VOLUME 36
NUMBER 2
JULY 2023

ISSN 2220-8992

Journal of the Bangladesh Society of Anaesthesiologists

Journal of The Bangladesh Society of Anaesthesiologists

Volume 36, No. 2, July 2023

OFFICIAL JOURNAL OF BANGLADESH SOCIETY OF ANAESTHESIOLOGISTS

PUBLISHED BY

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Printed at

Asian Colour Printing
Motijheel, Dhaka, Bangladesh

This journal is officially sponsored by
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Editorial

Ultrasound in Anaesthesia, Intensive Care and Pain Medicine: A New Era of Precision and Safety

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Citation: Akhtaruzzaman AKM. Ultrasound in Anaesthesia, Intensive Care and Pain Medicine: A New Era of Precision and Safety. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2):1-4.

(JBSA 2023; 36(2): 1-4)

Ultrasound (USG) has profoundly transformed regional anaesthesia and perioperative anaesthesia care and pain management. It also transforms intensive care services worldwide. Historical landmark-based teaching in anatomical skill labs establishes a foundational understanding of human topography, which directly translates to clinical competence in surface anatomy and safe landmark-guided regional anaesthesia practice since ancient era of medical education. Now a days, especially in the first world, replacing blind, landmark-based techniques with real-time, high-resolution imaging, USG has evolved into a vital diagnostic and procedural tool for both anaesthesiologists, intensivists and pain physicians [1]. Today, it bridges the gap between diagnosis and Intervention, heralding a true "new era" for anaesthesia.

The Paradigm Shift in Regional Anaesthesia

Ultrasound-guided regional anaesthesia (UGRA) is now widely considered the gold standard, with high-frequency probes providing detailed, real-time visualization of nerves, vasculature, muscles, and fascial planes [2]. This visual precision helps the clinicians to track the needle tip and witness the exact spread of local anaesthetic, ensuring targeted blockades with reducing dose [3]. The real-time visualization dramatically reduces the risk of inadvertent intravascular injections and direct neural trauma. The Brazilian *J Anesth Analg Crit Care (2025) and* The American College of Emergency Physicians (ACEP) 2023 guidelines note that the risk of peripheral nerve injury with ultrasound-guided blocks is as low as 0.03%, with local anaesthetic systemic toxicity occurring in only 1.3 per 10,000 patients [4, 5].

The emergence of fascial plane blocks including the erector spinae (ESP), serratus anterior (SAPB), and transversus abdominis plane (TAP) block — has broadened the application of regional anaesthesia to thoracic and abdominal pain management. Randomized trials have demonstrated significant reductions in pain scores and opioid consumption with these techniques for rib fractures, renal colic, and thoracostomy tube placement [2,4,6].

Vascular Access and Safety

Ultrasound allows for dynamic, real-time imaging of vessels, confirming patency and ruling out anatomical anomalies before needle insertion. USG guidance is now routinely applied to complex vascular access, dramatically increasing first-attempt success rates and minimizing patient discomfort. A 2022 national Delphi survey recommended that anaesthesiology residents perform a minimum of 20 ultrasound-guided central line and 20 arterial line placements during training to ensure competency [7, 8.]

The Rise of Perioperative POCUS

The role of ultrasound extends far beyond procedural guidance. The rise of Point-of-Care Ultrasound (POCUS) empowers the anaesthesiologist to act as a perioperative physician, with POCUS seamlessly integrated into several critical domains [8, 9]. The 2024 AHA/ACC Perioperative Cardiovascular Management Guidelines now formally recommend the emergency use of perioperative TEE or Focused Cardiac Ultrasound (FoCUS) as reasonable (Class 2a) in patients with unexplained hemodynamic instability during noncardiac surgery, when

expertise is available. A structured "head-to-toe" POCUS framework has been described for cardiac surgical patients, incorporating optic nerve sheath diameter, transcranial Doppler, cardiac ultrasound, and venous excess ultrasound (VExUS) for comprehensive assessment [10, 11].

Airway USG aids in evaluating difficult airways, verifying endotracheal tube placement, and guiding emergent cricothyrotomy. A large meta-analysis cited in the ACEP 2023 guidelines found that transtracheal ultrasound identified endotracheal versus oesophageal intubation with 99% sensitivity and 97% specificity [3]. On the other hand, lung USG is highly effective for diagnosing pneumothorax, consolidation, and pleural effusions. POCUS assessment for B-lines demonstrates 83–92% sensitivity and 84–92% specificity for pulmonary oedema, and 85–92% sensitivity and 93% specificity for pneumonia [3]. Bedside assessment of gastric content and volume lowers the risk of pulmonary aspiration in emergency or high-risk patients [12, 13].

Handheld Ultrasound: The 21st-Century Stethoscope

A transformative development is the proliferation of handheld, ultra-portable ultrasound devices. These pocket-sized probes can achieve multiple transducers and offer cloud-sharing and teleguidance capabilities, making bedside ultrasound accessible to all physicians[15]. The ACEP 2023 guidelines acknowledge that wireless transducers, handheld systems, and app-based imaging connected via smart devices even in cell phone are expanding the availability of ultrasound to new clinical settings[3]. However, concerns regarding operator qualifications, device security, cloud storage, data ownership, disinfection protocols, and patient confidentiality remain important considerations requiring adherence to institutional policies[3,16].

Artificial Intelligence and Machine Learning

The integration of AI and machine learning into USG technology represents the next frontier. AI-driven tools can now automatically measure left ventricular ejection fraction (LVEF), inferior vena cava collapsibility index, left ventricular outflow tract velocity time integral (LVOT VTI), and identify B-lines on lung ultrasound with reasonably high diagnostic accuracy [17]. The artificial intelligence (AI) and machine learning (ML) are revolutionizing ultrasound (USG) technology by automating image acquisition, enhancing diagnostic accuracy, and streamlining clinical workflows [23].

Training, Competency, and Standardization

While the benefits of USG are significant, the transition has not been without hurdles. Mastery of ultrasound requires a dedicated learning curve, as "sonoanatomy" differs fundamentally from the interpretation of standard cross-sectional imaging.

Incorporating ultrasound technology especially point of care USG (POCUS) and USG guided regional anaesthesia (UGRA) into the postgraduate anaesthesia curricula is essential. Its transitions from blind and landmark based techniques to real time image guided procedure, drastically reducing complications, lowering the local anaesthetics volume, improving diagnostic accuracy in pain medicine and intensive care patient at bedsides.

The World Federation of Societies of Anaesthesiologists (WFSA) and the European Society of Regional Anaesthesia and Pain Medicine (ESRAPM) strongly endorse a competency-based, simulation-integrated curriculum. The WFSA provides comprehensive educational materials through its Virtual Library, which includes direct-access tutorials on both basic ultrasound physics and ultrasound-guided neuraxial/caudal blocks. The ESRA has also established dedicated assessment frameworks like the European Diploma of Regional Anaesthesia (EDRA) to formalize qualifications across training centers in Europe and in Asia like Division of Pain Medicine and Regional Anaesthesia, Bangladesh Medical University in Bangladesh. They also offer its members exclusive access to structured digital learning programs and Point-of-Care Ultrasound (POCUS) guidelines.

The Path Forward

As technology continues to advance, the convergence of ultra-high-resolution imaging, AI-assisted interpretation, handheld device

miniaturization, and standardized competency-based training promises to further democratize ultrasound and enhance patient safety. The portable ultrasound probe is increasingly recognized as the 21st-century stethoscope, and its integration into perioperative and intensive care practice is no longer optional — it is essential [24].

Gradual addition of diagnostic tools like USG in undergraduate teaching needs to be incorporated. In the postgraduate anaesthesia curricula, we advocate for a structured, competency-based approach to ultrasound-guided (USG) training. Training generally incorporates classroom theory, simulation/phantom or cadaver models, and step by step clinical observation, culminating in supervised practice before independent competency is achieved.

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Original Article

Perfusion Index as a Parameter for Effectiveness of Ultrasound-guided Supraclavicular Brachial Plexus Block

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Abstract:

Background: *Ultrasound-guided (USG) supraclavicular brachial plexus block (SCBPB) in upper extremity surgery is a popular approach. Conventional methods for the evaluation of block success are time-consuming and need the patient's cooperation. The perfusion index (PI) is an oximetry reliability indicator, available on many monitors as a non-invasive parameter, indicating the ratio of arterial blood flow (pulsatile flow) to venous, capillary, and tissue blood flow (non-pulsatile blood flow), which is a more sensitive and earlier indicator of sympathetic blockade than temperature measurement. The main objective of this study is to evaluate the success of the supraclavicular block by using the perfusion index (PI) as a parameter.*

Methods: *This study was carried out between January, 2021 and January, 2022 at Dhaka Medical College in the orthopedics operation theatre. Patients received a total of 20 ml of 0.5% Bupivacaine for ultrasound guided supraclavicular brachial plexus block (SCBPB). Perfusion index was recorded on the index finger before & just after performance of SCBPB, after achieving complete sensory & motor block, after performance of SCBPB and at the time of the end of surgery. Comparison was done between the PI before SCBPB and just after SCBPB, after complete loss of sensory & motor function, and at the time of the end of surgery. Chi-square test was done for qualitative variables, and t-test was done for quantitative variables. A receiver operating characteristic (ROC) curve was used to determine the sensitivity and specificity of PI and to determine the cut-off point.*

Results: *A total of 90 patients were enrolled in the study. Considering PI just after SCBPB, at the time of complete sensory block, at the time of complete motor block, and at the time of the end of surgery with baseline PI, it was found statistically significant as $p<0.05$. While the area under the curve (95%CI) = 0.924(0.9-1.0) of PI at the time of complete motor block was greater than AUC (95%CI) = 0.913(0.9-1.0) of PI at the time of complete sensory block in the ROC curve. Perfusion index at the time of complete motor block has a higher 95.74% sensitivity and 97.3% specificity with 97.8% positive predictive value and 94.7% negative predictive value. Accuracy value 97.6%. And the cutoff value was >5.43. Where PI at the time of complete sensory block has 92.74% sensitivity and 97.56% specificity with 98.3% positive predictive value and 87.5% negative predictive value. Accuracy value 94%. And the cut off value was > 4.23. Mean PI value at the time of complete motor block 6.47±1.42 with percentage (%) change of PI from base line 197.6±18.6% was higher than mean PI value at the time of complete sensory block 5.47±1.12 and percentage (%) change of PI from base line 169.8±16.7%.*

Conclusion: *PI provides a real-time, objective, and continuous display, unlike intermittent, subjective clinical testing. It enables early identification of successful blocks, reducing operating time spent on sensory/motor assessments. So, PI can be used as a parameter of successful SCBPB.*

Keywords: *Brachial plexus block, Perfusion index, Monitoring, Accuracy, Sensitivity, Specificity.*

Citation: *Showrav SA, Mondal SK, Helali AM, Hossain MJ, Hossain MS, Kamal MM. Perfusion Index as a Parameter for Effectiveness of Ultrasound-guided Supraclavicular Brachial Plexus Block. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2).:5-13.*

Introduction:

Brachial plexus block, alone or in combination with general anaesthesia, has become one of the most important anaesthesia techniques for surgeries in the upper limb or shoulder. It provides excellent analgesia and muscle relaxation and considerably decrease the peri and postoperative opioid requirements[1]. In recent times, the use of brachial plexus block has been increasing in developing countries due to the growing expertise and confidence as well as improved access to ultrasound machine and nerve stimulators. The application of ultrasound technique for exact localization of nerves/plexus has revolutionized the regional anaesthesia field where in ultrasound probes with suitable frequencies have been successfully tried[2].

