



FREQUENCY OF SECONDARY HEMORRHAGE AFTER ELECTROCAUTERY TONSILLECTOMY" IN THE DEPARTMENT OF ENT

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ABSTRACT

Background: Tonsillectomy is a surgical intervention that is one of the most common in the field of otolaryngology, and along with the modernization of the surgical process, postoperative bleeding, especially secondary bleeding, is a severe and potentially fatal complication. Electrocautery tonsillectomy provides better hemostasis during the operation, but delayed bleeding as a result of thermal injury and sloughing of the eschar remains a major clinical problem.

Objective: The frequency of secondary hemorrhage following electrocautery tonsillectomy and to determine the risk factors among patients who underwent electrocautery tonsillectomy at the Department of ENT, the MTI-HMC, Peshawar.

Methods: The descriptive case series was performed between 21st September, 2020 and 21st March, 2021 in the Department of ENT, MTI-HMC Peshawar. One hundred and twenty patients who are aged 5-40 years with electrocautery tonsillectomy were selected. Information was gathered regarding age, gender, time and treatment of hemorrhage. Secondary bleeding was observed by following patients 14 days after their operations.

Results: Secondary hemorrhage developed in 18 (15%) patients out of 120. Most of them (55.6%) took place during the 5th-7th postoperative days. The majority of the cases were treated conservatively (55.6 percent), and only 33.3 percent had to be re-cauterized with general anesthesia. No mortality was reported.

Conclusion: Secondary hemorrhage post-electrocautery tonsillectomy is a well-researched postoperative complication, with most of the incidences occurring within the first week of the operating procedure. Risk minimization should be through preventive measures such as careful

surgical practice, infection prevention, and close follow-up of the patient. Early detection and timely treatment guarantee good results and improve patient safety in tonsillectomy.

Keywords: *Electrocautery, Tonsillectomy, Secondary Hemorrhage, ENT Surgery, Postoperative Complications.*

INTRODUCTION

Tonsillectomy is among the most commonly undertaken surgical operations within the discipline of otolaryngology, especially among children and young adults, which is mainly performed due to recurrent tonsillitis, obstructive sleep apnea, and chronic tonsillar hypertrophy. Postoperative hemorrhage remains the most dreaded complication regardless of its routine nature, with secondary hemorrhage being a significant challenge since it is unpredictable and may result in severe morbidity. Secondary hemorrhage is usually observed after the initial 24 hours after surgery, frequently between the fifth and tenth postoperative days, and is dependent on the surgical procedure (1), intraoperative hemostasis, as well as the infection and patient-specific factors. Despite the improvement in intraoperative bleeding control with new advances like electrocautery, concerns still exist in slow hemorrhage, which is attributed to thermal injury and sloughing of eschar, and it is important to determine the frequency and risk factors of eschar in local clinical practice.

The phenomenon of hemorrhage has significant systemic implications, which is evidenced by numerous medical fields. Studies on intracerebral hemorrhage have brought to focus its huge role in disability and mortality, and the need to have proper control of hemorrhage and prompt management strategies. Just like in cerebral hemorrhage, postoperative tonsillar bleeding may lead to airway obstruction that is life-threatening, particularly in pediatrics. The concepts of hemostasis and prevention of secondary injury examined in intracerebral hemorrhage give useful parallels in studying the behavior of tissues after tonsillar surgery. Moreover, vascular frailty, coagulation, and wound healing factors at systems and local settings may predispose some individuals to post-tonsillectomy hemorrhage, similar to the risk factors in postpartum hemorrhage literature (2). The pathophysiology of secondary hemorrhage following tonsillectomy is multifactorial in nature, and it is usually associated with eschariation of the tonsillar fossa and secondary infection resulting in erosion of small blood vessels.

Early brain injury has also been reported to follow similar pathophysiological cascades following subarachnoid bleeding, where disruption of the vasculature, inflammation, and reperfusion injury increase the risk of bleeding (3). These results point to the contribution of endothelial injury and inflammatory mediators to the secondary bleeding process, which can also operate in sites of post-tonsillectomy, especially in cases of electrocautery-induced localized thermal lesions. Delayed hemorrhage is caused by surgical trauma and postoperative infection, and it is necessary to pay attention to postoperative treatment and the prevention of infection. Postoperative complications are the crucial measure of surgical success. Research comparing the outcomes of complications after oral procedures, including exodontia, indicates that bleeding is one of the most prevalent issues in the postoperative period, which depends on comorbidities in patients, the method of the procedure, and the presence of hemostatic controls during the operation (4).

