratri DMN, et al. Study on dosage range evaluation opioid analgesic for breakthrough pain in cancer patients: A retrospective study. Ann Palliat Med. 2021;10(2):1237–43.[WebPage][PubMed]
10. Kemenkes KK. Pedoman Teknis Pelayanan Paliatif Kanker. 2013. 1–98 p. [WebPage]
11. Gropper MA, Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, et al. Miller's anesthesia, 2-volume set E-book. Elsevier Health Sciences; 2019. [WebPage]
12. Helander EM, Menard BL, Harmon CM, Homra BK, Allain A V., Bordelon GJ, et al. Multimodal Analgesia, Current Concepts, and Acute Pain Considerations. Curr Pain Headache Rep [Internet]. 2017;21(1). Available from: http://dx.doi.org/10.1007/s11916-017-0607-y [PubMed] [WebPage]
13. Gonella S, Sperlinga R, Sciannameo V, Dimonte V, Campagna S. Characteristics of Breakthrough Pain and Its Impact on Quality of Life in Terminally Ill Cancer Patients. Integr Cancer Ther. 2019;18. [PubMed] [WebPage]

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.37-44

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Case Report

ADMINISTRATION OF NITRATES AFTER SPONTANEOUS DELIVERY IN RHEUMATIC HEART DISEASE

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ABSTRACT

Introduction: Heart disease is one of the most common causes of maternal death. The incidence has increased since women with congenital and acquired heart disease reached fertile age. The circulation system changes during pregnancy which are induced by changes in the progesterone. The changes in progesterone levels increase heart work and cause death in pregnant women. **Objective:** This report aims to elaborate on the administration of nitrates as the management of labor in rheumatic heart disease (RHD). **Case Report:** A 27-year-old woman complained of shortness of breath and wanted to give birth. The patient was 38 weeks pregnant and had a history of heart disease. Antero-posterior chest radiography examination showed pulmonary edema and cardiomegaly. The patient was examined using echocardiography before spontaneous labor and was diagnosed as pregnant with rheumatic heart disease. As an emergency management, the patient was given painless spontaneous labor. The patient was given nitrates on the first day after delivery as a treatment for progesterone withdrawal syndrome in this case. After the delivery process was completed, the patient was admitted to the Intensive Care Unit (ICU). **Discussion:** Progesterone hormone produced by the corpus luteum and the placenta until the eighth week of pregnancy and before delivery, respectively, can reduce systemic vascular resistance. Progesterone hormone increase causes peripheral vasodilation by affecting the function of endothelial nitric oxide synthase (eNOS) and nitrite oxide (NO) production. **Conclusion:** A pregnant woman with rheumatic heart disease can be given exogenous nitrate. Administration of exogenous nitrates in this patient successfully prevent the reduction of peripheral vascular resistance and postpartum hemodynamic instability because it can replace the reduction in nitric oxide caused by progesterone withdrawal.

Keywords: Cardiovascular Disease; Maternal Health; Preventable Death; Progesterone; Rheumatic Heart Disease

ABSTRAK

Pendahuluan: Penyakit jantung merupakan salah satu penyebab kematian pada ibu hamil yang paling sering terjadi. Kejadian penyakit tersebut meningkat sejak wanita dengan riwayat penyakit jantung bawaan dan dapatan mencapai usia subur. Selama masa kehamilan terjadi perubahan sistem kardiovaskuler yang diinduksi oleh perubahan hormon progesteron. Perubahan hormon progesteron saat melahirkan dapat meningkatkan kerja jantung dan menyebabkan kematian pada ibu hamil. **Tujuan**: Laporan kasus ini bertujuan untuk menjelaskan manfaat pemberian nitrat sebagai tatalaksana persalinan pada *rheumatic heart disease*. **Laporan Kasus:** Seorang perempuan hamil berusia 27 tahun mengeluhkan sesak napas dan menunjukan tanda-tanda persalinan. Pasien hamil 38 minggu dengan riwayat penyakit jantung. Pemeriksaan penunjang foto radiologi *thorax anteroposterior* menunjukkan gambaran edema paru dan kardiomegali. Pemeriksaan ekokardiografi dilakukan pada pasien sebelum partus spontan dan pasien terdiagnosis sebagai *rheumatic heart disease (RHD).* Pasien diberikan tatalaksana dengan persalinan tanpa nyeri. Pasien diberikan nitrat pada hari pertama setelah melahirkan sebagai terapi *progesterone withdrawal syndrome* pada kasus tersebut. Setelah proses persalinan selesai, pasien dirawat di ruang *Intensive Care Unit (ICU)*. **Pembahasan:** Hormon progesteron yang dihasilkan oleh korpus luteum hingga minggu kedelapan dan plasenta hingga menjelang persalinan dapat menurunkan resistensi sistemik vaskular. Kejadian tersebut menyebabkan vasodilatasi perifer yang diperantarai oleh fungsi *endotel nitric oxide synthase* (eNOS) dan produksi Nitrit Oxide (NO). **Kesimpulan:** Pasien wanita hamil dengan *rheumatic heart disease* dapat diberikan nitrat eksogen. Pemberian nitrat eksogen pada pasien ini berhasil mencegah penurunan resistensi pembuluh darah perifer dan ketidakstabilan hemodinamik setelah melahirkan karena dapat menggantikan penurunan *nitic oxide* yang disebabkan oleh *progesterone withdrawal.*

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Kata kunci: Penyakit Kardiovaskular; Kesehatan Ibu Hamil; Kematian yang dapat dicegah; Progesteron; *Rheumatic Heart Disease*

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INTRODUCTION

Heart disease is one of the most common causes of maternal death. Heart disease is usually not identified at the time of delivery. The event occurred after the gestational age of more than 20 weeks. Fifteen percent of maternal deaths are related to heart disease during pregnancy (1). Cardiovascular disease can occur in 1-3% of pregnancies. The incidence has increased since women with congenital and acquired heart disease reached fertile age (2). Women with congenital heart disease may have congestive heart failure and arrhythmias during pregnancy (3).

The circulation system can change during pregnancy. The peripheral vasodilatation triggers a decrease in systemic resistance. This process occurs due to the induction of progesterone during pregnancy (3). Progesterone level increases with gestational age. Increased hormones can indirectly reduce the work of the heart by lowering systemic resistance (4). Decreased systemic resistance can increase cardiac output by 30% to 60% more than pre-pregnancy levels during pregnancy, and the cardiac output continues to rise during labor due to sympathetic stimulation and autotransfusion from uterine contractions (3).

There are several dangerous periods during pregnancy with heart disease, the first is between 12-16 weeks. Second, the critical period is between 28-32 weeks of gestation, and the third is during the delivery process. The last one is on 4-5 days postpartum (1). Overall perinatal mortality for pregnant patients with heart disease is as high as 20% (1).

We reported the case of a pregnant patient with a diagnosis of G1P0A0, 38 weeks pregnant, stage 1, with rheumatic heart disease (RHD). In this case, emergency and intensive care management were needed to help the mother give birth so that the baby could be born alive. This report explains about the administration of nitrates as the management of labor in RHD.

CASE REPORT

A 27-year-old pregnant woman with a gestational age of 38 weeks came to the emergency department of Dr. Soedono Madiun General Hospital. The patient complained of shortness of breath one month ago and had worsened three days before being admitted to the hospital. The complaint accompanied by discharge from the birth canal and an increase in heart palpitations. The patient explained that the heart palpitations had been felt since the patient was young and had never been to a doctor.

The physical examination of the general condition was good and fully conscious. Vital signs obtained were blood pressure of 142/100 mmHg, pulse of 160 beats per minute, lung respiratory rate of 20 times per minute, and temperature of 36.5 ℃. Upon obstetrical and gynecological examination, the uterine fundus height was 25 cm, the fetal heart rate was 140 beats per minute, and uterus contraction was palpable once in ten minutes which lasted for ten seconds. Speculum examination found 1 cm opening, 25% effacement, amniotic skin not palpable, head on Hodge 1. Anteroposterior chest x-ray examination revealed pulmonary edema and cardiomegaly (Figure 1).