However, a successful peripheral nerves block is usually evaluated by assessment of sensory and motor function. The traditional method of assessing the degree of anaesthesia produced by brachial plexus block is based on the repeated use of a painful stimulus, usually pinprick. If sensation is intact, this may be unpleasant and may rapidly destroy the patient's confidence. Pin prick method is subjective, time consuming, and depends on patient cooperation and cognition[3].

Various objective methods are used for evaluation of block success. These are evaluation of the sympathetic block and consequent physiological changes, such as vasodilation and changes in blood flow and skin temperature. However, most of the objective methods require more time or dependent on sophisticated equipment[4].

The patient's response to pinprick is evaluated to determine whether an effective and successful block is adequate[5]. In traditional methods, evaluation of the loss of sensory responses to stimuli and communication with the patient should be very good. Furthermore, results vary from person to person. Quantitative methods are therefore needed to be able to make more objective evaluations. These quantitative methods evaluate local vasodilatation, increase blood flow and increase skin temperature as a result of sympathetic nerve blockade in the blocked area after a successful block. Increased blood flow is detected in the area, where the block is provided, by laser Doppler applications. However, the clinical use of this method is remain limited since it is not a cost effective method and application of which is difficult. As an alternative method, the sympathetic block is evaluated by measuring the change of the skin electrical resistance. In terms of clinical use; fast responses cannot be obtained with these methods under intensive operating room conditions and in urgent cases where time is important. Therefore, the perfusion index (PI) used to evaluate the success of peripheral blocks has become popular in recent years[6].

A successful supraclavicular nerve block for limb surgery is associated with vascular dilatation[7]. Perfusion index (PI), which is automatically calculated by pulse oximetry, provides an indication of peripheral perfusion at the sensor site. The Perfusion Index reflects the ratio between pulsatile and non-pulsatile blood flow and is a measure for the level of vascular dilatation. It was also emphasized that hypovolemia can be predicted by PI without a reduction of stroke volume by more than 20%. The increase in perfusion index is a good predictor for block success and can be used as an alternative for sensory or motor function tests[6].

It is affected by changes in intravascular volume, elasticity, and intravascular pulse pressure. Therefore, it corresponds to changes in blood volume and varies in values depending on the distensibility of vascular walls and pulse pressure. The blockade of sympathetic nerve fibers after successful nerve block results vasodilation and increased local blood flow, eventually increasing the PI. Several studies have investigated the utility of the PI for assessing regional anaesthesia success and reported that the PI can be used to determine the success of peripheral nerve blocks[8,9]. The traditional methods (Pin-prick test and Modified Bromage Scale) are subjective, and they depend on patients' cooperation but PI is the objective measurement of the succeccful block. Thus, the aim of this study was to evaluate the usefulness of perfusion index as parameter for determining the success of US-guided supraclavicular block in patients undergoing upper extremity surgery by using PI as parameter.

Methods:

This observational study was carried out in the Department of Anaesthesia, Analgesia, Palliative and Intensive Care in collaboration with the

Orthopaedics & Traumatology Department at Dhaka Medical College Hospital, Dhaka, from January 2021 to January 2022. Prior to the commencement of this study, the research protocol was approved by the Ethical Review Committee [ERC-DMC/ECC/2021/386(R)]. Assuming a 95% confidence interval and a study power of 80%, with anticipating 5% dropout, the total sample size was 90. Adult patients aged 18-60 years with American Society of Anaesthesiologist (ASA) grade I and II scheduled for elective upper limb surgery who required supraclavicular brachial plexus block under ultrasound guidance were included in this study. Patients who have a psychiatric illness, peripheral neuropathy, a history of peripheral vascular disease, morbid obesity (BMIe"40), block failure, and whose PI signal was lost during measurements were excluded from this study.

Study procedure

All the patients were informed about the study objective, procedure, advantage & disadvantages. Then they were examined during the preoperative visit on the day prior to surgery. They were kept nothing per orally for 6 hours before the scheduled time of surgery and were premedicated with intravenous omeprazole (40mg) and midazolam (0.02mg/kg)[10] two hours before surgery.

On arrival in the operating theatre, standard monitors including electrocardiogram, noninvasive blood pressure (NIBP), pulse rate, and pulse oximetry were applied. To avoid the influence of any change in blood flow, the NIBP was measured at the contralateral arm; the temperature in the block room was kept constant (25 °C) to minimize the impact from the environment.

Supraclavicular brachial plexus block was performed by one expert anesthesiologist with extensive prior experience in performing regional anesthesia. Patients were placed in a semi-fowler's position with the head turned to the opposite side of the surgical area. Chlorhexidine gluconate 0.5% + 70% Isopropyl alcohol used for skin sterilization. After skin infiltrate with 2 ml of 1% lidocaine, a high-frequency linear transducer (6–13 MHz; X-porte; SonoSite, Bothell, Washington) was used to identify the brachial plexus in the supraclavicular fossa. A 22-G needle for peripheral nerve blocks (B. Braun Melsungen AG, Germany) was inserted following a lateral to medial direction using the in-plane technique. The needle was advanced to the intersection of the first rib and the subclavian artery (i.e., the corner pocket). After confirming that the aspirations test was negative, 2 ml of prepared solution of 0.5% bupivacaine was injected. Then the needle was reposition in the neural cluster the remaining 18 ml of 0.5% bupivacaine was injected. Total 20 ml of 0.5% bupivacaine was injected.

After the completion of the SCBPB procedure, the degree of sensory and motor blocks assessed just after SCBPB, at the time of achieve complete sensory & complete motor block. The sensory block was evaluated in the distributions of the radial, median, ulnar, and musculocutaneous nerve dermatomes with the pinprick test using a blunt-tip needle with a three-point scale (2 = normal sensation, 1 = loss of sensation to pinpricks, and 0 = loss of sensation to light touch). The motor block was tested according to the distribution of nerves as follows: radial (thumb abduction), median (thumb opposition), ulnar (thumb adduction), and musculocutaneous (elbow flexion) with grading on a three-point scale (2 = no loss of force, 1 = decreased force compared with the contralateral arm, and 0 = incapacity to overcome gravity)[11]. The block onset time was defined as the time from the completion of the injection of the study drug until a sensory score of 0 was reported, which was indicated the complete loss of sensory function in the radial, median, ulnar, and musculocutaneous nerves. Block success was defined as the complete loss of sensory function of the mentioned nerve distribution after completion of the SCBPB.

Block failure was defined by a sensory region involved in the surgery is not completely anesthetized or if there was pain at the surgical site, the block was considered as a failed block and supplemental analgesia or conversion to general anaesthesia was considered as per requirement of the patient and they were excluded from the study. Two patients were excluded considered as a failed block.

Perfusion index assessment

A pulse oximeter (Radical-7®; Masimo Corporation, Irvine, CA, USA) was used to monitor the PI. The machine applied to the index finger of operative hand to measure the PI. The PI record at the

following events of time: before the SCBPB (baseline), just after the SCBPB, at the time of complete sensory block (0 = loss of sensation to light touch), at the time of complete motor block (Modified Bromage scale >3) and at the time of end of surgery. Then the PI were compaired among the different events of time. If the pulse oximeter reading was lost in any patients during that period,they were also excluded from the study. Four patients were excluded considered as lost pulse oximeter reading.

The same surrounding environment was maintain until all parameter measurements were completed and to prevent changes in the PI.

Other data like SpO2, SBP, DBP, MAP and PR were measured before block performance and follow up data were recorded before the SCBPB, after the SCBPB , at the time of complete sensory block, at the time of complete motor block and at the time of end of surgery. All data were collected in separate data form and patients demographic data were collected from hospital record file.

The Primary outcome was to observe relation between perfusion index and the success of ultrasound-guided Supraclavicular Brachial Plexus Block by using the Receiver Operating Characteristic (ROC) curve. The Secondary outcome was to calculate the sensitivity (%) and specificity (%), positive predictive value (%) and negative predictive value (%) of perfusion index for determining the success of ultrasound-guided Supraclavicular Brachial Plexus Block.

Statistical analysis:

Data were statistically described in terms of mean ± standard deviation (±SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables among the study patients were done using Student t- test for independent samples. For comparing categorical data, Chi square (÷2) was performed. ANOVA was used for multiple comparisons among the variable. Receiver operating characteristic (ROC) curve was used to determine the sensitivity and specificity of PI and to determine the cut off point. P values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 25 for Microsoft Windows.

Results:

A total of 90 patients who were scheduled for upper limb surgery under SCBPB were selected for this study. During perioperative period four patient had lost signal from the pulse oximeter and two patient had block failure. So they were exclueded from the study. Then finally data were calculated for 84 patients who were fulfilled both inclusion and exclusion criteria. All the data were compared and expressed with table, graph and diagram (ROC curve).

Table-I: *Demographic characteristics of the patients (n=84)*

Characteristics		Value
Age (years)		34.68±12.76
Height (cm)		158.45±9.65
Weight(Kg)		61.83±6.43
BMI (kg/m^2)		23.74±2.93
Hemoglobin (g %)		12.38±1.57
Gender	Male	47 (57.3%)
	Female	35 (42.7%)
ASA	I	54 (65.9%)
	II	28 (34.1)

Data were expressed as mean±SD and percentage within the parenthesis.

Table I demonstrates the demographic characteristics of the patients. The mean age of the patient was 34.68±12.76 yrs, mean BMI was 23.74±2.93 and Hemoglobin (gm%) was 12.38±1.57. Maximum patient was ASA Class I (65.9%). On consideration of gender most of the patients was male in gender (57.3%).

Considering type of upper limb surgeries among patients such as elbow deformity (4.7%), forearm deformity (3.5%), hand deformity (7.1%), humerus fracture (21.4%), radius fracture (26.2%), ulna fracture (25.0%) and wrist deformity (11.9%). Table II showed the type of upper limb surgeries among the patients.

Table II. *The type of upper limb surgeries among the patients*

Diagnosis	Number of patients	Percent
Elbow fracture	4	4.7%
Forearm fracture	3	3.5%
Hand deformity	6	7.1%
Humerus fracture	18	21.4%
Radius fracture	22	26.2%
Ulna fracture	21	25.0%
Wrist deformity	10	11.9%

Values are expressed as percentage (%) over column in total.

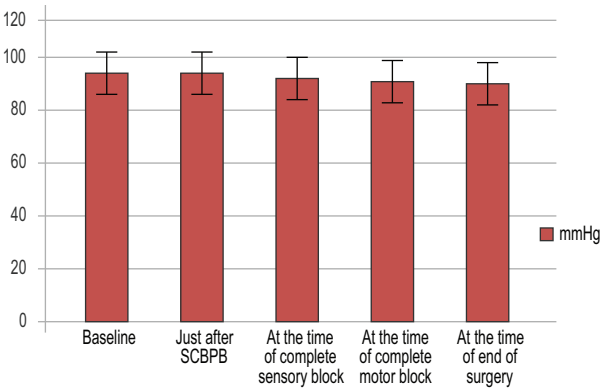

Figure 2: *Mean arterial pressure during perioperative periods among the patients*

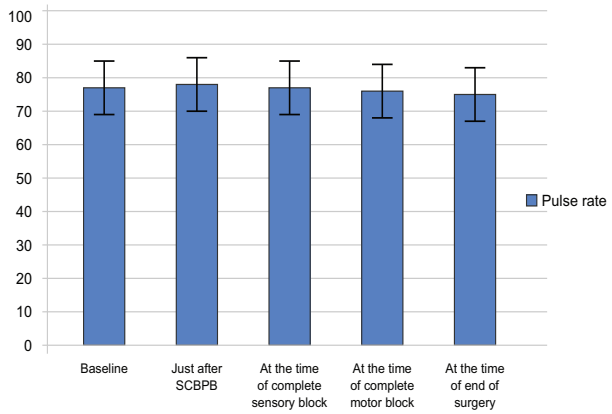

Figure 1: *Mean pulse rate during the perioperative periods among the patients.*

Figure 1 and 2 demonstrates no significant change in pulse rate and mean arterial pressure (MAP) during perioperative periods among the patients.