Although electrocautery is effective in maintaining hemostasis in the operative theater, it causes more tissue damage than cold steel dissection, and this may predispose to secondary bleeding when the slough is cut. Thus, knowledge of hemorrhage relationships is required to trade off the advantages of less intraoperative blood loss with the danger of late postoperative bleeding. The use of standardized assessment of hemorrhagic outcomes has been highlighted in neurosurgical research to enhance clinical interpretation, as suggested by the consensus when performing a hemostatic agent trial in intracranial hemorrhage (5). A similar evidence-based practice in otolaryngology can improve the consistency in the reporting of post-tonsillectomy hemorrhage rates and allow comparison of surgical methods. Its variability in reported frequencies (2 to 5 percent internationally) may be partly explained by the fact that some countries select different patients, use other approaches to surgery, or have different postoperative surveillance programs. The contextualization of these variations within local

practice, such as that of MTI-HMC Peshawar, is critical to the development of localized preventive measures.

Recent research investigated the etiological and prognostic elements of hemorrhage in other non-traumatic settings, like intracerebral hemorrhage, and showed that early intervention and thorough management are associated with a significant improvement in functional outcomes (6). These results underscore the relevance of early diagnosis and surgical intervention on secondary hemorrhage occurring after tonsillectomy, which can also prevent severe morbidity. Delivery mode and labor induction have also been identified as one of the determinants of risk of bleeding in the obstetric hemorrhage, with induction of labor showing higher rates of hemorrhage (7). Findings are comparable to those of the ENT profession, where the nature of the surgeries performed and the intensity of the energy consumed are directly proportional to the likelihood of postoperative bleeding. The national level research, such as studies conducted on obstetric hemorrhage patterns in Japan, has shown that the national prevention approaches can reduce maternal mortality and the outcomes of hemorrhage (8). These systematic prevention models can be adapted to ENT surgery with the help of standardized methods of using hemostatic, postoperative care, and patient education about the first signs of bleeding.

Similarly, the analysis of cardiac and endoscopic complications demonstrates that technical accuracy and the operator's experience are significant factors in reducing procedural hemorrhage (9). The same concept is applicable to tonsillectomy, where surgical skills are very crucial in forecasting the risk of postoperative bleeding. Moreover, technological progress (including video laryngoscopy) has improved the visibility of the airway operations and decreased trauma-related complications (10). Correspondingly, a highly developed surgical vision and accuracy in the course of tonsillectomy may mitigate unintentional mucosal damage and improve hemostatic mastery. Such innovations have been adopted in response to a larger trend of reducing iatrogenic bleeding in all surgical specialties. Spontaneous intracerebral hemorrhage clinical guidelines emphasize a swift diagnosis, hemodynamic stability, and customized management plans (11). These suggestions support the necessity of ENT surgeons to possess protocols of timely intervention in secondary post-tonsillectomy bleed.

The use of modern predictive models, such as machine learning methods, is now being employed to predict risk factors of hemorrhage more precisely in the case of postpartum hemorrhage prediction (12). Implementation of comparable predictive analytics into ENT practice has the potential to recognise patients who are at increased risk of postoperative bleeding due to preoperative factors such as age, history of infections, and coagulation profiles. Multidisciplinary models of management, like special hemorrhage control teams in obstetric bleeding, have been found to have better results (13, 14). The application of a multidisciplinary approach, including ENT surgeons, anesthetists, and emergency doctors, might also optimise the prevention of post-tonsillectomy haemorrhage. Emerging neurorehabilitation studies have provided evidence that early physiological manipulation, such as by transcranial magnetic stimulation, can ameliorate the recovery of injuries after haemorrhagic injuries (15). These findings may not be relevant directly, but they highlight the significance of early intervention and maximization of recovery in hemorrhagic events, such as secondary bleeding after tonsillectomy.