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Blood examinations of the patient in the emergency department were hemoglobin 11.2 g/dL, platelets 168x103/µL, hematocrit 33.2%, leukocyte count 9.9x103/µL, erythrocyte number 4.07 million/cm, MCV 89.8 fL, MCH 30.4 pg, MCHC 33.8 g/dl. Coagulation physiology showed PT and APTT of 8.7 and APTT 28.5 seconds, respectively. Clinical chemistry examination of liver function revealed albumin of 3.6 g/dl, SGOT of 21 U/L and SGPT of 18 U/L. Clinical examination of kidney function revealed BUN of 6 mg/dl, creatinine of 0.42 mg/dl, and carbohydrate metabolism blood glucose of 100 mg/dl. Blood electrolyte examination revealed blood sodium of 138 mmol/L, blood potassium of 3.74 mmol/L, and blood chloride of 108 mmol/L. Anti-HIV immunological examination was Non-reactive and HBsAg was Negative. Urinalysis examination found glucose, bilirubin, ketone, protein, urobilinogen, leukocytes were all negative while epithelium was positive. Furthermore, the urinalysis showed urine pH of 7 as well as urine sediment consisting of erythrocytes and leukocytes were 6-8/LPB and 4-6/LPB, respectively.

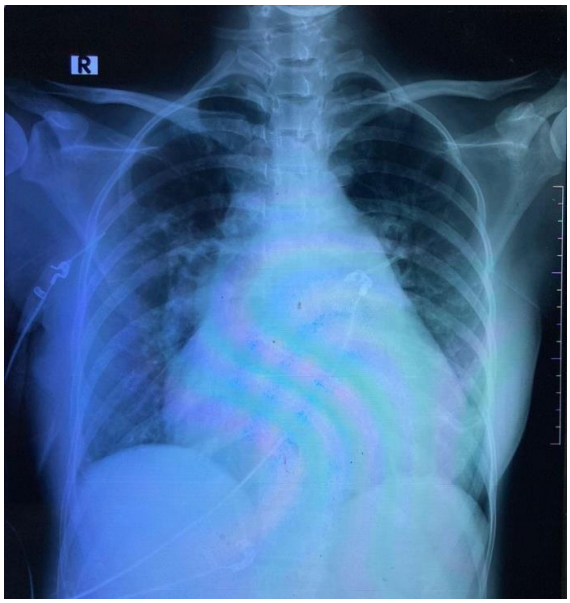

Figure 1. The Image of The Thorax Before Giving Birth

Blood gas analysis examination with a momentary arterial blood sample showed pH of 7.41, pCO_2 of 34 mmHg, pO_2 of 149 mmHg, NA^+ of 135 mmol/L, K^+ of 3.7 mmol/L, glucose of 77 mg/dl, lactate of 0.8 mmol/L, HCT of 34% and derived parameters consisting of Ca^{2+} (7.4) of 1.1 mmol/L, HCO_3^- of 21.6 mmol/L, HCO_3^- standard of 23.0 mmol/L, TCO_2 of 22.6 mmol/L, BEEcf of - 3 mmol/L, BE(B) of -2.5 mmol/L, SO2c of 99%, THbc of 10.5 g/dl, A-aDO_2 of 243 mmHg and PAO_2 of 392 mmHg.

The patient was examined using echocardiography with the results of heart chamber dimensions of left ventricle dilatation (EDD = 6.35 cm), left atrium dilatation (LAD = 4.17 cm), and right atrium and right ventricle were within normal limits. The patient also had normal left ventricular systolic function (EF Teich 64.9%), pseudonormal left ventricular diastolic function (E/A 1.06, DT 253 ms), and normal right ventricular systolic function (TAPSE 2.88 cm). Segmental analysis revealed normokinetic basal, middle, and apex. Examination of heart valves and volume revealed severe mitral regurgitation, prolapse of the anterior mitral leaflet, 3-layer aortic calcification, severe tricuspid regurgitation (est PASP 132 mmHg), mild pulmonary regurgitation, severe probability pulmonary hypertension, and eccentric left ventricular hypertrophy (LVMI 193.28 g/m^2).

Treatment

A pregnant patient with a diagnosis of G1P0A0, 38 weeks, latent phase 1 *inpartu* with RHD underwent spontaneous labor without pain. Postpartum therapy was given oxygen 8-10 lpm, Asering infusion 7 dpm, IV paracetamol injection 1 gram/8 hours, ondansetron injection 4 mg/8 hours, esomeprazole injection 40 mg/12 hours, injection of furosemide 1 mg/hour using pump

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and nitroglycerin 1 mg/hour using syringe Pumps.

Result and Follow-Up

Spontaneous labor without pain gave good results. After the delivery process was completed, the patient was admitted to the Intensive Care Unit (ICU). The patient was given therapy in the form of D10% infusion 8 dpm, ceftriaxone injection 1 gram/12 hours (H7), esomeprazole injection 40 mg/12 hours, paracetamol injection 1000 mg K/p, nitroglycerin injection 1 mg/hour using syringe pump, furosemide injection 5 mg/hour, peroral captopril 12.5 mg 2 times, spironolactone 25 mg 1 time, digoxin 0.25 mg 1 time, and 1 tablet VIP Albumin 3 times. Complaints of shortness of breath and chest palpitations decreased after one day of ICU treatment. After that, the patient underwent an antero-posterior chest x-ray examination which aimed to evaluate the cardiac features and pulmonary edema (Figure 2).

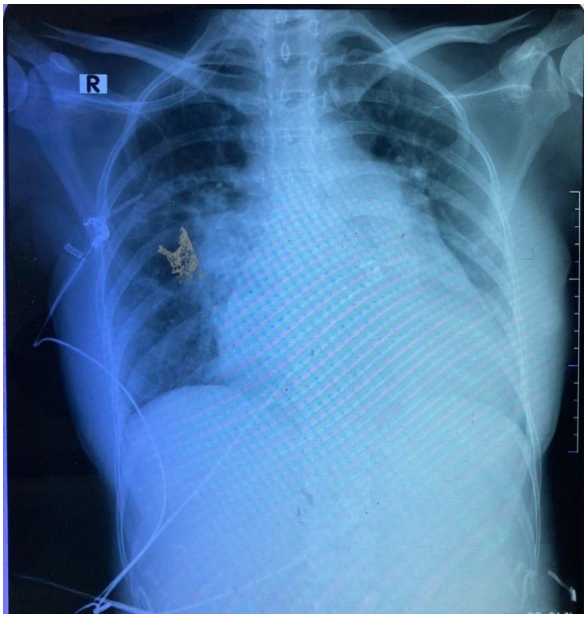

Figure 2. The image of the thorax after giving birth

The patient was re-x-rayed to determine the patient's progress after four days post-treatment in the ICU. The patient's complaints decreased, and the chest X-ray indicated that the pulmonary edema also subsided (Figure 3).

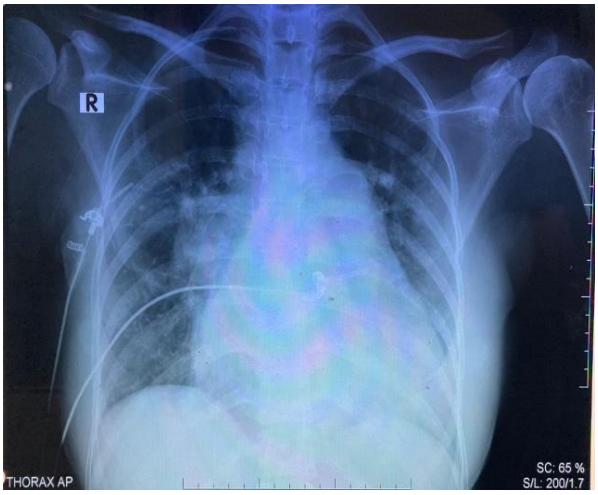

Figure 3. The image of the thorax four days after treatment

The patient was re-examined 14 days postpartum. This examination was aimed to assess heart function during the treatment process. The results of the echocardiography examination showed that the dimensions of the heart chambers were left ventricle dilated (EDD 5.66 cm), left atrium dilated (LAD 4.17 cm), and right atrium, and right ventricle within normal limits. The patient also had normal left ventricular systolic function (EF Teich 54.4%), pseudonormal left ventricular diastolic function (E/A 1.07, DT 159 ms), and normal right ventricular systolic function (TAPSE 3.12 cm). Segmental analysis revealed normokinetic basal, middle and apex. Examination of the valves and heart volume revealed severe mitral regurgitation, prolapse of the anterior mitral leaflet, 3 layers of aortic calcification, severe tricuspid regurgitation (est PASP 93 mmHg), mild pulmonary regurgitation, severe probability pulmonary hypertension and

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eccentric left ventricular hypertrophy (LVMI 181.48 g/m^2).