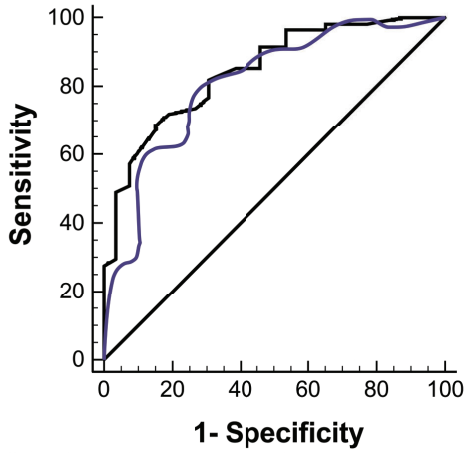

Figure 3: *ROC curve of PI at the time of complete sensory block, at the time of complete motor block. (Blackline- at the time of complete motor block Blue line – at the time of complete sensory block.)*

Table III. *Comparison of perfusion index (PI) values measured at different events*

Points of time	Mean±SD	% change of PI from baseline	p* value
Baseline(Before SCBPB)	3.23±0.75		
Just After SCBPB	4.12±0.96	128.5±7.4	0.0028
At the time of complete sensory block	5.47±1.12	169.8±16.7	0.0023
At the time of complete motor block	6.47±1.42	197.6±18.6	0.0021
At the time of end of surgery	6.12±1.68	186.9±20.5	0.0024

ANOVA was used for multiple comparisons and dependent t-test was used for binary comparisons.

Table III described that there had statistically significant difference in different time of interval while considered PI.

The ROC curve had shown that AUC (95% CI) = 0.913(0.9-1.0) in case of PI at the time of complete sensory block. While AUC (95%CI) =0.924(0.9-1.0) of PI at the time of complete motor block. (Figure 3)

Table IV: *Cross tabulation showing percentage change of perfusion index at the time of complete sensory block (N=84)*

The change of perfusion index at the time of complete sensory block	The perfusion index		P-value
	Change of PI (>50%)(n=55)	Change of PI (<50%)(n=29)	
Cut off value >4.23%	51 (TP)	1 (FP)	<0.05
Cut off value d" 4.23	4 (FN)	28 (TN)	<0.05
Total	55	29	

True positive (TP) =51, False positive (FP) = 1, False negative (FN) = 4, True negative (TN) =28.

From the values of the above table, sensitivity, specificity, positive predictive value and negative predictive value of perfusion index at the time of complete sensory block were 92.74%, 97.56%, 98.3%, and 98.3%, respectively. The accuracy value at the time of complete sensory block was 94%.

Table V: *Cross tabulation showing percentage change of perfusion index at the time of complete motor block (N=84)*

The change of perfusion index at the time of complete motor block	The perfusion index		P-value
	Change of PI (>50%)(n=47)	Change of PI (<50%)(n=29)	
Cut off value >5.43	45 (TP)	1 (FP)	<0.05
Cut off value d"5.43	2 (FN)	36 (TN)	<0.05
Total	47	37	

True positive (TP) =45, False positive (FP) = 1, False negative (FN) = 2, True negative (TN) =36.

The sensitivity and specificity of PI at the time of complete motor block are 95.74% and 97.3% respectively. Similarly, the positive predictive value and negative predictive value of perfusion index at the time of complete motor block are 97.8% and 94.7% respectively. The accuracy value at the time of complete motor block was 96.4%.

Perfusion index at the time of complete sensory block has 92.74% sensitivity and 97.56% specificity with 98.3% positive predictive value, 87.5% negative predictive value & accuracy value was 94%. Where the cutoff value was >4.23. But the PI at the time of complete motor block has higher 95.74% sensitivity and 97.3% specificity with 97.8% positive predictive value 94.7% negative predictive value & accuracy value was 96.4%. Where the cutoff value was >5.43. (table VI)

Table VI: Ability of PI at the various point of time to predict block success.

Parameter	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy value %	AUROC (95%CI)	Cut-off Value
PI At the time of complete sensory block	92.74%	97.56%	98.3%	87.5%	94%	0.913(0.9-1.0)	>4.23
PI At the time of complete motor block	95.74%	97.3%	97.8%	94.7%	97.6%	0.924(0.9-1.0)	>5.43

AUROC=area under the receiver operating characteristic curve; CI= confidence interval; PI=perfusion index

Discussion

A successful peripheral nerve block (PNB) results in the blockade of sympathetic nerve fibers cause some physiological changes. These changes can be measured by some conventional methods & some modern methods. Among them, perfusion index (PI) has been studied more commonly in the last two decades as it is simple, rapid, noninvasive, and easy to measure and interpret. The role of PI in predicting the success of various peripheral nerves block, as a parameter for fluid responsiveness and early detection of blood loss and post spinal hypotension has been evaluated in literature[12,13,14].

The results of the current study shown that PI is a good predictors of successful SCBPB. After administration of LA drug patients with SCBPB blocks had showed increase in PI values suggesting that increase in PI values is associated with sympathetic blockade. Here calculated cut off value of PI 4.23 at the time of complete sensory block and cut-off value of PI 5.43 at the time of complete motor block. However, the ROC curve had showed that AUC (95%CL) = 0.913(0.9-1.0) in case of PI at the time of complete sensory block, while AUC (95%CI) =0.924(0.9-1.0) in case of PI at the time of complete motor block.

Similarly, the positive predictive value (PPV) of 98.3% for PI at the time of complete sensory block and PPV of 97.8% at the time of complete motor block indicate that almost all predicted number of successful blocks actually turned out to be successful. While negative predictive value (NPV) 87.5% for PI at the time of complete sensory block and NPV 94.7% for PI at the time of complete motor block. These indicate that the predicted number of successful blocks actually a good options for prediction of block success. This means that PI is very accurate in assessing efficacy of ultrasound guided supraclavicular brachial plexus block. Finally, the outcome value of PI at the time of complete sensory block was 92.74% sensitivity and 97.56% specificity, where PI at the time of complete motor block was higher 95.74% sensitivity and 97.3% specificity. Accuracy value at the time of complete sensory block was 94% & accuracy value at the time of complete motor block was 96.4%. So, PI is an acceptable parameter of assessing efficacy of ultrasound guided supraclavicular brachial plexus block. This is because the value of sensitivity indicate that all the successful blocks were correctly identified as successful and a value of specificity indicate that none of the successful blocks were incorrectly identified as unsuccessful. Similar results were presented by Abdelnasser et al., (2017)[15] who also tested the use of PI to predict and provide a cut-off value for ultrasound-guided supraclavicular brachial plexus nerve block success and reported higher PI in the blocked limb at all three-time intervals when compared with the unblocked limb. Further, after injection, the PI at 10 minutes showed a sensitivity and specificity of 100% for block success at cut-off values of 3.3 and 1.4, respectively as was registered in the present research. This similarity in the cut-off value between the two studies despite the methodological differences in the site (supraclavicular nerve block vs axillary and sciatic nerve block) technique (ultrasound vs nerve stimulator), and drug (bupivacaine and lidocaine vs mepivacaine) would be a clue to reach a definitive cut-off value[6].

Candan et al. (2018)[16] used 1 mg/kg 0.5% bupivacaine + 5mg/kg 2% prilocaine and 0.09 % NaCl to complete it to 45 ml in their study about infraclavicular block. The results of the study showed a 132% increase in perfusion index when the 5th minute PI value compared to baseline PI value. As a result, the PI in the infraclavicular block was defined as a sensitive test that predicts block success more quickly than traditional methods. In our study we have also found 169% increase in the ratio of PI values at the end of sensory block to base line PI values. We have used the same local anesthetics but in lower volumes. Higher volumes of local anesthetics used in the supraclavicular block can cause Horner syndrome[16].

In other studies using PI, Galvin,et al. (2006)[6] used 1.5% mepivacaine and found 155% increase in PI at the 10th minute of axillary block and at the 12th minute of the sciatic block. Kuº et al. (2013)[17] found an increase of 120% in PI at the 10th minute of infraclavicular block using 20 ml of levobupivacaine + 10ml lidocaine. Yamazaki et al. (2012)[18] found that an increase of 61.4% in PI in the 5th minute of stellate ganglion block with 6 ml 1% mepivacaine was sufficient for block success. The reasons of difference between our

study & this study are the type of drug, volume of drug, the approach of the procedure, duration of time.

In our study Mean±SD PI value at base line was 3.23±0.75, just after SCBPB was 4.12±0.96, at the time of complete sensory block was 5.47±1.12, at the time of complete motor block was 6.47±1.42, and at the end of surgery was 6.12±1.68. PI value was increased significantly at different events of time & SCBPB was adequate to perform surgery when PI was 6.47±1.42 as at that time, complete sensory & motor block was achieved.

Percentage (%) change of PI from baseline just after SCBPB was 128.5±7.4%, at the time of complete sensory block was 169.8±16.7%, at the time of complete motor block was 197.6±18.6%, and at the time of the end of surgery was 186.9±20.5%. This indicates that 186.9±20.5 % change of PI from baseline to perform surgery with adequate SCBPB, as at that time complete sensory & motor block was achieved.

Detection of block success is usually performed using traditional assessment of sensory and motor function. Traditional methods are usually time-consuming. Traditional methods need patient cooperation, so they are not applicable while the patient is under general anaesthesia. Previous studies showed other objective methods for the detection of successful block; these methods included thermographic temperature measurement, laser doppler perfusion imaging, and skin electrical resistance. The PI is characterized by being simple, rapid, and user-friendly compared with other objective methods for the evaluation of block success. Early and accurate detection of peripheral block success would enable rapid corrective action either by block supplementation or by switching to general anaesthesia; this would save the operating room time and improve patient satisfaction. Objective methods of evaluation of block success would also avoid repeated pin pricking and allow block evaluation in sedated and anaesthetized patients also.

Conclusion:

The Perfusion Index successfully demonstrates its effectiveness in ultrasound-guided Supraclavicular Brachial Plexus Block. This can be used as a parameter for effectiveness in regional blocks.