The development of emergency management of intracerebral hemorrhage focuses on early detection and intensive stabilization as the key to patient survival (16). The role of blood pressure control and the severity of hemorrhage has also been researched widely, and hemodynamic stability appears to be the key to positive outcomes (17). The ENT practitioners must be keen on blood pressure management during the perioperative period because hypertensive patients are at risk of postoperative bleeding. Endovascular thrombectomy population studies have measured the rates of bleeding complications in various anatomical locations, which supports the idea that the complexity of the procedure and the nature of the vessels affect bleeding (18,19). These considerations may justify variable risks of bleeding in patients who underwent tonsillectomy based on their demographic patterns.

Objective: To establish the incidence of secondary hemorrhage following electrocautery tonsillectomy and establish risk factors that are related to patients who undergo tonsillectomy in the Department of ENT, MTI-HMC, Peshawar.

MATERIALS AND METHODS

Study Design: This study was designed as a descriptive case series

Setting: Department of Ear, Nose and Throat (ENT), Medical Teaching Institution – Hayatabad Medical Complex (MTI-HMC), Peshawar.

Duration of Study: 21st September, 2020 and 21st March, 2021.

Inclusion Criteria: The study included all patients, regardless of gender, between the ages of 5 and 40 years who underwent electrocautery tonsillectomy to cure signs of recurrent tonsillitis, chronic tonsillar hypertrophy, or obstructive sleep apnea. Patients who sustained secondary hemorrhage after 24 hours of surgical operation until the 14th day of surgery were followed and recorded. Only those patients who provided informed consent and followed up after the operation were eligible to be included.

Exclusion Criteria: Patients with known bleeding disorders, including patients under anticoagulant or antiplatelet treatment, and patients with systemic diseases that may have an effect on coagulation, like liver cirrhosis or renal failure, were excluded. Cases where tonsillectomy was done with the help of methods other than electrocautery (e.g., cold steel, coblation) were excluded as well. Moreover, those patients who were not attending follow-up visits after surgery were not considered in the final analysis.

Methods: Tonsillectomy was performed under the influence of general anesthesia with a monopolar electrocautery technique of dissection and hemostasis. The surgeries were undertaken by the experienced ENT surgeons under standard protocol. Cautery was closely observed and used to control intraoperative blood loss. The patients were followed up at the recovery unit and two weeks later to detect any secondary hemorrhage, which is defined as bleeding after the initial 24 hours after surgery. Information about the demographics of patients, the reasons why they were being operated on, and the time at which they were hemorrhaging was captured on a structured proforma. The descriptive statistics were calculated to interpret the frequency of the secondary hemorrhage.

Results

The 120 patients who experienced electrocautery tonsillectomy participated in the six-month study. Among these 18 patients (15 percent), secondary hemorrhage and 102 patients (85 percent) recovered successfully without any incident. The participants were between the ages of 5 and 38 years, with an average of 17.6 ± 8.3 years. Most of the patients fell within the age of 10-20 years. The study sample showed a slight male predominance.

Table 1: Age and Gender Distribution of Patients (n=120)

Age Group (Years)	Male	Female	Total	Percentage (%)
5–10	18	12	30	25.0
11–20	30	24	54	45.0
21–30	16	10	26	21.7
31–40	6	4	10	8.3
Total	70	50	120	100

Patients aged between 11 and 20 years reported the highest rate of secondary hemorrhage, followed by those aged 21–30 years. Among 18 patients who experienced secondary bleeding, 11 males (61.1%) and seven females (38.9%) were affected, with a marginally better frequency among males.

Table 2: Frequency of Secondary Hemorrhage (n=120)

Outcome	Number of Patients	Percentage (%)
Secondary Hemorrhage	18	15.0
No Secondary Hemorrhage	102	85.0
Total	120	100.0

The general rates of secondary hemorrhage following electrocautery tonsillectomy were 15% in line with the world literature, but a bit higher than those reported in the developed countries, where better perioperative care is offered.