DISCUSSION

The diagnosis of RHD can be divided into three categories, namely the diagnosis of rheumatic fever (RF), the presence of active vs. inactive disease with recurrent RF, and the identification of carditis due to valve damage in RHD (4). Identification of carditis due to valve damage is the main goal in establishing the diagnosis and therapy in these cases. Rheumatic endocarditis can be described as damage to the heart valves. The disease can occur as a result of permanent RF damage to the heart valves (4). Based on the results of the history, physical examination, and supporting examinations that have been mentioned, the patient was pregnant with a diagnosis of G1P0A0, 38 weeks, latent phase 1 labor with RHD.

Spontaneous delivery is the first choice for pregnant women with heart disease. Spontaneous delivery and low-dose regional anesthesia are the best options. Regional anesthesia is highly recommended to reduce the increase in cardiac output and oxygen demand of the heart muscle during labor (5). Therefore, pregnancy with RHD is not an absolute indication of a caesarean section.

RHD disease or sub-clinic carditis can affect the cardiovascular system during pregnancy. This process occurs due to disturbances in the heart valves and can be a pathological stimulus due to excessive pressure. This occurs due to an increase in cardiac afterload volume and causes concentric and eccentric hypertrophy. These events can lead to cardiomyopathy and heart failure (6).

The progesterone hormone produced by the corpus luteum until the eighth week and the placenta until before delivery can reduce systemic vascular resistance (6). The progesterone hormone causes peripheral vasodilation by affecting the function of endothelial nitric oxide synthase (eNOS), a process known as the genomic and non-Genomic mechanism (6). Progesterone activates phosphoinositide/AKT (P13T/AKT) and an increase in eNOS leads in an increase of nitric oxide (NO) production. The results of cellular studies in animals suggest that the generation of NO and prostacycline has potential benefits on endothelial vasodilation and promotes endothelial repair and regeneration, with anti-inflammatory and antioxidant effects (6). Progesterone levels peak at the time of delivery and decrease drastically shortly after delivery which is also known as progesterone withdrawal. Progesterone withdrawal causes NO production to decrease (7).

Patients with heart failure should be placed on medical therapy such as angiotensin-converting enzyme (ACE) inhibitors, diuretics, and beta-blockers (8). Nitrates can significantly reduce vascular resistance in heart failure patients due to heart valve disorders. Nitrates are one of the drugs commonly used for patients with heart failure (9,10). These drugs can be used to reduce afterload in patients with systolic dysfunction (11). These effects can generally increase cardiac output (10,12).

CONCLUSION

A pregnant woman with rheumatic heart disease can be given exogenous nitrate. Administration of exogenous nitrates in this patient successfully prevent the reduction of peripheral vascular resistance and postpartum hemodynamic instability because it can replace the reduction in nitric oxide caused by progesterone withdrawal.

Acknowledgment
None.

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Conflict of Interest

The authors declare no conflict of interest.

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Authors' Contributors

All authors have contributed to all processes in this research.

REFERENCES

1. Khatun J. A 25-Year-Old Pregnant Lady with Heart Disease. Journal of Enam Medical College. 2017;7(1):42–3. [WebPage]
2. Huisman CM, Zwart JJ, Roos-Hesselink JW, Duvekot JJ, van Roosmalen J. Incidence and Predictors of Maternal Cardiovascular Mortality and Severe Morbidity in the Netherlands: A Prospective Cohort Study. PLoS One. 2013 Feb 14;8(2). [PubMed] [WebPage]
3. Hu H, Pasca I. Management of Complex Cardiac Issues in the Pregnant Patient. Vol. 32, Critical Care Clinics. W.B. Saunders; 2016. p. 97–107. [PubMed] [WebPage]
4. Kumar RK, Tandon R. Rheumatic fever & rheumatic heart disease: The last 50 years. Indian Journal of Medical Research. 2013;137(4):643–58.[PubMed][WebPage]
5. Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, Blomström-Lundqvist C, Cífková R, de Bonis M, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Vol. 39, European Heart Journal. Oxford University Press; 2018. p. 3165–241. [PubMed] [WebPage]
6. Kodogo V, Azibani F, Sliwa K. Role of pregnancy hormones and hormonal interaction on the maternal cardiovascular system: a literature review. Clinical Research in Cardiology [Internet]. 2019;108(8):831–46. Available from: http://dx.doi.org/10.1007/s00392-019-01441-x. [PubMed] [WebPage]
7. Grattan DR, Ladyman SR. Neurophysiological and cognitive changes in pregnancy [Internet]. 1st ed. Vol. 171, Handbook of Clinical Neurology. Elsevier B.V.; 2020. 25–55 p. Available from: http://dx.doi.org/10.1016/B978-0-444-64239-4.00002-3. [PubMed] [WebPage]
8. Clarissa Dass, Arun Kanmanthareddy. Rheumatic Heart Disease. StatPearls; 2022. [PubMed]
9. Chen RS, Bivens MJ, Grossman SA. Diagnosis and management of valvular heart disease in emergency medicine. Emerg Med Clin North Am. 2011;29(4):801–10. [PubMed] [ScienceDirect]
10. Gottlieb M, Long B, Koyfman A. Evaluation and Management of Aortic Stenosis for the Emergency Clinician: An Evidence-Based Review of the Literature. Journal of Emergency Medicine [Internet]. 2018;55(1):34–41. Available from: https://doi.org/10.1016/j.jemermed.2018.01.026. [PubMed] [WebPage]
11. Ashrafi R, Curtis SL. Heart Disease and Pregnancy. Cardiol Ther. 2017;6(2):157–73. [PubMed] [WebPage]
12. Lloyd JW, Nishimura RA, Borlaug BA, Eleid MF. Hemodynamic Response to Nitroprusside in Patients with Low-Gradient Severe Aortic Stenosis and Preserved Ejection Fraction. J Am Coll Cardiol [Internet]. 2017;70(11):1339–48. Available from: http://dx.doi.org/10.1016/j.jacc.2017.07.736. [PubMed] [WebPage]

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Literature Review

REGIONAL ANESTHESIA SUBARACHNOID BLOCKADE (RASAB) IN SCOLIOSIS PATIENTS

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ABSTRACT

Introduction: Scoliosis is a three-dimensional spinal deformity that is mainly determined based on the lateral curvature of the spine. Furthermore, regional anesthesia often infiltrates the peripheral nerves with an anesthetic agent and blocks transmission to avoid or relieve pain. A previous study revealed that scoliosis in patients is one of the factors affecting the success of spinal anesthesia. **Objective:** To obtain a theoretical basis that can support the solution to the RASAB problem. The acceptance of the theory is the first step to providing a better understanding of the study problem based on the scientific framework of thinking. Furthermore, the similarities, differences, and views of several pieces of literature that discussed related issues were evaluated in this review. **Review:** Regional anesthesia subarachnoid blockade (RASAB) or spinal anesthesia, is a procedure, which involves the administration of local anesthetic drugs into the subarachnoid space. Furthermore, the process is carried out between the lumbar (L) vertebrae L2-L3, L3-L4, or L4-L5. Spinal anesthesia is often used in surgical procedures involving the lower abdomen, pelvis, perineum, and lower extremities. **Summary:** In the setting of scoliosis, spinal anesthesia is challenging, but is not an absolute contraindication. Patients with scoliosis have unique characteristics, hence, anesthetists need to understand the impact of the disease on the body.