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Original Article

Dexmedetomidine as an Adjunct to Propofol for Sedation in Patients undergoing Endoscopic Retrograde Cholangiopancreatography

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Abstract

Background: *Endoscopic retrograde cholangiopancreatography (ERCP) often requires moderate sedation to ensure patient comfort and procedural success. Propofol is widely used but may cause hemodynamic instability and respiratory depression at higher doses. Dexmedetomidine, an á2-adrenergic agonist with sedative and analgesic properties, may reduce these adverse effects when used as an adjunct. This study evaluated the effectiveness of dexmedetomidine in combination with propofol for moderate sedation during ERCP.*

Methods: *This prospective study was carried out at Dhaka Medical College Hospital between March 2019 and July 2022. Thirty patients (ASA I–III) were included. Each patient received Dexmedetomidine (1 ìg/kg over 10 minutes), followed by propofol as needed to maintain an RSS of 4. Throughout the procedure, we monitored depth of sedation, hemodynamics, oxygen saturation, pain scores, total propofol and opioid use, and recovery time.*

Results: *The mean onset of sedation was 4.25 ± 1.45 minutes. RSS values remained stable throughout the procedure. Dexmedetomidine was associated with a moderate reduction in heart rate but without clinically significant hypotension or oxygen desaturation. The lowest SpO, observed was 97.5 ± 1.9%. Analgesic requirements were minimal, with F-PRS remaining low except at 25 minutes. Total propofol (75.5 ± 6.2 mg) and opioid consumption (52.5 ± 6.7 µg) were reduced. Recovery was rapid, with a mean time of 5.65 ± 1.45 minutes.*

Conclusion: *Dexmedetomidine as an adjunct to propofol provides effective, stable moderate sedation during ERCP, offering hemodynamic stability, reduced sedative and opioid requirements, minimal respiratory compromise, and faster recovery. Its use may enhance both patient safety and procedural efficiency.*

Key Words*: Conscious sedation, Dexmedetomidine, ERCP.*

Citation: *Boby N, Miah MAK, Akter S, Sarkar MAA, Akter A, Begum H. Dexmedetomidine as An Adjunct to Propofol for Sedation in Patients Undergoing Endoscopic Retrograde Cholangio-Pancreatography. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2):14-20.*

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is now a primary diagnostic and therapeutic option for pancreaticobiliary pathologies.[1] Patients undergoing ERCP are often in poor health and may experience with pain, anxiety, and nausea if not adequately sedated.[2] ERCP procedure involving papillotomy, sphincterotomy, dilatation of ampulla of Vater, stent removal needed for moderate sedation.[3] There are many challenges during moderate sedation for ERCP in endoscopy unit; as remote location, less familiar area, semi prone

position, lengthy procedure and shared airway.[4]

Moderate or conscious sedation there is purposeful response to verbal or tactile stimulation, usually no airway intervention required, spontaneous ventilation and cardiovascular function is maintained. But in general anaesthesia needed longer preparation time, induction, intubation and reversal which leads to more duration and cost in this procedure.[5] To improve patient clinical outcome, increasing patient satisfaction, moderate sedation uses as an alternative to general anaesthesia in gastrointestinal endoscopy procedure.[6,7]

A number of agents are available for moderate sedation during endoscopic procedures, including benzodiazepines, opioids, propofol, and dexmedetomidine.[8,9] Propofol is most commonly used in day-case procedures due to its rapid onset and short half-life, allowing patients regain normal mental activities shortly after intravenous administration. However, high dose propofol can lead to serious adverse effects such as hypotension and hypoxia, which are common during gastrointestinal endoscopy.[10] Prolonged hypoxia is a significant concern as it can lead to cardiac arrhythmia and coronary ischemia. Additionally, propofol's analgesic effects are insufficient to manage visceral traction pain.[11]

Dexmedetomidine (DEX) is a potent, highly selective á2-adrenergic receptor agonist. It has the properties of sedation, analgesia, anxiolysis, and sympathetic tone inhibition.[12,13] Dexmedetomidine has recently gained popularity in gastrointestinal endoscopic procedures due to its superiority over conventional sedatives, including cooperative or semi-rousable sedation, minimal respiratory depression at high doses, and also maintaining hemodynamic stability.[14,15,16]

Mukhopadhyay et al. found dexmedetomidine could reduce propofol requirement and provide a more stable level of sedation during ERCP procedure.[17] However, it was proved that dexmedetomidine infusion alone was not as effective as propofol on sedation quality and was associated with significantly low blood pressure and heart rate and prolonged recovery time.[18,19] Hence, various agent used as adjunct such midazolam, fentanyl, remifentanil, dexmedetomidine etc. to reduce total propofol requirement and consequently its adverse effects also increasing level of analgesia.

So, in this study we aim to investigate the efficacy of dexmedetomidine as an adjunct drug to propofol for moderate sedation during ERCP procedures. We evaluate its effects on hemodynamics, respiratory effects also onset of sedation and recovery time.

Methodology

This is a prospective study, carried out in the department of Anesthesia, Pain, Palliative and Intensive care medicine, Dhaka Medical College Hospital, Dhaka in the period of March 2019 to July 2022. A total 30 patients of ASA class I, II and III undergoing ERCP had participated according to inclusion criteria. Patients with known hypersensitivity to study drugs, difficulty in communication, uncontrolled comorbidity, long term opioid use or alcohol use and patients whom converted to general anaesthesia were excluded from the study. Purposive sampling technique was followed. Patients had received dexmedetomidine 1ìg/kg intravenous (IV) bolus in 10 min. After that propofol 1mg/kg bolus dose was given, then intermittently 20mg IV given to achieve Ramsay sedation score-4. Depth of sedation, hemodynamics, SpO, , pain during procedure, recovery time, total requirement of propofol and analgesics were observed and noted. Statistical analyses of the results were obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24), where required.

Results

Table 1: Distribution of the patients according to the demographic characteristics

Characteristics	Value
Age (years)	55.4±4.2
Weight (kg)	54.6±5.4
ASA status, (n)	
Class I	11(36.7%)
Class II	19(63.3%)
Gender, (n)	
Male	12(40%)
Female	18(60%)
Duration of procedure (min)	27.8±4.9

Values are presented as mean ± SD for continuous variables and n (%) for categorical variables.

On the basis of demographic characteristics of the patients, the mean age of patients 55.4±4.2 years. Maximum patients were ASA Class II and most of the patients had female gender. Average duration of procedure was 27.8±4.9 minutes.

Table II: Assessment of onset of sedation time by RSS score.

Variables	Mean ± SD
Onset of sedation time (RSS>4)(min)	4.25±1.45

Values are expressed as Mean ± SD.

On assessment of onset of sedation time by RSS score, mean onset of sedation adjunct with dexmedetomidine was 4.25±1.45min.

Table-III: Assessment of periprocedural RSS scores

RSS (Score)	Mean ± SD
Beginning of ERCP	4.15±0.8
5min	4.1±0.7
10min	4.2±0.5
15min	4.1±0.6
20min	4.3±0.5
25min	4.15±0.6
30min	4.10±0.4
35min	3.8±0.8
40min	3.5±0.8

Values are expressed as Mean ± SD.

The RSS scores were higher at those point of time where the patients deeply sedated. Mean sedation scores ranged from 3.5±0.8 to 4.3±0.5. RSS score was increased after giving rescue sedative at 10min and 20min.

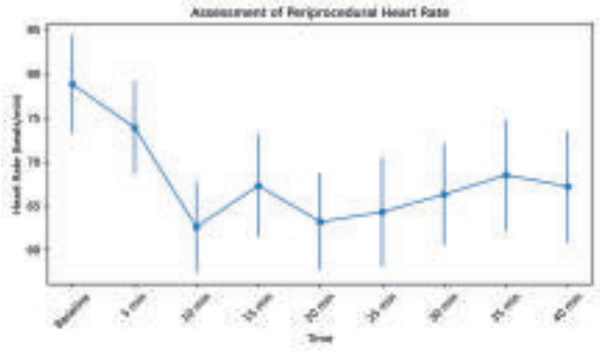

Figure 1: Assessment of periprocedural heart rate

In respect to heart rate, patients had gradually decrease in heart rate from the baseline. At baseline heart rate of the patients was 78.8±5.6, after 10 mins it was the lowest 62.6±5, also at the point time 20min heart rate was 63.2±5.5.

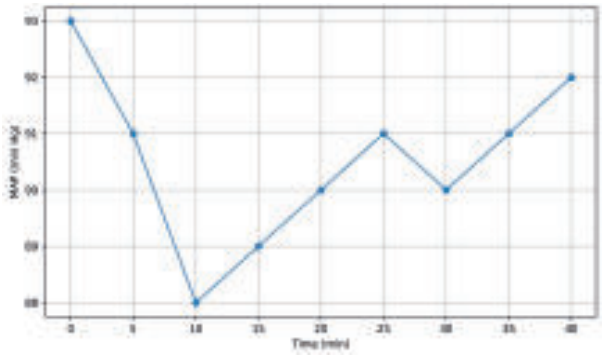

Figure 2: *Assessment of periprocedural MAP*

MAP remained relatively stable throughout the procedure, ranging from 88 ± 2.1 to 93 ± 2.3mm of Hg.

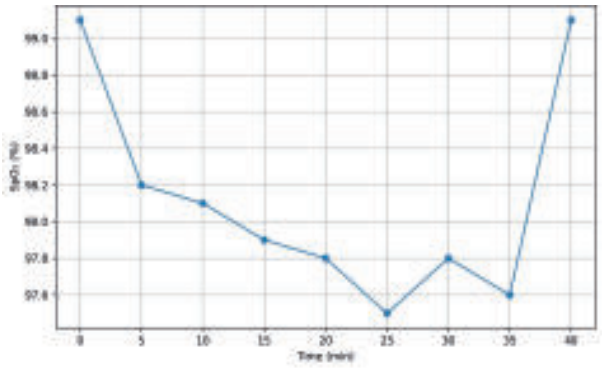

Figure 3: *Assessment of periprocedural SpO,*

Oxygen saturation remained within acceptable limits during the procedure. The lowest mean SpO, was 97.5 ± 1.9 at 25 minutes.

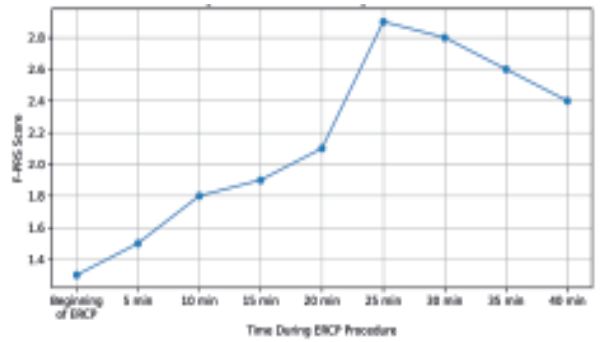

Figure 4: Assessment of periprocedural F-PRS score

Mean F-PRS score remained low throughout the procedure, ranging from 1.3 ± 0.2 to 2.9 ± 0.6, indicating minimal pain and minimal requirement of additional analgesia.

Table IV: *Assessment of total propofol consumption and total opioid consumption during ERCP*

Variables	Mean ± SD.
Total propofol consumption (mg)	75.5 ± 6.2
Total opioid consumption (ìg)	52.5 ± 6.7

Table V: Assessment of recovery time by Modified Aldrete's Score

Variables	Mean ± SD.
Recovery time ((Modified Aldrete's Score>9) (min)	5.65±1.45

After observing recovery time, mean recovery time after ERCP procedure was earlier estimated with Modified Aldrete's Score>9.

Discussion

This study was conducted in Department of Anaesthesia, Pain, Palliative and Intensive care Medicine, Dhaka Medical College and Hospital to assess the effectiveness of Dexmedetomidine as adjunct for sedation in patient undergoing ERCP.

In this study, onset of sedation in adjunct with dexmedetomidine was early and level of sedation (RSS) was more stable. RSS score did not frequently fall below level 4.

In a study by Pushkarna et al, patients had rapid onset of sedation in midazolam group but did not achieve the adequate depth of sedation as compared to dexmedetomidine group [20]. Probable cause may be method of administration IV bolus versus infusion.

In this study, it was observed that patient had comparatively lower HR throughout the procedure. After assessment of mean arterial pressure (MAP) during ERCP period, there had been no statistically significant difference in all over the point time. Dexmedetomidine causes activation of postsynaptic alpha 2 receptors leads to sympatholysis and results in hypotension and bradycardia.[21]

Muller et al, concluded that dexmedetomidine associated with higher hemodynamic instability.[22] This finding is different from our study. This difference may be due to high doses of dexmedetomidine, which was used solely during the entire procedure.

In other study, dexmedetomidine compared with midazolam and found that statistically significant lower heart rates in dexmedetomidine group compared with midazolam group. MAP was comparatively stable in dexmedetomidine group.[23,24]

In this study, on consideration of SpO, of the patients during ERCP period there had no statistically significant change of SpO, .