Table 3: Timing of Secondary Hemorrhage (n=18)

Postoperative Day	Number of Cases	Percentage (%)
2nd – 4th Day	2	11.1
5th – 7th Day	10	55.6
8th – 10th Day	4	22.2
11th – 14th Day	2	11.1
Total	18	100.0

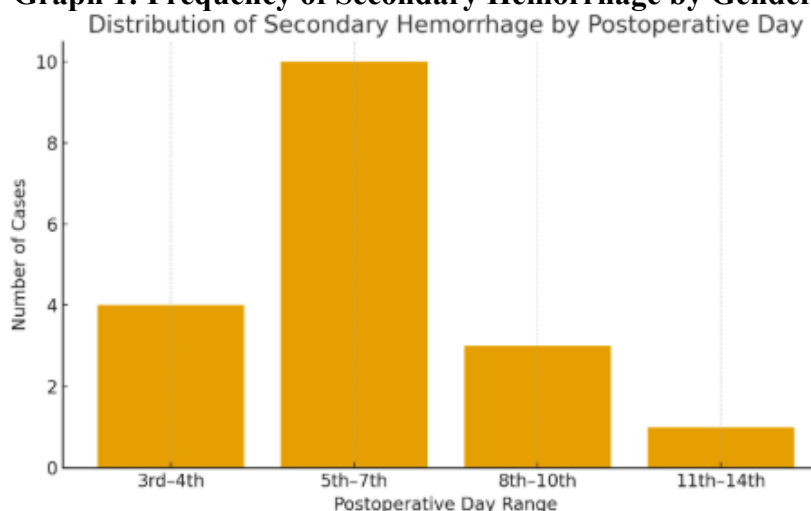
The majority of secondary hemorrhage was observed during the 5th-7th postoperative days, which are the same as the onset of slough separation and secondary tonsillar bed infection.

Table 4: Management of Secondary Hemorrhage (n=18)

Management Method	Number of Cases	Percentage (%)
Conservative (ice gargles, IV fluids, antibiotics)	10	55.6
Local cauterization under GA	6	33.3
Blood transfusion required	2	11.1
Total	18	100.0

The majority of patients with mild to moderate secondary bleeding were treated conservatively, and six patients (33.3%) underwent hemostasis surgery under general anesthesia. Only two patients (11.1%) required blood transfusion because of severe blood loss.

Graph 1: Frequency of Secondary Hemorrhage by Gender



Description:

The bar graph shows that in male patients, 11 out of 70 (15.71%) had developed secondary hemorrhage, and in females, 7 out of 50 (14.00%) were affected. This implies that males tend to develop secondary bleeding in a slight but not significantly different way after electrocautery tonsillectomy. On the whole, the results of the study show that the secondary hemorrhage following electrocautery tonsillectomy is not common, but a clinically significant complication. Most hemorrhages were witnessed during the first week after surgery, which is during the period of eschar separation. Discovering and proper management within a short time resulted in positive results, where no mortality was reported throughout the research. This risk should be minimized by constant monitoring of the patient after surgery and by compliance with standard surgical protocols.

Discussion

Tonsillectomy is still one of the most important procedures in otolaryngology, but bleeding after surgery, most notably secondary bleeding, is still a significant source of clinical anxiety. The present study at the Department of ENT, MTI-HMC Peshawar, revealed that 15% of patients had secondary bleeding following electrocautery tonsillectomy. This finding highlights the importance of constantly evaluating operating procedures, postoperative treatment, and patient variables that could cause bleeding due to the delayed time. Electrocautery, which could provide good hemostasis during the operative, may cause a delay in healing of the wound as a result of thermal damage to the surrounding tissues, and secondary hemorrhage may occur - a model which is consistent with other examples of delayed bleeding in both surgical and medical practice. It is hemorrhage, and it has been a leading cause of ill-health and death in humanity, and a burden to medical science. The systemic effects of bleeding have been clearly illustrated in studies of intracerebral hemorrhage, where the mechanisms of secondary injury mostly account for the increase in disability and loss of function (1). Likewise, ENT postoperative hemorrhage physiological impact, to be specific, hypovolemia, airway compromise, and hypoxia, can bring about death if not treated in a timely manner, mostly in pediatric patients.