Keywords: Lumbar Spine; Regional Anesthesia; Scoliosis; Spinal Anesthesia; Subarachnoid.

ABSTRAK

Pendahuluan: Skoliosis adalah kelainan bentuk tiga dimensi tulang belakang yang sebagian besar ditentukan berdasarkan kelengkungan lateral tulang belakang. Anestesi regional terdiri atas prosedur infiltrasi saraf perifer dengan agen anestesi dan memblokir transmisi untuk menghindari atau menghilangkan rasa sakit. Kondisi skoliosis pada pasien dapat menjadi salah satu faktor yang mempengaruhi keberhasilan anastesi spinal. **Tujuan:** Untuk mendapatkan landasan teori yang bisa mendukung pemecahan masalah *regional anesthesia subarachnoid blockade* (RASAB). Teori yang didapatkan merupakan langkah awal agar peneliti dapat lebih memahami permasalahan yang sedang diteliti dengan benar sesuai dengan kerangka berpikir ilmiah. Peneliti mencari kesamaan, perbedaan, memberikan pandangan, membandingkan dan meringkas beberapa literatur yang membahas masalah terkait. **Review:** *Regional anesthesia subarachnoid blockade* (RASAB) atau yang dapat disebut dengan anestesi spinal, merupakan prosedur anestesi dengan melakukan pemberian obat anestetik lokal ke dalam ruang *subarachnoid*. Prosedur ini dilakukan pada ruang *subarachnoid* di daerah antara vertebra lumbal (L) L2-L3 atau L3-L4 atau L4-L5. Anestesi spinal seringkali digunakan pada prosedur bedah yang melibatkan perut bagian bawah, panggul, perineum, dan ekstremitas bawah. **Ringkasan:** Pada keadaan skoliosis, tindakan anestesi spinal menjadi sulit untuk dilakukan, namun bukan kontraindikasi absolut. Pasien dengan skoliosis merupakan populasi dengan karakteristik khas sendiri. Dokter anestesi perlu memahami dengan baik dampak penyakit ini pada tubuh.

Kata kunci: Vertebra Lumbar; Anestesi Regional; Skoliosis; Anestesi Spinal; Subarakhnoid.

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INTRODUCTION

Anesthesiology is a branch of medical science that underlies various actions, including the administration of anesthesia, maintaining the safety of surgery patients, as well as providing Basic Life Support (BLS), intensive treatment to critically ill inpatients, inhalation therapy, and chronic pain management (1). Several stages must be carried out in the management of anesthesia during surgical procedures, including pre-anesthesia, which consists of mental and physical readiness of patients, anesthetic planning, prognosis determination, and preparation on the day of surgery (2). Furthermore, the anesthetic management stage comprises premedication, anesthesia and maintenance, recovery, and post-anesthesia care phases(2,3).

Scoliosis is a three-dimensional deformity of the spine that is primarily determined by the lateral curvature of the spine (4). This disorder is divided into structural and nonstructural (postural) types (5). Structural scoliosis can be reclassified into idiopathic and non-idiopathic with unknown and known causes, respectively (6). The incidence of this condition varies in different countries, between 2% and 13.6% (7). The leading causes of scoliosis are still unknown, but several etiologies, such as genetic factors, growth, hormonal dysfunction, changes in bone mineral density, abnormalities in body tissues, abnormal platelet levels, biomechanical aspects, and central nervous system abnormalities, affect the incidence (8). Previous studies revealed that it can be treated using different methods, such as conservative treatment or surgery with specific indications (7,9).

Regional anesthesia often infiltrates the peripheral nerves with an anesthetic agent, thereby blocking transmission to avoid or relieve pain (10). This procedure differs from this general method because it does not affect the patient's level of consciousness to alleviate pain. Furthermore, regional anesthesia subarachnoid blockade (RASAB), or spinal anesthesia, is an anesthetic procedure, which involves the administration of local anesthetic drugs into the subarachnoid space (11). This procedure is often performed in the space between the lumbar (L) vertebrae L2-L3, L3-L4, or L4-L5. Several studies have reported the use of spinal anesthesia in surgical procedures involving the lower abdomen, pelvis, perineum, and lower extremities (9,12,13).

A previous study revealed that scoliosis in patients is one of the factors affecting the success of spinal anesthesia (14). Several risks associated with clinical conditions have also been reported in patients with this condition who were administered with anesthetic agents, especially among severe cases (7,15). Patients with scoliosis are a population of people with unique characteristics due to their condition. Therefore, thos study aims to provide in-depth knowledge to anesthesiologists on the reduction of anesthetic errors and complications. The similarities, differences, views of several literature that discussed related issues were collected and then compared.

This literature review used previous articles obtained with the keywords "Regional anesthesia subarachnoid blockade" and "scoliosis" from online journals. The articles were then sorted, classified, and selected based on the predetermined criteria. The data obtained were analyzed using descriptive analysis based on structured evaluation, classification, and grouping of the selected literature. Subsequently, the data were

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combined and processed into a review discussing RASAB in scoliosis patients.

REVIEW

REGIONAL ANESTHESIA

Regional anesthesia is the temporary blocking of pain impulses from a part of the body through the sensory nerves. During the process, the motor function can be partially or totally affected, but the patient remains conscious (2).

Regional Anesthesia/ Analgesia Division (2)

Central or neuraxial block includes spinal, epidural, and caudal blocks. Euroaxial n-block often causes a sympathetic and motor blockage, as well as sensory analgesia depending on the dose, concentration, and volume of the local anesthetic drug.
Furthermore, the peripheral or nerve blocks consist of topical anesthetics, local infiltration, field blockage, and intravenous regional analgesia.

Regional Anesthesia Advantages(2)

1. Minimal tools, relatively simple techniques, and lower costs.
2. Relatively safe for patients who are not fasting (emergency surgery, full stomach) because they remain conscious during the process.
3. There were no airway or respiratory complications.
4. No pollution of the operating room by anesthetic gas.
5. Postoperative care is lighter.

Regional Anesthesia Disadvantages (2)

1. Not all patients want regional anesthesia.
2. Requires patient cooperation.
3. Difficult to carry out in children.
4. Not all surgeons prefer regional anesthesia.
5. There is a possibility of failure of the regional anesthetic technique.

Regional Anesthesia Preparation (2)

Regional anesthetic preparation is similar to the general method because it also anticipates systemic toxic reactions, which can be fatal, and require resuscitation mechanisms. For example, spinal/epidural anesthetic drugs that enter the blood vessels can cause cardiovascular collapse as well as cardiac arrest. Failure of this method is also anticipated, and it is often continued with general anesthesia.

SPINAL ANESTHESIA

Definition (16,17)

Spinal anesthesia is the administration of a local anesthetic into the subarachnoid space. This process is also known as intradural spinal analgesia/block or intrathecal block (16).
Furthermore, to reach the cerebrospinal fluid, the syringe penetrates the subcutaneous, supraspinous, and interspinous ligaments, as well as the epidural space, ligamentum flavum, dura mater, and subarachnoid space (16).

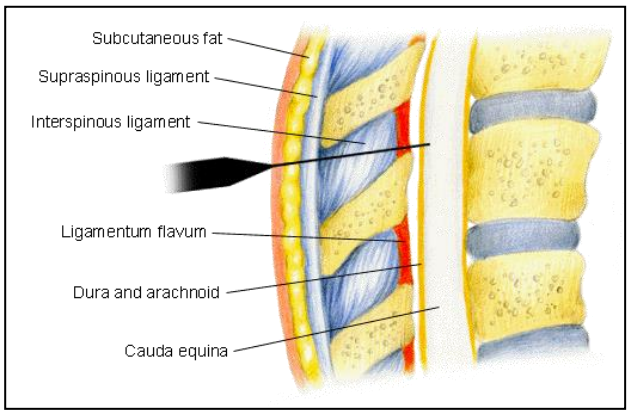

Figure 1. Location of Needle Insertion in Spinal Anesthesia (17)

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The spinal cord is surrounded by cerebrospinal fluid in the spinal canal, which is covered by the meninges, including the dura mater, fat, and venous plexus. In adults, it ends as high as L1, but terminates at the level of L2 and L3 in children and infants, respectively. Therefore, spinal anesthesia/analgesia is often performed in the subarachnoid space between the L2-L3, L3-L4, or L4-L5 vertebrae (16).