In a study by Sethi et al, there was also no statistically significant decrease in SpO, during the procedure when comparable in between two groups.[25] This study has concordance to our study result. Other study by Emad Salem et al, used dexmedetomidine during sedation of obstructive sleep apnea patients for upper gastro endoscopic procedures and concluded that dexmedetomidine can reduce the incidence of respiratory depression.[26]

In this study, after observing F-PRS throughout the procedure statistically significant difference was found at 20 min time of interval. Mean value of F-PRS was very low with dexmedetomidine, and the patients seldom need additional analgesia. Dexmedetomidine binds with alpha 2 receptors at dorsal horn of spinal cord and seems to employ analgesic effect.[27]

Another study found dexmedetomidine showed better F-PRS score. At 15 min of procedure, both groups that was dexmedetomidine and midazolam had similar F-PRS.[25]

In this study, total propofol requirement was less during the procedure. A synergistic effect was seen when these sedative drugs were used in combination with propofol. Mukhopadhyay et al, evaluated the efficacy of a dexmedetomidine as an add-on for prolonged deep sedation for ERCP and to compare three deep sedation regimens regarding safety and efficacy.[17] They concluded that the sedative and analgesic cocktail was superior to the conventional propofol-midazolam regimen, dexmedetomidine as add-on increased the

efficacy and safety of sedato-analgesic effect. It reduces propofol requirement, helps to maintain the patient a safe and stable level of sedation. Similar observation also found another study.[28]

In this study, observed that recovery time which was assessed by Modified Aldrete Score was faster adjunct with dexmedetomidine that was 5.65±1.45 min after ERCP procedure. Midazolam when used with propofol provide faster onset of sedation but did not produce quality sedation. So, need more incremental sedative and analgesic to maintain expected level of sedation, thus leads to prolong recovery time. The characteristic arousable sedation action of dexmedetomidine can be explained by its action on alpha 2 adrenoceptors in locus ceruleus in the brain stem.[20]

Similar observation also found by Tomer et al.[29] But another study showed recovery times between dexmedetomidine and midazolam were very similar[30]. The reason for this might be their duration of procedure relatively short compared to our study.

This study highlights that dexmedetomidine had a stable level of sedation, less chance of desaturation and rapid recovery time in patient undergoing ERCP. On the other hand, our study also suggests that adjunctive use of dexmedetomidine reduces propofol and fentanyl requirements and increase surgeon's satisfaction during ERCP.

Conclusion

This study supports the growing evidence that combining dexmedetomidine with propofol enhances the quality of moderate sedation for ERCP, improves patient stability, and may increase procedural efficiency. Larger randomized studies would help validate these findings and further define the optimal dosing strategy, but the present results reinforce the role of dexmedetomidine as an effective adjunct in gastrointestinal endoscopic sedation.

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Original Article

Attenuation of Extubation Reflexes with Lignocaine and Propofol following Laparoscopic Cholecystectomy – A Quasi-experimental Study

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Abstract

Background: *The purposeful removal of the endotracheal tube (Tracheal extubation) from the trachea, can be associated with detrimental airway and haemodynamic responses like an increase in coughing, bronchospasm, laryngospasm, heart rate, blood pressure, intracranial pressure, intraocular pressure and so on. Different extubation techniques and medications have been attempted for attenuation of the airway and cardiovascular responses. Propofol and Lignocaine are widely available drugs in resource-limited settings and can be used to attenuate these responses and its complications. The objective of this study was to evaluate the effects of propofol and lignocaine in attenuating the extubation reflexes in patients undergoing laparoscopic cholecystectomy.*

Methods: *This quasi-experimental study was carried out between March 2021 and April 2022 at Dhaka Medical College and Hospital. All enrolled participants were randomly allocated into three groups: Normal saline (Group A), Lignocaine 1mg/kg (Group B) and Propofol 0.5mg/kg (Group C). These medications were administered 2 min before extubation. Airway responses like (coughing, bucking, and laryngospasm), respiratory rate, oxygen saturation, and haemodynamic parameters (HR, SBP, DBP, and MAP) were recorded at different time intervals.*

Results: *A total of 90 patients belonging to ASA I and II of either sexes (30 patients in each group) were included in this study. Demographic status and clinical characteristics of the patient were comparable among groups, with p-values > 0.05. After extubation, heart rate, systolic, diastolic, and mean arterial blood pressure were decreased significantly in propofol (Group C) and lignocaine (Group B) up to 15 min. A significant statistical difference was observed among the three groups in case of developing cough (p-values = 0.002). Group C (propofol) showed a significant result in comparison with group B (lignocaine) (p-value = 0.001). There was no statistically significant difference found in case of SpO_2 and respiratory rate among the groups and between the groups. (p-value > 0.05)*

Conclusions: *Propofol is more effective than lignocaine in attenuating extubation reflexes. Propofol also reduces the incidence of post extubation airway complications.*

Key Words: *Extubation reflexes, Lignocaine, Propofol, Laparoscopic cholecystectomy.*

Citation: *Ali MS, Khan AKMN, Ahmed MI, Chhanda CS, Helali AM, Hossain MJ. Attenuation of Extubation Reflexes with Lignocaine and Propofol Following Laparoscopic Cholecystectomy – A Quasi-Experimental Study. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2):21-30.*

Introduction:

Tracheal extubation is a high-risk phase of anaesthesia. The majority of problems that occur during extubation and emergence are of a minor in nature, nut a small and significant number may result in injury or death.[1]

The problems associated with extubation may be broadly categorised into cardiovascular and respiratory complications. Respiratory complications include coughing, breath-holding, masseter-spasm, airway obstruction, laryngospasm, desaturation and aspiration. Cardiovascular complications include tachycardia and hypertensive episodes.[2] Although most patients can tolerate these transient effects without any significant consequences, but it is more hazardous in a patient with hypertension, myocardial insufficiency or cerebral vascular disease and is associated to increased incidence of cerebral haemorrhage, myocardial ischemia and pulmonary oedema.[3] Even these could be more detrimental in patients operated for cardiac, neurological or ophthalmic lesions.[4] Laparoscopic cholecystectomy is known as one of the most common laparoscopic surgeries worldwide. Carbon dioxide (CO_2) is used for pneumoperitoneum, which may result in the adverse cardiovascular effects. They mainly include an abrupt elevation of mean arterial pressure, systemic vascular resistance and decreased cardiac output because of the release of both catecholamines and vasopressin.[5]

Several techniques, as well as drugs, have been used to attenuate these responses during tracheal extubation. Techniques like extubation in a deeper plane of anaesthesia, substitution of the Endotracheal Tube with a laryngeal mask airway in deep plane and drugs like low dose propofol, â1 blockers like esmolol, landiolol, combined á â blocker like labetalol, Ca2+ channel blockers like diltiazem, verapamil, intravenous lignocaine, lignocaine spray, intracuff lignocaine, low dose intravenous opioids like fentanyl, remifentanil, alfentanil, sufentanil, central sympatholytics like clonidine, dexmedetomidine, vasodilators like nitrates, prostaglandins and MgSO4 have been studied as sole agent or in combination to control haemodynamic changes and upper airway tract events with different success.[4,6]

Dexmedetomidine and Fentanyl are associated with bradycardia, emesis and shivering.[7] Alkaya et al. (2014)[8] found that esmolol infusion before extubation can prevent hypertension and tachycardia caused by extubation in patients undergoing elective craniotomy. In another study, larger dose of esmolol of 2mg/kg significantly decreases in systolic blood pressure[9] and it is found that extubation time is prolonged in the patients taking alfentanyl.[10] Clonidine causes bradycardia in significant number of people undergoing extubation.[11] Magnesium sulfate can reduce blood pressure, but with the increase in extubation time for laparoscopic cholecystectomy.[5] Thus each of them has their own merits and demerits respectively.

The use of propofol is safe and effective, and there are no significant adverse reactions during anaesthesia and extubation.[12] Propofol is known as a potent inhibitor of airway reflexes in hypnotic concentration and even subhypnotic doses prevent laryngospasm on extubation in children[13]. Subhypnotic doses of propofol (0.25mg/kg) have been used for the treatment of postextubation laryngospasm and have proven effective.[14] Propofol in a small dose (0.8 mg/kg) was a useful drug to relieve laryngospasm in most children following the removal of the LMA.[15] Intavenous propofol 0.5mg/kg attenuates haemodynamic responses to extubation immediately and satisfactorily.[16]

On the other hand, Lignocaine, an amide local anesthetic agent can decrease heart rate, blood pressure and cough reflex induced during endotracheal extubation by its mechanisms of direct myocardial depressant effect, peripheral vasodilator effect, interruption of cholinergic synaptic transmission, and suppression of the cough reflex.[17]

A number of studies have evaluated the efficacy of both the drugs, either independently or in comparison to other drugs. But there is limited studies comparing between lignocaine and propofol to attenuate extubation reflexes during emergence in surgical patients. This study has planned to compare the effects of lignocaine and propofol to extubation reflexes following laparoscopic cholecystectomy.

Methods:

This quasi-experimental study was conducted in the Department of Anaesthesia, Pain, Palliative & Intensive Care Medicine, Dhaka Medical College Hospital, Dhaka, from March 2021 to April 2022. The adult patient with ASA I or II and Mallampati score I or II who required elective laparoscopic cholecystectomy under general anaesthesia was included in the study population. Patients with history of allergy to any of the study drugs, patients with arrhythmia, heart failure, ischemic heart disease, heart block and taking antiarrhythmic or steroid therapy, patients with impaired liver function, renal function, dementia or psychiatric disorder, bronchial asthma, chronic obstructive pulmonary disease, and BMI >40 kg/m^2 were excluded from this study. Patients were allocated into Group A, Group B, and Group C. Each group received the following drugs 2 minutes before extubation: Group A (control) received 10 ml 0.9% saline, Group B received intravenous Lignocaine 1 mg/kg diluted in 10 ml and Group C received intravenous Propofol 0.5 mg/kg diluted in 10 ml.

Study procedure:

With approval of the Ethical Review Committee of Dhaka Medical College (ERC-DMC/ECC/2021/280), this quasi-experimental study was carried out in 90 adult patients belonging to ASA I or II scheduled for elective laparoscopic cholecystectomy surgery under general anaesthesia with Mallampati class I and II.

During pre-anesthetic visit, the patients were selected on the basis of inclusion & exclusion criteria, explained about the study purpose, advantages and risks of procedure and informed written consent was obtained. History taking focusing clinical features, disease duration along with physical examination was done as per standard protocol. Patients were kept nil per mouth at least for six hours before surgery and premedicated with Tab. Midazolam (7.5mg) orally at bed time day before surgery.

On arrival to the operating room, an 18 gauge IV cannula was inserted in a peripheral vein in non-dominant forearm. Multi-parameter monitor was attached. Electrocardiography (ECG), peripheral oxygen saturation (SPO2), systolic (SBP), diastolic (DBP) and mean (MAP) arterial pressure monitoring were recorded as baseline values and noted for each patient. For induction, 2 ìg kg"1 fentanyl and 5mg kg"1 thiopental sodium were used. 1.5mg kg"1 suxamethonium was used for muscle relaxation to facilitate intubation. Two minutes after induction agents, all the patients were intubated by the oral route. Isoflurane at 0.6-0.8% end-tidal concentration in 50% O2/N2O was used for anaesthesia maintenance and vecuronium incremental was used for maintaining muscle relaxation. The concentration of isoflurane was increased or decreased during surgery to maintain BP and HR between 80% and 120% of the baseline values. When the per operative SBP exceeded 20% of the baseline value, the dose of isoflurane increased up to maximum of 1.2% end-tidal concentration and if an adequate decrease cannot be obtained, then 50-100 ìg nitroglycerin was administered. Hypotension (a decrease in SBP >20% from baseline or an SBP <90 mm Hg) was controlled by increasing the fluid infusion rate and decreasing isoflurane concentrations by 0.2% intervals down to a minimum 0.4%. If the MAP lower than 60 mmHg, 5 mg inj. ephedrine was given. If the HR will lower than 50 beats min"1 then 0.5 mg atropine was given.