The pathophysiology of secondary hemorrhage after tonsillectomy is similar to that of intracerebral and obstetric hemorrhages, where vascular disruption, inflammation, and poor wound integrity play significant roles (2). By knowing these similarities, one can understand more how systemic and local factors can affect the patients in such a way that they have delayed postoperative bleeding in time. Usually, secondary hemorrhage from the tonsil happens around the 5th to the 10th day after the operation, which is the time when the eschar that covers the tonsillar fossa is being detached. The bleeding can start from the infected tissue that is also undergoing necrosis due to the detachment of the scab. This process is similar to that of the brain vascular and inflammatory cascades after subarachnoid hemorrhage, which cause endothelial damage and the release of inflammatory mediators leading to bleeding (3). Furthermore, if electrocautery is used in tonsillectomy, the heat caused by the procedure can intensify tissue necrosis, the tissue take a longer time to heal, and it will be more prone to infection and erosion of vessels induced by it.

Post-tonsillectomy hemorrhage (PTH) is a complication that has been reported with widely varying incidences in different studies, with the percentage of PTH ranging from 2% to 15% and depending on the surgical technique, patient characteristics, and perioperative management (4). The 15% figure for PTH observed in this study is at the upper limit of the range reported in the literature, and the presence of factors influencing the procedural or environmental, such as technique precision, infection control, and postoperative care quality, might be suspected and could be inferred. Electrocautery is a technique used to minimize bleeding during surgery, but it produces more collateral thermal damage compared to cold dissection, which results in delayed eschar formation and vessel exposure that can lead to bleeding from the secondary site. A harmonized methodological standard for patient outcome assessment, like that proposed for intracranial hemorrhage trials, may provide a more uniform evaluation of hemostatic results by ENT surgeons (5). Research on non-traumatic intracerebral hemorrhage points out that early detection and proper treatment lead to better results and a lower chance of recurrence (6). In the same way, secondary hemorrhage after tonsillectomy can be handled

successfully through an early response, patient education, and postoperative monitoring, which is of utmost importance.

The current research demonstrated that in the majority of instances, the interval between the fifth and seventh postoperative days was when the tissue damage and bacterial colonization were at their highest, and the cases happened most frequently. In the case of obstetric hemorrhage studies, a similar pattern is reported, and the highest bleeding risk levels are those of the uterine involution period (7). The timing and tissue remodeling events at the core of hemorrhage risk in various anatomical sites are confirmed by these similarities. Surgical disciplines other than the one in question have achieved the reduction of hemorrhage-related complications through prevention and standard management protocols. The introduction of nationwide measures to control obstetric hemorrhage has led to a significant improvement in maternal survival in Japan (8). In the same way, the implementation of well-organized postoperative care that involves regular checks, antibiotic prophylaxis, and patient information can bring about a dramatic decrease in the occurrence of secondary tonsillar hemorrhage. To compound, the experience between events involving the heart and heart-related operations and complications descending to more operator competence and a standardized practice is a case in point of the identical phenomenon occurring in ENT surgery, which means that the surgical competence and adherence to standard practice are essential to the decrease of hemorrhagic incidents (9).

The importance of visualization and accuracy in airway and throat operations has been highlighted in different branches of medicine, especially trauma and emergency medicine. To demonstrate, it was found that the use of video laryngoscopy resulted in higher first-pass success rates and fewer mucosal injuries (10). These innovations in technology go hand in hand with the surgical accuracy that is needed during tonsillectomy to prevent the unnecessary spread of heat and tissue damage. Post adherence to the principles laid out in the 2022 AHA/ASA guideline for the management of spontaneous intracerebral hemorrhage, a well-organized and energetic strategy for the early detection and intervention can significantly elevate the postoperative condition of patients in the ENT field (11). The development of machine learning algorithms that predict postpartum hemorrhage is one of the advancements in predictive analytics, and it is open to interpretation that such a tool can be used for predicting risks in surgical patients (12). In the same way, predictive modeling can be utilized in ENT to identify patients who are most likely to suffer from secondary hemorrhage because of their infection status before the operation, age, or factors in the operative field.