Spinal Anesthesia Indications and Contraindications

Indication:(16)

1. Lower extremity surgery
2. Pelvic surgery
3. Actions around the perineal rectum
4. Obstetric-gynecological surgery
5. Urological surgery
6. Lower abdominal surgery
7. In pediatric upper and lower abdominal surgery, it is usually combined with mild general anesthesia.

Table 1. Contraindications for Spinal Anesthesia (16).

Contraindications		
Absolute	**Relatively**	**Controversy**
a. Infection at the injection site	a. Sepsis	a. history of spinal surgery at the injection site
b. The patient's refusal	b. Uncooperative patient	b. Complicated operation
c. Coagulopathy or blood clotting disorders	c. Existing neurological deficit	c. Long operation
d. Severe hypovolemia	d. Demyelinized lesion	d. Massive blood loss
e. ICT Improvement	e. Lesion or stenosis of heart valves	e. Maneuvers that inhibit respiration
	f. Left ventricular outflow obstruction or hypertrophic obstructive cardiomyopathy	
	g. Severe spinal deformity	

Preparation for Spinal Anesthesia (16)

The preparation for spinal anesthesia is similar to general anesthesia, where the area around the puncture site is first examined for potential difficulties. The possible difficulties include anatomical spine abnormalities and obesity, which causes the inability to palpate the spinous process protrusion. Furthermore, the following must be noted:

a. Informed consent: The patient must not be forced to agree to spinal anesthesia
b. Physical examination: No specific abnormalities, such as spinal deformities were found
c. Recommended laboratory tests
d. Hemoglobin, Hematocrit, PT (Prothrombin Time), PTT (Partial Thromboplastin Time)
e. Spinal analgesia equipment
   Monitoring instrument: blood pressure, pulse, and oxygen saturation
   Resuscitation equipment
   Spinal needle: with a sharp tip (spinal bamboo tip / Quincke-Bacock) or a pencil tip (pencil point white care)

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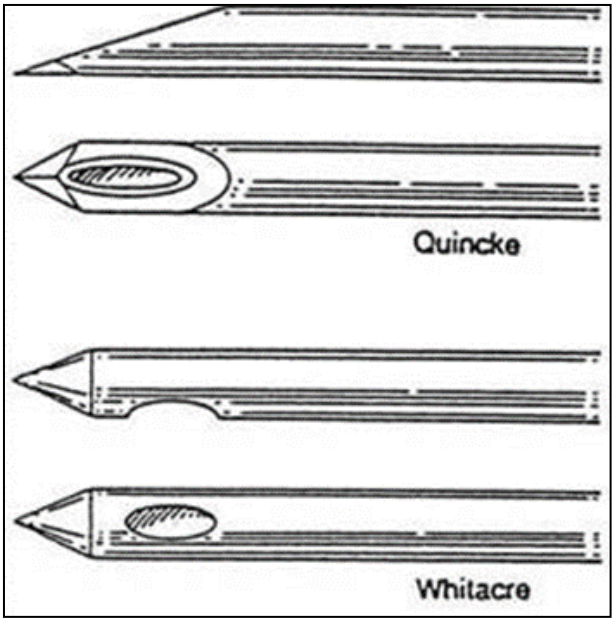

Figure 2. Spinal Needle (16).

Local Anesthetics for Spinal Analgesia

The specific gravity of cerebrospinal fluid (CSF) at 37º C is 1.003-1.008, and local anesthetics with a specific gravity equal to CSF are called isobaric. Meanwhile, those with values lower and higher than the cerebrospinal fluid are known as hypobaric and hyperbaric, respectively. Local anesthetics that are often used are the hyperbaric types, which are obtained through mixing with dextrose. An example of the common hypobaric type is tetracaine produced through mixing with water injection.

Table 2. Drugs for Spinal Anesthesia (16).

Drugs Used	Duration of Anesthesia during surgery
0.5% Tetracaine in 5% dextrose	90-120 minutes
5% Lidocaine in dextrose and 7.5% in water	45-60 minutes
0.75% Bupivacaine in 8.5% dextrose in water	90-120 minutes
0.5% Bupivacaine in 8% dextrose in water	90-120 minutes but not yet FDA approved
5% Meperidine in 10% dextrose, equal volume to hyperbaric	45-50 minutes

The Spinal Anesthetic Technique (16)

The sitting or the lateral decubitus sleeping position with a puncture in the midline is the most common method used for spinal anesthesia. The process is often carried out on the operating table without being moved again, and only a slight change in the patient's position is required. Excessive position variation in the first 30 minutes can cause the spread of the drug.

a. After monitoring, put the patient to sleep, for example, in the lateral decubitus position. Give a head pillow to increase the comfort level and stabilize the spine. Make the patient bend maximally for easy palpation of the spinous process. Another common position used for this process is sitting.
b. The intersection of the line connecting the two iliac crest lines, namely, L2-L3, L3-L4, or L4-L5. Puncture at L1-L2 or above increases the risk of trauma to the spinal cord.
c. Sterilize the puncture site with betadine or alcohol.

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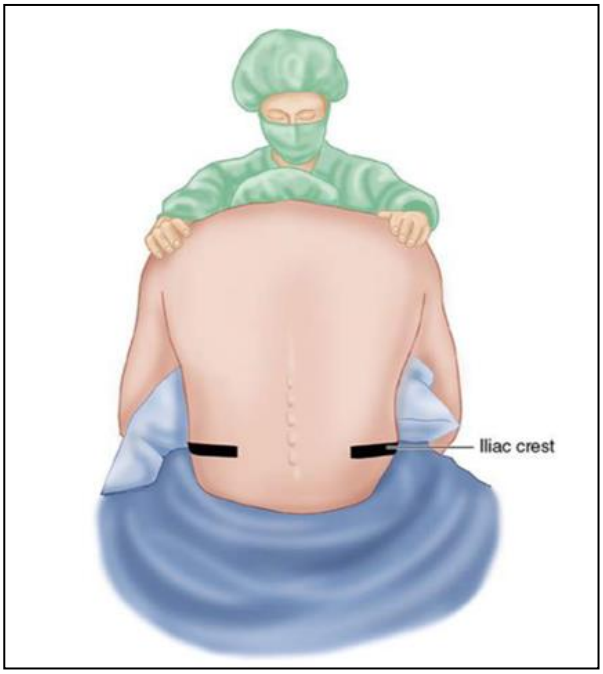

Figure 3. Sitting Position in Spinal Anesthesia (16).

d. Give local anesthesia at the puncture site, for example, with 2-3 ml of 1-2% lidocaine.
e. The median or paramedian puncture method. 22G, 23G, and 25G can be used for large spinal needles. For the small 27G or 29G, it is advisable to use a needle guide, namely an ordinary 10 cc syringe. Furthermore, insert the introducer about 2cm deep, slightly in the cephalic direction, then insert the spinal needle and the mandrin into the hole. During the use of a sharp needle (Quincke-Babcock), the incision (bevel) must be parallel to the dura mater, namely in the sleeping position on the side of the bevel pointing up or down to avoid leakage of liquor, which can result in post-spinal headache. After the resistance disappears, the spinal needle mandrin is removed. Insert a syringe filled with the drug, and insert slowly (0.5 ml/sec) with a slight aspiration to ensure it is in a good position. If the liquid does not come out, the turn can be turned 90º, and a catheter can be inserted for continuous spinal analgesia.