The vecuronium incremental injection was stopped approximately 30 min before the end of the operation. Isoflurane concentration was reduced by 50% when there will 5 min left to the end of the procedure. At the very last suture of the surgery, the isoflurane and N2O were stopped completely. Patients were planned for extubation by clinical judgement (when patient was awake, obeyed command and head raised for at least 5 seconds) as our institution had no facility for neuromuscular and depth of anaesthesia monitoring.

In Group A, 10 ml 0.9% saline was given intravenously over 60s; in Group B, 1mg/kg lignocaine diluted in 10 ml was given intravenously over 60s; in Group-C received injection propofol 0.5 mg/kg diluted in 10 ml was given intravenously over 60s before 2 min of extubation. One min after administering the drugs respective of the groups, the endotracheal secretion was aspirated, reversal drugs were given and then extubated.

The patients were given 100% O2 inhalation through masks for 10 minutes following extubation. SBP, DBP, MAP, HR, SPO2 and RR were recorded just before anaesthesia as baseline, 1 min before

extubation and at 1, 3, 5, 10 and 15 min after extubation. Numbers of the patients developed the airway reflex (cough, bucking and laryngospasm) during this extubational and recovery period were recorded.

Statistical analysis:

Every patient's data was collected and recorded on a separate data sheet. Data analysis was performed by mean ± standard deviation (±SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was performed using student's t- test for independent samples. For comparing categorical data, Chi-square (X 2) was performed. Inter group analysis was done by ANOVA. $p < 0.05$ was considered statistically significant. All statistical calculations was done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc.,Chicago, IL, USA) version 26 for Microsoft Windows.

Results

This quasi-experimental study was carried out during 1st March 2021 to 30 April 2022 in the tertiary-level hospital (DMCH) in Dhaka city. A total of 90 patients were enrolled in this study by inclusion and exclusion criteria & they were randomly divided into three groups (group A, B and C); 30 patients in each group and no patient was excluded. Data like demographic variables (Age, height, weight, BMI, ASA status I or II, Mallampati score I or II) and Outcome variables (Coughing, Bucking, Laryngospasm, SpO2, RR, HR, SBP, DBP, MAP) were collected from the patient data collection form. All data were expressed as tables and charts.

There was no statistically significant difference found in case of demographic variables and clinical status. (Table I)

Considering airway reflexes, there were significant statistical difference observed among three groups in case of developing cough (p values was 0.002). Group C showed significant result in comparison with group B (p values was 0.001). In case of bucking the ETT & laryngospasm, no statistical differences were observed. Table II demonstrates the airway reflexes during extubation.

Table I: Distribution of the patients by demographic variables and clinical status (n=90)

Characteristics	Group A (n=30)	Group B (n=30)	Group C (n=30)	P value
Age in years	40.75±9.67	42.65±14.73	41.05±11.19	0.867
Sex				
Male	15(50%)	13(43.3%)	12(40%)	0.730
Female	15(50%)	17(56.7%)	18(60%)	
Height	151.50±39.1	165.85±4.47	164.50±5.59	0.102
Weight	77.50±30.05	71.35±10.5	73.60±6.15	0.579
BMI	25.4±1.77	25.89±3.39	26.88±3.06	0.230
Co-existing disease				
DM	4(13.3%)	0(00)	2(6.7%)	0.294
HTN	8(26.7%)	10(33.3%)	7(23.3%)	
HTN+DM	3(10%)	2(6.7%)	6(20%)	
ASA				
I	17(56.7%)	16(53.3%)	11(36.7%)	0.128
II	13(43.3%)	14(46.7%)	19(63.3%)	
Mallampati score				
Class I	17(56.7%)	20(66.7%)	12(40%)	0.111
Class II	13(43.3%)	10(33.3%)	18(60%)	

A= Control Group, B= Lignocaine Group, C= Propofol Group, n= number of patients. Data were presented as mean±SD and percentage. P value reached from chi square test and student's t test.

Table II: Distribution of patients by airway reflexes and comparison among three groups (n=90)

Variables	Group A	Group B	Group C	P value	Gr A vs B	Gr A vs C	Gr B vs C
Develop cough	14(46.7%)	7(23.3%)	2(6.7%)	0.002[s]	0.013[s]	0.001[s]	0.001[s]
Bucking the ETT	10(33.3%)	11(36.7%)	7(23.3%)	0.510	0.236	0.569	0.394
Develop laryngospasm	2(6.7%)	0(00)	0(00)	0.354	0.297	0.278	-

Data were expressed as percentages. p <0.05 statistically significant, s= statistically significant. ANOVA was performed among three groups.

Table III: Comparison of SpO_2 of the study subject among three groups (n=90)

					Pairwise significance		
SPO_2	Group A	Group B	Group C	P value	Gr A vs B	Gr A vs C	Gr B vs C
Baseline	98.55±1.35	98.10±2.73	97.40±3.42	0.390	0.513	0.171	0.479
Before drug injection	99.90±0.44	100.00±0.00	99.95±0.22	0.552	0.324	0.657	0.324
1 minute before extubation	100.00±0.00	100.00±0.00	100.00±0.00	-	-	-	-
1 minute after extubation	99.70±0.80	100.00±0.00	100.00±0.00	0.069	0.178	0.102	-
3 minutes after extubation	98.65±4.40	100.00±0.00	100.00±0.00	0.162	0.186	0.178	-
5 minutes after extubation	98.65±4.81	100.00±0.00	100.00±0.00	0.216	0.225	0.218	-
10 minutes after extubation	99.90±0.44	99.90±0.44	100.00±0.00	0.609	0.100	0.324	0.324
15 minutes after extubation	99.95±0.22	99.95±0.22	100.00±0.00	0.609	0.100	0.330	0.324

Values are expressed as Mean±SD. ANOVA was performed among three groups.

There was no statistically significant difference found in case of SpO_2 among the groups and between the groups.

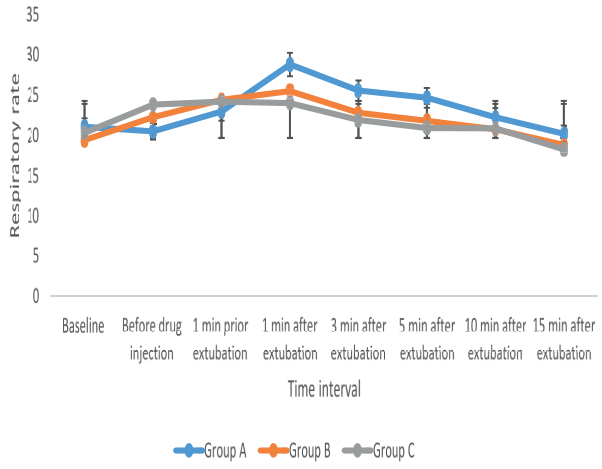

Figure 1: Changes of respiratory rate of the study participants

There was no statistically significant difference found in case of respiratory rate among the groups and between the groups.(Figure 1)

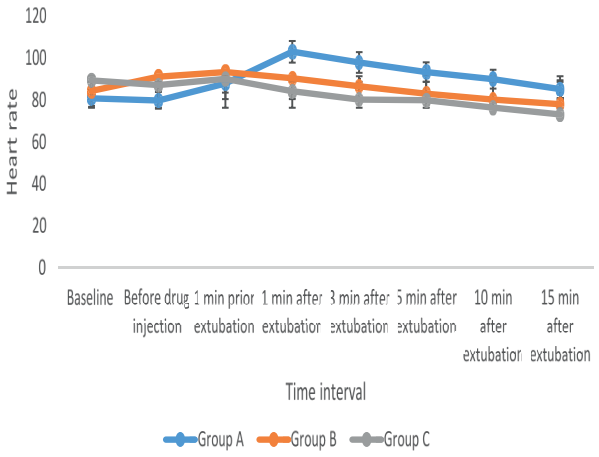

Figure 2: Changes of heart rate of the study participants

Considering heart rate, there were significant statistical difference observed among three groups (p values was 0.001) upto 15 minutes of postextubation period. Group C showed significant result in comparison with group B upto 10 minutes of postextubation period. (Figure 2)

Table IV: Comparison of Systolic blood pressure of the study subject among three groups (n=90)

Systolic	Group A	Group B	Group C	P value	Pairwise significance		
					Gr A vs B	Gr A vs C	Gr B vs C
Baseline	124.70±9.84	123.25±16.11	130.50±13.36	0.201	0.733	0.126	0.130
Before drug injection	123.95±15.52	127.80±21.60	127.60±13.84	0.430	0.495	0.375	0.972
1 minute before extubation	138.10±10.62	128.35±18.95	124.15±10.24	0.308	0.034^s	0.010^s	0.024^s
1 minute after extubation	140.40±11.64	131.30±19.02	122.25±8.65	0.001^s	0.041^s	0.001^s	0.003^s
3 minutes after extubation	134.10±12.99	128.50±19.72	118.90±9.95	0.007^s	0.002^s	0.001^s	0.031^s
5 minutes after extubation	132.05±12.22	125.45±17.64	117.90±10.52	0.008^s	0.012^s	0.001^s	0.029^s
10 minutes after extubation	130.05±12.22	125.45±17.64	117.90±10.52	0.008^s	0.031^s	0.002^s	0.004^s
15 minutes after extubation	126.05±13.85	121.40±17.61	113.10±12.80	0.001^s	0.017^s	0.004^s	0.361

Values are expressed as Mean±SD, p <0.05 statistically significant, s= statistically significant. ANOVA was performed among three groups.

Considering SBP, there were significant statistical difference observed among three groups upto 15 minutes of postextubation period. Group C showed significant result in comparison with group B upto 10 minutes of postextubation period.

Table V: Comparison of Diastolic blood pressure of the study subject among three groups (n=90)

					pairwise significance		
Diastolic	Group A	Group B	Group C	P value	Gr A vs B	Gr A vs C	Gr B vs C
Baseline	76.50±5.36	80.00±9.30	87.15±9.72	0.001^s	0.153	0.001^s	0.023^s
Before drug injection	83.75±3.80	83.30±6.64	87.60±11.32	0.176	0.794	0.158	0.151
1 minute before extubation	88.50±1.19	85.90±6.8	83.95±6.21	0.230	0.377	0.022^s	0.140
1 minute after extubation	88.80±5.61	83.10±19.52	78.65±5.89	0.005^s	0.024^s	0.001^s	0.027^s
3 minutes after extubation	88.80±5.61	82.05±6.26	77.40±5.55	0.001^s	0.044^s	0.001^s	0.018^s
5 minutes after extubation	82.5±5.39	76.95±6.98	71.35±7.08	0.001^s	0.013^s	0.001^s	0.045^s
10 minutes after extubation	80.35±5.39	73.95±6.98	70.35±7.08	0.001^s	0.025^s	0.001^s	0.033^s
15 minutes after extubation	79.70±6.20	75.05±6.81	72.30±7.88	0.006^s	0.030^s	0.002^s	0.246

Values are expressed as Mean±SD, p <0.05 statistically significant, s= statistically significant. ANOVA was performed among three groups.

Considering DBP, there were significant statistical difference observed among three groups upto 15 minutes of postextubation period. Group C showed significant result in comparison with group B upto 10 minutes of postextubation period.