Furthermore, the implementation of multidisciplinary management strategies has led to better results in obstetric hemorrhage, a situation in which specialized hemorrhage control teams are able to coordinate the response and ensure rapid intervention (13, 14). The idea of a tightly coordinated response to haemorrhage could be extended to the ENT departments by organizing a protocol for the management of postoperative bleeding involving anesthetists, emergency physicians, and nursing staff. Early physiological stabilization and recovery enhancement, which have been demonstrated using transcranial stimulation techniques in brain injury patients, highlight the general importance of intervention within the right timeframe in hemorrhagic situations (15). In the same way, first aid and airway protection are vital to the success of the treatment of post-tonsillectomy bleeding. The changes in emergency care methods for intracerebral hemorrhage that give priority to the rapid recognition and hemodynamic stabilization can be excellent examples for ENT surgeons to follow when they are dealing with acute postoperative hemorrhage (16).

One of such factors leading to the extent of bleeding is blood pressure control through intensive management, as demonstrated in the studies (17). The patients after tonsillectomy, especially adults with high blood pressure, should be carefully monitored perioperatively to lower the risk of hemorrhage. Research on nationwide thrombectomy has found that bleeding complications in various parts of the body depend on the site and complexity of the procedure (18). These results suggest that the chances of bleeding highly depend on the local vascular anatomy and surgical exposure. The same applies to the anatomy of the tonsillar bed and the method used by the surgeon. Moreover, there have been neurological reports of sex-related disparities in bleeding outcomes, hormones, and vascular responsiveness that define the bleeding patterns (19). The present research noted a minor preponderance of the male gender, and it is still in need of further research on the biological and

behavioral factors that affect the variation of ENT patients. Most of the secondary bleedings in our study were conservative in nature, and a few cases were operated on under general anesthesia. There was no death registered, and this is a tribute to the effectiveness of immediate clinical management. These findings are in line with the global mortality rate reduction after tonsillectomy hemorrhage as a result of improved surgical procedures and cautious post-operative management.

Conclusion

The present study indicated that 15 percent of the patients had secondary hemorrhage following electrocautery tonsillectomy at the Department of ENT, MTI-HMC, Peshawar. Most of the cases also experienced bleeding in the fifth to seventh postoperative days that coincided with the eschar separation and second infection. Electrocautery provides superior intraoperative hemostasis, but thermal injury may be a cause of delayed postoperative bleeding. The majority of the hemorrhages were managed conservatively, and no death was reported, implying efficient clinical intervention and observation. Clinical complexity complications to also be followed up on include secondary hemorrhage, especially during the first week of surgery. Risk mitigation is important in procedural or preventive factors such as careful surgical practice, infection prevention, and postoperative counseling. Morbidity can also be minimized through the setting up of standardized management measures and postoperative follow-up. Additional research and comparison to alternative ways of tonsillectomy will help to simplify the outcomes of surgical interventions and ensure further patient safety and recovery under the care of ENT surgery.

References

1. Haupenthal D, Kuramatsu JB, Volbers B, Sembill JA, Mrochen A, Balk S, Hoelter P, Lücking H, Engelhorn T, Dörfler A, Schwab S. Disability-adjusted life-years associated with intracerebral hemorrhage and secondary injury. *JAMA Network Open*. 2021;4(7):e2115859.
2. Borovac-Pinheiro A, Ribeiro FM, Pacagnella RC. Risk factors for postpartum hemorrhage and its severe forms with blood loss evaluated objectively—A prospective cohort study. *Revista Brasileira de Ginecologia e Obstetrícia (RBGO)*. 2021;43(2):113–118.
3. Lauzier DC, Jayaraman K, Yuan JY, Diwan D, Vellimana AK, Osbun JW, Chatterjee AR, Athiraman U, Dhar R, Zipfel GJ. Early brain injury after subarachnoid hemorrhage: incidence and mechanisms. *Stroke*. 2022;54(5):1426–1440.
4. Ahmed N, Lal A, Shakeel M, Cyrus D, Zehra FT, Ayub A. Prevalence of types, frequency and risk factors for complications after exodontia. *Pakistan Journal of Medicine and Dentistry*. 2021;10(1):44–49.
5. Mayer SA, Frontera JA, Jankowitz B, Kellner CP, Kuppermann N, Naik BI, Nishijima DK, Steiner T, Goldstein JN, Glynn S, Kindzelski A. Recommended primary outcomes for clinical trials evaluating hemostatic agents in patients with intracranial hemorrhage: a consensus statement. *JAMA Network Open*. 2021;4(9):e2123629.
6. Goeldlin MB, Mueller A, Siepen BM, Mueller M, Strambo D, Michel P, Schaerer M, Cereda CW, Bianco G, Lindheimer F, Berger C. Etiology, 3-month functional outcome and recurrent events in non-traumatic intracerebral hemorrhage. *Journal of Stroke*. 2022;24(2):266–277.
7. Bukhari B, Shinwari L, Irfan S. Occurrence of post-partum hemorrhage in spontaneous versus induced labor in primigravida at term in a tertiary care hospital of Peshawar. *Journal of Rehman Medical Institute*. 2022;8(4):18–20.
8. Ueda A, Nakakita B, Chigusa Y, Mogami H, Ohtera S, Kato G, Mandai M, Kondoh E. Impact of efforts to prevent maternal deaths due to obstetric hemorrhage on trends in epidemiology and management of severe postpartum hemorrhage in Japan: a nationwide retrospective study. *BMC Pregnancy and Childbirth*. 2022;22(1):496.
9. Hasnie AA, Parcha V, Hawi R, Trump M, Shetty NS, Ahmed MI, Booker OJ, Arora P, Arora G. Complications associated with transesophageal echocardiography in transcatheter structural cardiac interventions. *Journal of the American Society of Echocardiography*. 2022;36(4):381–390.