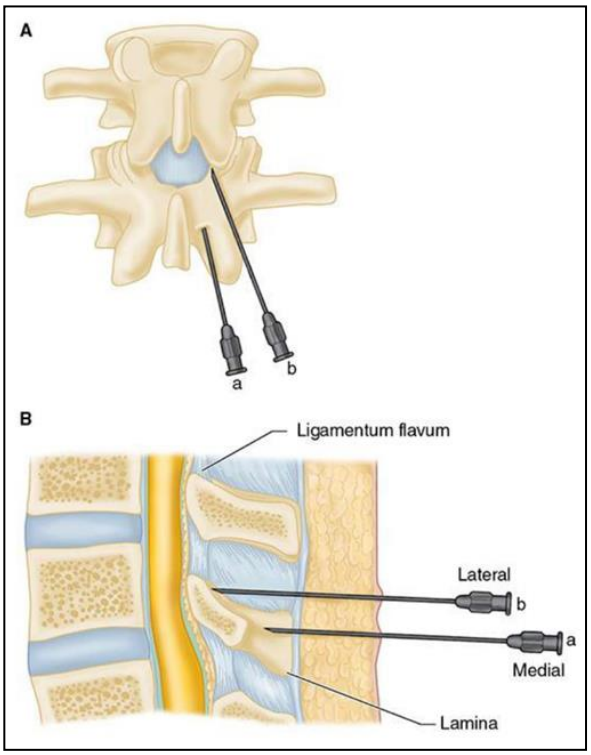

Figure 4. Needle Puncture in Spinal Anesthesia (16).

f. The sitting position is often used for perineal surgery, such as hemorrhoid surgical procedures (hemorrhoids) with hyperbaric anesthesia. Furthermore, the Adult Skin-Ligamentum flavum distance is ± 6cm.
    a. Local anesthetic distribution depends on:
        i. Main factor:
            1. Local anesthetic specific gravity (baricity)
            2. Patient position
            3. Local anesthetic dose and volume
        ii. Additional factors
            1. Injection height
            2. Injection speed/barbotage
            3. Needle size
            4. Patient's physical condition

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5. Intra-abdominal pressure

b. The duration of action of local anesthetics depends on:
   i. Types of local anesthetics
   ii. The size of the dose
   iii. Vasoconstrictor
   iv. The magnitude of the local anesthetic distribution

c. Complications of spinal anesthesia:
   i. Severe hypotension: Venous pooling occurs due to the sympathetic block. In adults, it is prevented by giving 1000 ml of electrolyte fluid or 500 ml of colloid before the procedure.
   ii. Bradycardia: can occur in the absence of hypotension or hypoxia due to the block to T2.
   iii. Hypoventilation: is caused by phrenic nerve paralysis or respiratory control center hypoperfusion
   iv. Nerve vessel trauma
   v. Nerve trauma
   vi. Nauseous vomit
   vii. Hearing disorders
   viii. High spinal block or total spinal

d. Postoperative complications
   i. Injection site pain
   ii. Back pain
   iii. Headache due to liquor leakage
   iv. Urinary retention
   v. Meningitis

Physiological Effects of Neuraxial Block

a. Cardiovascular Effects:

Sympathetic block often causes a decrease in blood pressure, thereby leading to hypotension. Furthermore, the effect of sympathectomy depends on the height of the block. In the spinal cord, 2-6 dermatomes are above the level of sensory block, while the blockage often occurs at the same level in the epidural (18).

Hypotension can be prevented with the administration of fluids (pre-loading) to reduce the relative hypovolemia caused by vasodilation before spinal/epidural anesthesia. The condition can also be treated by giving fluids and vasopressors, such as ephedrine (19).

A high spinal block on cardio accelerator fibers at T1-T4 can cause bradycardia and cardiac arrest (20).

b. Respiration Effect:

A high spinal block of more than the T5 dermatome can lead to hypoperfusion of the respiratory center in the brainstem as well as respiratory arrest (21).

There can also be blockage of the phrenic nerve, causing disturbances in the movement of the diaphragm and abdominal muscles required for inspiration and expiration (22).

c. Gastrointestinal Effects:

Nausea and vomiting induced by 20% neuraxial block can cause gastrointestinal hyperperistalsis due to increased parasympathetic activity and blocked sympathetic system. Meanwhile, this is advantageous in abdominal surgery because bowel contractions often lead to maximal operating conditions (23).

SCOLIOSIS

Definition

Scoliosis is a complicated spinal deformity involving the lateral curvature and rotation of the spine, as well as angulation of the ribs, which leads to the deformation of the thoracic ribs. Furthermore, this condition was first introduced by Galen, a Greece doctor. Scoliosis refers to the lateral curvature of the

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spine, but it is often used generically to refer to all spinal deformities in children (24).

Previous reported showed that the prevalence of spinal curvature > 10°, 20°, and 30° is 1.5%-3%, 0.3%-0.5%, and 0.2%-0.3%, respectively. The male-to-female prevalence ratio depends on the patient's age, but scoliosis requiring surgical correction is more common in women. The ratio increased with the severity of the curvature, namely 2:1 and 10:1 for the curvature of 10° and > 30° (24).

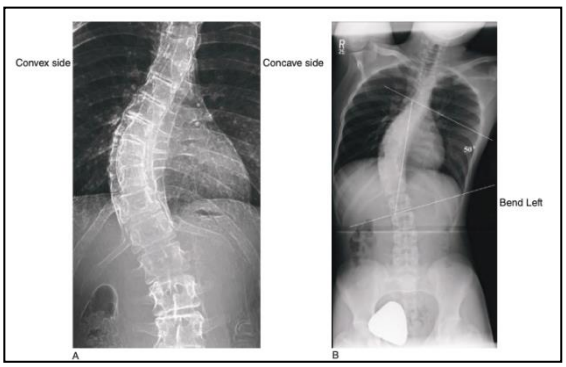

Figure 5. Radiological Features of Scoliosis Patients. (9)

Classification

There are several etiological classifications for structural scoliosis. Furthermore, the types include idiopathic, congenital, neuromuscular, myopathies, trauma, and tumors. Idiopathic scoliosis is the most common, accounting for 70% of all cases and it often occurs in infantile and juvenile forms (25). A previous study revealed that its adolescent form is the most common in the United States (24).

Neuromuscular scoliosis can be caused by cerebral palsy, muscular dystrophy, poliomyelitis, and familial dysautonomia. It has also been reported to be associated with a significantly increased intraoperative blood loss compared to the idiopathic type (26). Congenital scoliosis is often induced by congenital abnormalities, such as hemivertebrae and fused ribs. A previous study stated that Neurofibromatosis and Marfan syndrome have an association with scoliosis. Furthermore, these underlying conditions can have a significant impact on the anesthetic plan (24).

In 1948, John Cobb developed a method for measuring the magnitude of spinal curvature (27) using a posteroanterior radiograph of the spine (28). This technique helps surgeons to identify the vertebrae that are most tilted above and below the curve's apex. The Cobb angle is often calculated between the intersecting lines drawn perpendicular to the top of the affected vertebra above and the bottom of the bottom-most affected vertebra. In 1966, the Scoliosis Research Society standardized a method for assessing the severity of scoliosis. A perpendicular line (2) is drawn from the bottom of the lowest vertebra (1), whose bottom slopes toward the concave of the curve, and another (4) from the top of the highest vertebra (3) whose top slopes toward the concave. The angle (5) where the lines intersect is known as the Cobb angle. Several studies have documented that the more severe the thoracic curve, the greater the impairment in lung function. Surgical treatment is usually recommended for curves greater than 45 to 50°, and those > 60 degrees are associated with decreased lung function (24).