Table VI: Comparison of MAP of the study subject among three groups (n=90)

					pairwise significance		
MAP	Group A	Group B	Group C	P value	Gr A vs B	Gr A vs C	Gr B vs C
Baseline	91.60±5.79	92.25±11.28	98.37±9.38	0.063	0.820	0.012[s]	0.090
Before drug injection	96.10±5.25	96.85±10.40	100.21±11.49	0.358	0.775	0.018[s]	0.344
1 minute before extubation	100.50±5.87	102.25±12.31	96.84±7.04	0.164	0.569	0.167	0.103
1 minute after extubation	104.90±7.05	97.55±11.14	93.68±5.34	0.001[s]	0.017[s]	0.001[s]	0.017[s]
3 minutes after extubation	101.85±7.88	94.00±14.26	90.10±6.16	0.002[s]	0.028[s]	0.001[s]	0.032[s]
5 minutes after extubation	98.60±7.02	89.75±14.43	85.47±12.24	0.050	0.039[s]	0.015[s]	0.021[s]
10 minutes after extubation	96.90±7.90	88.475±9.37	84.18±8.47	0.001[s]	0.048[s]	0.001[s]	0.038[s]
15 minutes after extubation	94.35±8.12	86.35±9.38	84.57±8.69	0.004[s]	0.020[s]	0.001[s]	0.109

Values are expressed as Mean±SD, p <0.05 statistically significant, s= statistically significant. ANOVA was performed among three groups.

Considering MAP, there were significant statistical difference observed among three groups upto 15 minutes of postextubation period. Group C showed significant result in comparison with group B upto 10 minutes of postextubation period.

Discussion

Endotracheal extubation is an unpredictable and difficult part of anaesthetic management. Elevation of blood pressure, heart rate, incidence of coughing, breath-holding, laryngospasm, airway obstruction and aspiration during extubation are brief but may have detrimental effects. Both lignocaine and propofol attenuate the hemodynamic response to tracheal extubation by its direct myocardial depressant effect and peripheral vasodilatory effect, and their suppressive effect of haemodynamic and airway instability is due to the effect on synaptic transmission. There is limited research comparing the effectiveness of both drugs in attenuating extubation reflexes. This study compared the effects of lignocaine and propofol in attenuating extubation reflexes following laparoscopic cholecystectomy.

In our study, the demographic and clinical characteristics (age, sex, marital status, weight, height, Mallampati, ASA score) were comparable among the three groups (p> 0.05).

In this study, post extubation cough reflexes were significantly reduced in propofol compared to lignocaine and control group. Jung, Park and Kim (2014)[18] demonstrated that sub-hypnotic dose (0.3 mg/kg) of propofol decreased the incidence and severity of coughing effectively; which also supports our study result. These findings of our study also correlated with the study by Cheng et al. (2011)[12], who concluded that incidence of cough in post extubation period was significantly lower in propofol (0.5mg/kg) group when compared to urapidil group. Yang et al. (2019)[19] concluded that the preoperative and intraoperative administration of intravenous lignocaine decreased the incidence of cough after extubation. Cliviuo et al. (2018)[20] also showed that within a range of 0.5–2 mg/kg, intravenous lignocaine dose dependently prevents intubation, extubation and opioid-induced cough in adults.

Though there were some supporting evidences that intravenous lignocaine may decrease post extubation cough reflexes, however Jee and Park (2003)[21] observed no difference in incidences of coughing after administration of intravenous lignocaine (1 mg/kg) 3mins before extubation. This discrepancy could be due to variation in time, types of surgery and dosage of drug.

There were no significant differences in post-extubation SpO2 and respiratory rate between the groups, which is consistent with the study conducted by Swamy et al. (2018). In this study, there were statistically significant differences in hemodynamics (HR, SBP, DBP, MAP) between the groups (p < 0.05).

Heart rate was lower in propofol and lignocaine groups at 1, 3, 5, 10 & 15 minutes after extubation

when compared to the control group ($p< 0.05$). Heart rate in propofol group was significantly lower than lignocaine group upto 10 minutes following extubation. In line with our study, Cheng et al. (2011)[12] demonstrated that a reduction in heart rate after extubation for upto 10 minute in patients who received intravenous propofol (0.5 mg/kg). Nagrale, Indurkar & Pardhi (2016)[16] compared the haemodynamic effects of intravenous Propofol 0.5mg/kg, Lignocaine 1mg/kg and Esmolol 1.5mg/kg given two minutes prior to extubation in the patients scheduled for major surgeries. In their study, heart rate decreased ($p<0.05$) immediately in group E (Esmolol) and group P (Propofol) after study drug was given and remained stable at that level upto 10 mins after extubation. It increased significantly in Lignocaine group upto three minutes after extubation and decreased at 5 and 10 minutes after extubation. Another study by Sirajuddin et al. (2021)[22] concluded that hemodynamic values like heart rate was significantly less in Propofol group compared to Lignocaine group in post extubation period. These findings are in agreement with the current study.

In contradiction to our results, Sanikop and Bhatt (2010)[23] showed reduced heart rate after extubation for up to 10 min in patients who received intravenous lignocaine (1.5 mg/kg) when compared with patients who received placebo. Jung, Park and Kim (2014)[18] concluded that patients who received propofol 0.3 mg/kg did not experience a reduction in HR up to 10 min after extubation when compared to their controls ($p >0.05$), The contradiction might be due to dosage difference of study drugs.

Blood pressure measurements (SBP, DBP, and MAP) were lower in propofol (0.5 mg/kg) and lignocaine (1 mg/kg) groups at 1, 3, 5, 10 and 15 minutes after extubation when compared to control group. SBP, DBP and MAP in propofol group were significantly lower than lignocaine group upto 10 minutes following extubation. In line with our study Kumar & Laxminarsaiah (2018)[3] demonstrated that patients who received 0.5 mg/kg of propofol and 1.5 mg/kg of esmolol showed a significant decrease in systolic blood pressure post-extubation upto 10 min in both groups. Moein Vaziri et al. (2013)[24] concluded that propofol 0.5mg/kg given 2 minutes prior extubation reduced SBP, DBP, MAP, HR and cough production upto 5 minutes after extubation compared with placebo group. Savitha and Joylin (2014)[25] showed that fall in HR, SBP, DBP and MAP was statistically significant upto 5 minutes who received intravenous lignocaine 1mg/kg given 2 minutes prior to extubation.

Contrary to our finding, Jung, Park and Kim (2014)[18] showed that HR and MAP increased from discontinuation of anaesthetic drugs to 10 minutes in PACU compared to before induction in both propofol (0.3mg/kg) and placebo group. Sanikop and Bhat (2010)[23] showed significant differences on SBP and DBP after extubation for upto 10 min in patients who received intravenous lignocaine (1.5 mg/kg) when compared to plaebo group. Nagrale, Indurkar & Pardhi (2016)[16] showed that IV lignocaine 1mg/kg given 2 minutes prior to extubation was not effective immediately and attenuation of haemodynamic responses to extubation occurred after 5 minutes postextubation period.

Conclusion

Intravenous propofol is more effective than lignocaine in attenuating extubation reflexes especially incidence of cough, heart rate, systolic, diastolic and mean arterial pressure in patients undergoing laparoscopic cholecystectomy.

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Original Article

Management of Complex Tibial Plateau Fractures Using the Ilizarov External Fixator

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Abstract

Background: *High-energy bicondylar tibial plateau fractures are challenging because of articular comminution, metaphyseal bone loss, and associated soft-tissue compromise. Circular external fixation using the Ilizarov technique provides stable fixation with minimal soft-tissue disruption.*

Methods: *A prospective study was conducted on twenty patients with Schatzker type V and VI tibial plateau fractures treated using the Ilizarov external fixator. Closed or minimally invasive reduction was achieved using ligamentotaxis, followed by frame application. Early knee range-of-motion exercises were initiated, and progressive weight bearing was allowed. Functional outcomes were evaluated using Rasmussen's functional scoring system.*

Results: *Fracture union was achieved in all patients (100%). The mean time to union was 18 weeks (range, 16–20 weeks). According to Rasmussen's criteria, 80% of patients achieved good to excellent functional outcomes. Superficial pin-tract infection was the most common complication; no deep infection, malalignment, implant failure, or nonunion was observed.*

Conclusions: *Ilizarov external fixation is a reliable and effective treatment option for complex tibial plateau fractures, particularly in high-energy injuries with compromised soft tissues.*

Key words: *Tibial plateau fracture, Ilizarov external fixator, Schatzker type V and VI, Ligamentotaxis, Circular external fixation, High-energy fractures*

Citation: *Tareque HM, Mahmud G, Islam MS, Hassan S, Hasan MJ, Samrat MH. Management of Complex Tibial Plateau Fractures Using the Ilizarov External Fixator. Journal of the Bangladesh Society of Anaesthesiologists.2023;36(2):31-33.*

Introduction

Tibial plateau fractures account for approximately 1–2% of all fractures and include a broad spectrum of injury patterns. High-energy fractures, particularly Schatzker type V and VI injuries, are frequently associated with severe comminution,[1] metaphyseal bone loss, and soft-tissue compromise. The goals of treatment include restoration of articular congruity, maintenance of mechanical alignment, stable fixation, and early mobilization to prevent knee stiffness & post-traumatic arthritis[2,3].

Although open reduction and internal fixation (ORIF) has traditionally been advocated, it is associated with a substantial risk of wound complications in high-energy injuries. Circular external fixation using the Ilizarov technique offers stable fixation through ligamentotaxis while preserving the soft-tissue envelope.[3,4]

Materials and Methods

This prospective study included twenty patients with Schatzker type V and VI tibial plateau fractures treated at a tertiary orthopaedic center. Patients with vascular injuries or those requiring flap coverage were excluded.

All patients underwent closed or minimally invasive reduction using ligamentotaxis followed by application of an Ilizarov circular external fixator.[3,4] Early postoperative knee range-of-motion exercises were encouraged. Progressive weight bearing was allowed based on clinical and radiological evidence of fracture union. Patients were followed for a minimum period of six months.

Functional outcomes were assessed using Rasmussen's functional scoring criteria, and radiological union was evaluated with serial radiographs.

Table 1. *Patient Demographics and Injury Characteristics*

Variable		Value
Number of patients		20
Age range (years)		25–65
Mean age (years)		42
Sex (Male : Female)		14 : 6
Side involved (Right : Left)		12 : 8
Mechanism of injury		High-energy trauma (road traffic accidents, fall from height)
Schatzker classification	Type V	9 patients (45%)
	Type VI –	<11 patients (55%)

Associated soft-tissue injury Present in majority of cases

Table II. ***Treatment Protocol***

Parameter	Description
Reduction technique	Closed / minimally invasive reduction
Fixation method	Ilizarov circular external fixator
Principle applied	Ligamentotaxis
Knee mobilization	Early postoperative range-of-motion exercises
Weight bearing	Gradual, guided by radiological union
Minimum follow-up	6 months
Functional assessment	Rasmussen's functional scoring criteria

Results

All fractures achieved radiological union, resulting in a 100% union rate. The mean duration to union was 18 weeks (range, 16–20 weeks). According to Rasmussen's functional scoring system, 9 patients (45%) had excellent outcomes, 7 patients (35%) had good outcomes, and 4 patients (20%) had fair outcomes. Overall, 80% of patients achieved good to excellent functional results.

The most common complication was superficial pin-tract infection, which was managed successfully with local care and oral antibiotics. No cases of deep infection, malalignment, implant failure, or nonunion were observed.

Table III. Radiological and Functional Outcomes

Outcome Measure	Result
Fracture union rate	100%
Mean time to union	18 weeks
Range of union time	16–20 weeks
Rasmussen score – Excellent	9 patients (45%)
Rasmussen score – Good	7 patients (35%)
Rasmussen score – Fair	4 patients (20%)
Good to excellent outcome	80%

Table IV. Complications

Complication	No. of Patients	Percentage
Superficial pin-tract infection	6	30%
Deep infection	0	0%
Malalignment	0	0%
Implant failure	0	0%
Nonunion	0	0%

Discussion

The management of complex tibial plateau fractures remains controversial, particularly in high-energy injuries with compromised soft tissues. The principal finding of the present study is that Ilizarov external fixation resulted in a 100% union rate with satisfactory functional outcomes and a low complication profile.