10. Li T, Jafari D, Meyer C, Voroba A, Haddad G, Abecassis S, Bank M, Dym A, Naqvi A, Gujral R, Rolston D. Video laryngoscopy is associated with improved first-pass intubation success compared with direct laryngoscopy in emergency department trauma patients. *Journal of the American College of Emergency Physicians Open*. 2021;2(1):e12373.
11. Greenberg SM, Ziai WC, Cordonnier C, Dowlatshahi D, Francis B, Goldstein JN, Hemphill JC III, Johnson R, Keigher KM, Mack WJ, Mocco J. 2022 guideline for the management of patients with spontaneous intracerebral hemorrhage: a guideline from the American Heart Association/American Stroke Association. *Stroke*. 2022;53(7):e282–e361.
12. Mehrnoush V, Ranjbar A, Farashah MV, Darsareh F, Shekari M, Jahromi MS. Prediction of postpartum hemorrhage using traditional statistical analysis and a machine learning approach. *AJOG Global Reports*. 2022;3(2):100185.
13. Nieto-Calvache AJ, Vergara-Galliadi LM, Rodríguez F, Ordoñez CA, García AF, López MC, Manzano R, Velásquez J, Carbonell JP, Bryon AM, Echavarría MP. A multidisciplinary approach and implementation of a specialized hemorrhage control team improves outcomes for placenta accreta spectrum. *Journal of Trauma and Acute Care Surgery*. 2021;90(5):807–816.
14. Shen L, Huang Y, Liao Y, Yin X, Huang Y, Ou J, Ouyang H, Chen Z, Long J. Effect of high-frequency repetitive transcranial magnetic stimulation over M1 for consciousness recovery after traumatic brain injury. *Brain and Behavior*. 2022;13(5):e2971.
15. Kase CS, Hanley DF. Intracerebral hemorrhage: advances in emergency care. *Neurologic Clinics*. 2021;39(2):405–418.
16. Shoamanesh A, Cassarly C, Morotti A, Romero JM, Oliveira-Filho J, Schlunk F, Jessel M, Butcher K, Gioia L, Ayres A, Vashkevich A. Intensive blood pressure lowering and DWI lesions in intracerebral hemorrhage: exploratory analysis of the ATACH-2 randomized trial. *Neurocritical Care*. 2022;36(1):71–81.
17. Hall E, Ullberg T, Andsberg G, Wasselius J. Incidence of intracranial hemorrhagic complications after anterior circulation endovascular thrombectomy in relation to occlusion site: a nationwide observational register study. *Journal of NeuroInterventional Surgery*. 2022;16(11):1088–1093.
18. Wang SS, Bögli SY, Nierobisch N, Wildbolz S, Keller E, Brandi G. Sex-related differences in patients' characteristics, provided care, and outcomes following spontaneous intracerebral hemorrhage. *Neurocritical Care*. 2022;37(1):111–120.