Impact of Scoliosis on the Body

Scoliosis patients undergoing surgical correction often have several challenges due to the pathophysiological disturbances caused by the disease (24).

a. Abnormalities in Lung Function

A restrictive pattern with decreased lung volume is the most common PFT abnormality in thoracic scoliosis. The

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most significant declines occurred in vital capacity, which reduced to 60% to 80% of the estimate. There was also a decrease in the total lung, functional residual, and inspiratory capacities, as well as expiratory reserve volume also decreased. Furthermore, increased residual volume has been reported in patients with congenital and idiopathic scoliosis, 3 years after corrective spinal fusion. (24)

These abnormalities in lung function are often caused by abnormal thoracic cage geometry due to a marked decrease in chest wall compliance rather than abnormalities in the lungs or the respiratory muscles. On dynamic magnetic resonance imaging, adolescent girls with idiopathic scoliosis and healthy controls showed no difference in diaphragmatic movement. Changes in chest wall compliance can be replicated in regular volunteers with chest straps. The exceptions include congenital and infantile scoliosis, where lung growth can be impaired early in development by a thoracic deformity (24).

b. Abnormalities in Blood Gas Analysis

Based on data from a previous study, patients with thoracic scoliosis had arterial oxygen desaturation compared to normal controls. Arterial hypoxemia can be caused by ventilation/perfusion (V/Q) inequalities. Decreased diffusion capacity and alveolar hyperventilation also play a role in this condition. Furthermore, these differences are related to the population of patients studied, and/ or the severity of scoliosis. Severe and long-lasting scoliosis can lead to severe deformity, alveolar hypoventilation, carbon dioxide retention, and severe hypoxemia. This condition can increase the risk of premature death from respiratory failure after the age of 40 years when it is not treated properly (24).

c. Abnormalities in the Cardiovascular System

Patients with scoliosis can have increased pulmonary vascular resistance and hypertension, thereby leading to right ventricular hypertrophy and perfusion failure. Previous studies revealed that several factors often cause increased pulmonary vascular resistance. Furthermore, hypoxemia can lead to increased pulmonary vasoconstriction, vascular resistance, and artery pressure. Chronic hypoxemia causes hypertension due to vascular changes, and this makes pulmonary hypertension irreversible. Several studies reported that deformities in the chest wall compress several parts of the lung, thereby leading to increased resistance of the blood vessels in the area. Pulmonary vascular growth can be impaired if scoliosis develops in the first 6 years of life due to chest wall deformities (24).

Patients with high-grade scoliosis and pulmonary hypertension are at risk for cor pulmonale (29). This often occurs due to loss of lung capillaries and subsequent arterial hypoxemia. Hypoxia caused by pulmonary vasoconstriction occurs due to a decrease in PaO2. The continuity of this condition can lead to hypertrophy of the vascular smooth muscle in the lungs, and permanently increased vascular resistance. This increased resistance is then transmitted back to the right ventricle, where it causes hypertrophy and cardiomyopathy. In patients with known or suspected cardiac disorders, consultation with a cardiologist during the perioperative period as well as invasive

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cardiac monitoring during the operative period are necessary (24).

SPINAL ANESTHESIA IN SCOLIOSIS

Indications for surgery in patients with scoliosis depend on the type. In idiopathic scoliosis, the indicators include a progression curve above 40 degrees with non-operative treatment, 40–45° curvature in skeletally immature patients, and a curve of > 50° in adolescents and adults. Furthermore, the indications for surgery in people with the congenital type depend on the underlying anomaly and the prediction of its development. For scoliosis that are secondary to neuromuscular disease, surgery can be indicated to improve wheelchair posture, assist nursing care and prevent the development of restrictive lung defects in patients with compromised respiratory function (9,30).

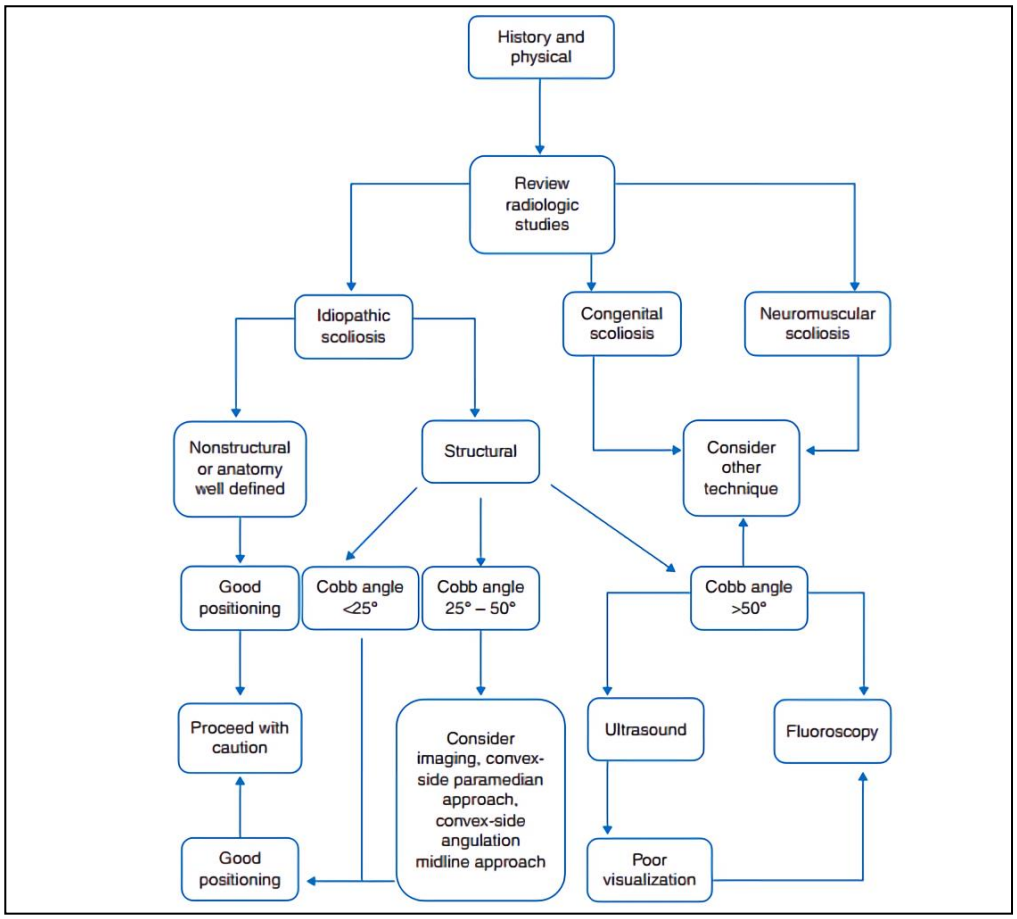

Figure 6. Radiological Features of Scoliosis Patients (30).

Several imaging procedures, such as spinal X-rays, CT scans, and MRIs can help with regional anesthesia for patients with scoliosis. In some literature, spinal anesthesia in scoliosis patients has several risks. The process is often performed in the intrathecal space, which contains spinal fluid, and is safe for multiple operations. In a patient with severe scoliosis, the first intrathecal injection of 6 mg hyperbaric bupivacaine caused inadequate motor and sensory block. However, blockage at Th 10 level was achieved through the injection of 6.25 mg of hypobaric bupivacaine (2 ml). Due to the unexpected effect of the local anesthetic fluid, the treatment was changed to an intrathecal

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injection of 12.5 mg hypobaric bupivacaine (4 ml) at the second operation. The sensory block was then regained at Th 10, and the patient was reported to be satisfied with each of these anesthetics and had no complications (9,30).

SUMMARY

In the setting of scoliosis, it is very challenging to carry out spinal anesthesia, but it is not an absolute contraindication. Furthermore, this anesthetic method in scoliosis patients can pose a variety of risks. Some of the difficulties include the inability to puncture the spinal needle, wrong insertion of syringe, and administering anesthetic drugs to an inappropriate space.

Patients with scoliosis have unique characteristics, and anesthesiologists need to understand the impact of the disease on the body. It is also necessary to carry out holistic management from the beginning of the preoperative to postoperative stage to get maximum results. Therefore, accuracy and experience are needed to minimize the risk of the process to ensure its continuity.

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Conflict of Interest

The authors declare no conflict of interest.

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This study did not receive funding from any organization.

Authors' Contribution

All authors have contributed to all processes in this study.

REFERENCES

1. Kotur PF, Kurdi MS, Sengupta S, Akilandeshwari M, Panditrao M, Kiran S. Emerging responsibilities of the anaesthesiologist in competency-based undergraduate medical education. Indian J Anaesth. 2022;66(1):8. [PubMed]
2. Indra I, Kulsum K. Pre-Anesthesia Assessment and Preparation. Budapest Int Res Exact Sci J. 2020;2(2):228–35. [WebPage]
3. Sheen MJ, Chang F-L, Ho S-T. Anesthetic premedication: new horizons of an old practice. Acta Anaesthesiol Taiwanica Off J Taiwan Soc Anesthesiol. 2014 Sep;52(3):134–42. [PubMed] [ScienceDirect]
4. Guan T, Zhang Y, Anwar A, Zhang Y, Wang L. Determination of three-dimensional corrective force in adolescent idiopathic scoliosis and biomechanical finite element analysis. Front Bioeng Biotechnol. 2020;8:963. [PubMed] [WebPage]
5. Krishnan SP. Scoliosis. In: Trauma management in orthopedics. Springer; 2013. p. 213–28.
6. Kruzel K. CHAPTER ELEVEN IDIOPATHIC SCOLIOSIS KIMBERLY KRUZEL AND MARC MORAMARCO. Schroth's Textb Scoliosis Other Spinal Deform. 2020;380.
7. Karimi MT, Rabczuk T. Scoliosis conservative treatment: A review of literature. J craniovertebral junction spine. 2018;9(1):3. [PubMed] [WebPage]
8. Dayer R, Haumont T, Belaieff W, Lascombes P. Idiopathic scoliosis: etiological concepts and hypotheses. J Child Orthop. 2013;7(1):11–6. [PubMed] [WebPage]
9. Hadzic A. Hadzic's Textbook of Regional Anesthesia and Acute Pain Management.

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.51-63

New York School of Regional Anesthesia. 2017. [WebPage]
10. Prasad GVK, Khanna S, Jaishree SV. Review of adjuvants to local anesthetics in peripheral nerve blocks: Current and future trends. Saudi J Anaesth. 2020;14(1):77. [PubMed] [WebPage]
11. Schwartz RH, Hernandez S, Noor N, Topfer J, Farrell K, Singh N, et al. A Comprehensive Review of the Use of Alpha 2 Agonists in Spinal Anesthetics. Pain Physician. 2022;25(2):E193–201. [PubMed] [WebPage]
12. Kayir S, Kisa A. The evolution of the regional anesthesia: a holistic investigation of global outputs with bibliometric analysis between 1980-2019. Korean J Pain. 2021;34(1):82. [PubMed] [WebPage]
13. Folino TB, Mahboobi SK. Regional Anesthetic Blocks. 2020;
14. Ballarapu GK, Nallam SR, Samantaray A, Kumar VAK, Reddy AP. Thoracolumbar curve and Cobb angle in determining spread of spinal anesthesia in Scoliosis. An observational prospective pilot study. Indian J Anaesth. 2020;64(7):594. [PubMed]
15. Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, Ortega R, et al. Anestesia clínica. Wolters Kluwer; 2018. [WebPage]
16. Butterworth JF, Mackey DC, Wasnick JD. Morgan and Mikhail's clinical anesthesiology. McGraw-Hill Education; 2018. [E-book]
17. Olawin AM, Das JM. Spinal Anesthesia. StatPearls [Internet]. 2021; [PubMed]
18. Lee J-K, Park JH, Hyun S-J, Hodel D, Hausmann ON. Regional Anesthesia for Lumbar Spine Surgery: Can It Be a Standard in the Future? Neurospine. 2021;18(4):733. [PubMed] [WebPage]
19. Ferré F, Martin C, Bosch L, Kurrek M, Lairez O, Minville V. Control of spinal anesthesia-induced hypotension in adults. Local Reg Anesth. 2020;13:39. [PubMed] [WebPage]
20. Qin C, Jiang Y, Liu J, Pang H. Venoarterial Extracorporeal Membrane Oxygenation as an Effective Therapeutic Support for Refractory Cardiac Arrest in the Setting of Spinal Anesthesia: A Case Report and Literature Review. Int J Gen Med. 2021;14:73. [PubMed] [WebPage]
21. Siddhartha V, Shankaranarayana P. A study on hemodynamic changes and adverse reactions between isobaric levobupivacaine 0.5% versus isobaric levobupivacaine 0.5% with 3mcg dexmeditomidine. IJMA. 2019;2(2):159–63. [WebPage]
22. Patel Z, Franz CK, Bharat A, Walter JM, Wolfe LF, Koralnik IJ, et al. Diaphragm and Phrenic Nerve Ultrasound in COVID-19 Patients and Beyond: Imaging Technique, Findings, and Clinical Applications. J Ultrasound Med. 2022;41(2):285–99. [PubMed] [WebPage]
23. Gudin MT, López-Vicente R, Ortigosa E, Mar Caro Cascante M Del, Molina CG, Martin S. Neuraxial blockade: subarachnoid anesthesia. In: Essentials of Regional Anesthesia. Springer; 2018. p. 213–32. [E-book]
24. Mokini Z, Vrenozi D, Forget P. Yao & Artusio's Anesthesiology: Problem-Oriented Patient Management. LWW; 2021. [WebPage]
25. Rüwald JM, Eymael RL, Upenieks J, Zhang L, Jacobs C, Pflugmacher R, et al. An overview of the current state of pediatric scoliosis management. Z Orthop Unfall. 2020;158(05):508–16. [PubMed] [WebPage]
26. Toombs C, Kushagra Verma MD, Lonner

Available at https://e-journal.unair.ac.id/IJAR | DOI: 10.20473/ijar.V5I12023.51-63

BS, Feldman D, Errico T. Preliminary Analysis of Factors Associated with Blood Loss in Neuromuscular Scoliosis Surgery. Bull NYU Hosp Jt Dis. 2018;76(3):207–15. [PubMed]

27. Horng M-H, Kuok C-P, Fu M-J, Lin C-J, Sun Y-N. Cobb angle measurement of spine from X-ray images using convolutional neural network. Comput Math Methods Med. 2019;2019. [PubMed] [WebPage]
28. Morrison DG, Chan A, Hill D, Parent EC, Lou EHM. Correlation between Cobb angle, spinous process angle (SPA) and apical vertebrae rotation (AVR) on posteroanterior radiographs in adolescent idiopathic scoliosis (AIS). Eur Spine J. 2015;24(2):306–12. [PubMed] [WebPage]
29. DePaola K, Cuddihy LA. Pediatric Spine Disorders. Pediatr Clin North Am. 2020 Feb;67(1):185–204. [PubMed] [WebPage]
30. Gropper MA, Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, et al. Miller's anesthesia, 2-volume set E-book. Elsevier Health Sciences; 2019. [WebPage]

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Here are some examples of the references:

1. Standard journal article

Up to six authors, list all the authors.

- Yi Q, Li K, Jian Z, Xiao Y. Risk factors for acute kidney injury after cardiovascular surgery: Evidence from 2,157 cases and 49,777 controls - A meta-analysis. Cardio Renal Med. 2016; 6: 237–50

More than six authors, list the first six authors, followed by et al.

- Amini S, Najafi MN, Karrari SP, Mashhadi ME, Mirzaei S, Tashnizi MA, et al. Risk factors and outcome of acute kidney injury after isolated cabg surgery: A prospective cohort study. Brazilian J Cardiovasc Surg. 2019; 34(1): 70–5.

2. A book

McKnight CL, Burns B. Pneumothorax. In: StatPearls. StatPearls Publishing; 2021.

3. *Homepage/Web site*

Ikatan Dokter Anak Indonesia. Rekomendasi Ikatan Dokter Anak Indonesia: Asuhan Nutrisi Pediatrik (Pediatric Nutrition Care). Paediatric. 2011; 3(2): 5–6.

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