Open reduction and internal fixation of bicondylar tibial plateau fractures has been associated with a high incidence of wound complications. Young and Barrack reported wound complication rates of up

to 23% following internal fixation of high-energy tibial plateau fractures.[6] Extensive surgical exposure and soft-tissue stripping are major contributing factors to infection and wound breakdown.[6]

In contrast, circular external fixation minimizes soft-tissue disruption and preserves periosteal blood supply. Dendrinos et al. reported reliable fracture union and favorable functional outcomes using the Ilizarov technique for high-energy tibial plateau fractures.[3] Similarly, Catagni et al. emphasized the advantages of ligamentotaxis-based reduction and early mobilization achieved with circular fixation.[4]

The three-column concept of tibial plateau fractures described by Luo et al. has improved understanding of posterior column involvement.[5] The modular nature of the Ilizarov frame allows stabilization of all columns without the need for extensive posterior surgical exposure.

Pin-tract infection was the most common complication in the present study; however, all cases were superficial and resolved with conservative management. Importantly, no deep infections or mechanical failures were encountered.

The limitations of this study include a relatively small sample size and short follow-up duration. Long-term follow-up is required to evaluate the incidence of post-traumatic osteoarthritis and long-term functional outcomes.[1]

Conclusions

Ilizarov external fixation provides a stable, minimally invasive, and biologically friendly solution for the management of complex tibial plateau fractures. It is particularly advantageous in high-energy injuries with significant soft-tissue compromise, allowing early mobilization and achieving satisfactory functional and radiological outcomes.

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Risk Factors for Perineal Wound Infection after Abdominoperineal Excision of Rectum in Rectal Cancer: A Prospective Observational Study

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Abstract

Background: *Perineal wound infection (PWI) remains a frequent and morbid complication following abdominoperineal excision of rectum (APER) for rectal cancer. This study aimed to identify independent risk factors for PWI in a South Asian population.*

Methods: *A prospective observational study was conducted at a tertiary cancer center in Bangladesh between January 2021 and March 2022. Forty-one patients with histologically confirmed rectal adenocarcinoma undergoing elective APER were enrolled. Demographic, clinical, laboratory, oncological, and operative variables were analyzed. Univariate analysis followed by multivariate logistic regression was performed to identify independent predictors of PWI.*

Results: *PWI occurred in 13 patients (31.7%), at a median of 8 postoperative days. On univariate analysis, diabetes mellitus, hypoalbuminemia (<3.5 g/dl), anemia (≤11 g/dl), and neoadjuvant chemoradiotherapy were significantly associated with PWI. Multivariate analysis identified hypoalbuminemia (adjusted OR 6.45, 95% CI 1.52–27.38; p=0.011) and diabetes mellitus (adjusted OR 11.87, 95% CI 1.89–74.52; p=0.008) as independent predictors. Patients with PWI had significantly prolonged hospital stays (18.3±4.2 vs. 12.1±2.8 days; p<0.001).*

Conclusion: *Hypoalbuminemia and diabetes mellitus are independent risk factors for perineal wound infection following APER. Preoperative nutritional optimization and strict perioperative glycemic control may reduce postoperative morbidity and improve outcomes.*

Keywords: *Rectal cancer; Abdominoperineal excision; Perineal wound infection; Risk factors; Hypoalbuminemia; Diabetes mellitus.*

Citation: *Shil RK, Hossain MT, Jamil MAY, Abedin J, Sarker S, Tasnim R. Risk Factors for Perineal Wound Infection after Abdominoperineal Excision of Rectum in Rectal Cancer: A Prospective Observation Study. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2): 34-37.*

Introduction

Introduction

Rectal cancer accounts for approximately one-third of colorectal malignancies worldwide. Abdominoperineal excision of rectum (APER), first described by Miles in 1908,x remains an essential surgical option for low rectal cancers when sphincter preservation is not feasible.[3],[11],[12] Despite advances in surgical technique and perioperative care, perineal wound infection (PWI) continues to be a common postoperative complication, with reported incidences ranging from 29% to 64%.[4,7,14]

PWI is associated with delayed wound healing, prolonged hospital stay, increased healthcare costs, delayed initiation of adjuvant therapy, and impaired quality of life.[2,5,24] Multiple patient-related, disease-related, and treatment-related factors have been implicated, including malnutrition, diabetes mellitus, anemia, obesity, smoking, neoadjuvant radiotherapy, and prolonged operative

duration.[2,7,15,22] However, data from South Asian populations remain limited. This prospective study aimed to identify independent risk factors for PWI following APER in rectal cancer patients treated at a tertiary referral center in Bangladesh.[19]

Materials and Methods

Study Design and Setting

This prospective observational cohort study was conducted at the Department of Surgical Oncology, National Institute of Cancer Research and Hospital (NICRH), Dhaka, Bangladesh, from January 2021 to March 2022. Ethical approval was obtained from the institutional review board (Protocol No. NICRH/EC/2020/245), and written informed consent was secured from all participants.

Patient Selection

Patients aged 20–80 years with histologically confirmed rectal adenocarcinoma undergoing elective APER with curative intent were included. Exclusion criteria were emergency surgery, distant metastasis, prior pelvic surgery or radiotherapy, active perineal infection, and chronic immunosuppressive therapy.

Perioperative Management

All patients followed a standardized perioperative protocol including mechanical bowel preparation, prophylactic antibiotics (cefuroxime and metronidazole), maintenance of intraoperative normothermia, extralevator APER technique,[1]p ,[23] and primary perineal wound closure with closed suction drainage.[17]

Data Collection

Collected variables included demographics, comorbidities, laboratory parameters (hemoglobin, serum albumin), oncological characteristics, operative details, and postoperative outcomes. PWI was defined according to CDC criteria. Performance status was assessed using ECOG criteria.[16]

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 26. Continuous variables were compared using Student's t-test or Mann–Whitney U test, and categorical variables using chi-square or Fisher's exact test.[18] Variables with $p<0.20$ on univariate analysis were entered into multivariate logistic regression. A p-value <0.05 was considered statistically significant.

Results

Patient Characteristics

The study included 41 patients with a mean age of 49.1±11.5 years; 63.4% were male. Diabetes mellitus was present in 22.0% of patients, and 39.0% had hypoalbuminemia. Neoadjuvant chemoradiotherapy was administered to 80.5%.

Table I. Baseline characteristics of patients undergoing abdominoperineal excision (N=41)

Variable	Overall (N=41)	PWI (n=13)	No PWI (n=28)	p-value
Age (years), mean ± SD	49.1 ± 11.5	53.8 ± 9.2	46.9 ± 11.9	0.065
Age e"50 years, n (%)	22 (53.7)	11 (84.6)	11 (39.3)	0.005
Male sex, n (%)	26 (63.4)	6 (46.2)	20 (71.4)	0.114
Body mass index (kg/m²), mean ± SD	22.8 ± 3.2	22.1 ± 2.9	23.2 ± 3.3	0.312
Diabetes mellitus, n (%)	9 (22.0)	7 (53.8)	2 (7.1)	<0.001
Hemoglobin (g/dl), mean ± SD	11.8 ± 1.6	10.9 ± 1.4	12.2 ± 1.5	0.014
Hemoglobin d"11.0 g/dl, n (%)	14 (34.1)	8 (61.5)	6 (21.4)	0.011
Serum albumin (g/dl), mean ± SD	3.6 ± 0.5	3.1 ± 0.4	3.8 ± 0.4	<0.001
Albumin <3.5 g/dl, n (%)	16 (39.0)	11 (84.6)	5 (17.9)	<0.001
Neoadjuvant chemoradiotherapy, n (%)	33 (80.5)	12 (92.3)	21 (75.0)	0.185

Incidence of Perineal Wound Infection

PWI developed in 13 patients (31.7%), consistent with rates reported in the literature.[4,14,24] Most infections were superficial; however, four patients required surgical debridement.[1] The most common isolated organisms were *Escherichia coli* and *Enterococcus* species.[15]

Risk Factor Analysis

Table II. *Univariate analysis of risk factors for perineal wound infection*

Variable	Category	PWI n/N (%)	No PWI n/N (%)	Risk Ratio (95% CI)	p-value
Age	≥50 years	11/22 (50.0)	11/22 (50.0)	3.13 (1.24–7.91)	0.002
Sex	Female	7/15 (46.7)	8/15 (53.3)	1.91 (0.96–3.79)	0.024
Diabetes mellitus	Present	7/9 (77.8)	2/9 (22.2)	14.22 (1.20–18.80)	0.007
Hemoglobin	≤11.0 g/dl	8/14 (57.1)	6/14 (42.9)	2.85 (0.73–11.13)	0.024
Serum albumin	<3.5 g/dl	11/16 (68.8)	5/16 (31.2)	7.76 (1.97–30.63)	0.001
Neoadjuvant CCRT	Received	12/33 (36.4)	21/33 (63.6)	2.84 (0.72–24.07)	0.023

Table III. *Multivariate logistic regression analysis of independent predictors of PWI*

Variable	Category	Adjusted OR	95% CI	p-value
Serum albumin	<3.5 g/dl	6.45	1.52–27.38	0.011
Diabetes mellitus	Present	11.87	1.89–74.52	0.008

Patients who developed PWI had significantly longer hospital stays (18.3±4.2 vs. 12.1±2.8 days; p<0.001) & delayed initiation of adjuvant chemotherapy.[2,5,22]

Discussion

This prospective study demonstrates that hypoalbuminemia and diabetes mellitus are independent risk factors for perineal wound infection following APER. The observed PWI rate of 31.7% is consistent with international literature.[4,7,14,23]

Hypoalbuminemia reflects poor nutritional and inflammatory status and adversely affects wound healing through impaired collagen synthesis and immune dysfunction.[2,15,20] Diabetes mellitus compromises wound healing via microvascular disease and impaired leukocyte function.[7,22] These findings emphasize the importance of preoperative nutritional assessment and perioperative glycemic control.[5,15]

Although anemia and neoadjuvant chemo-radiotherapy were significant on univariate analysis, they did not retain significance on multivariate analysis, possibly due to limited sample size.[2,4,23] Prior studies have similarly noted that neoadjuvant radiotherapy poses a considerable wound-healing burden, particularly with primary perineal closure.[4,17] Extralevator APER, while reducing circumferential resection margin positivity,[21] has been associated with larger perineal defects and may increase wound complication risk when not supplemented by reconstructive techniques.[1,23]

Limitations

The main limitations include small sample size, single-center design, and limited ability to adjust for all potential confounders.[2,22] Nevertheless, the prospective design and standardized protocols strengthen the validity of the findings.

Conclusion

Perineal wound infection remains a significant postoperative complication after abdominoperineal excision of rectum.[14,24] Hypoalbuminemia and diabetes mellitus are independent predictors of infection. Targeted preoperative optimization of nutritional status and glycemic control may reduce postoperative morbidity.[2,5,25]

Acknowledgments

The authors thank the surgical, nursing, and enterostomal therapy teams of NICRH for their support, and the patients for their participation.

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Postoperative bilateral parotid gland swelling following spinal anaesthesia: A case report and literature review

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Citation: *Hossain MM, Kamal MM, Ahmed N, Hossain MB. Postoperative Bilateral Parotid Gland Swelling Following Spinal Anaesthesia: A Case Report and Literature Review. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2): 38-39.*

Background:

Acute transient parotid gland swelling, colloquially known as "anesthesia mumps," is a rare postoperative complication, typically associated with general anaesthesia. Its occurrence following spinal anaesthesia, particularly in obstetric procedures, is exceedingly uncommon.[1,4-6] Awareness of this benign and self-limiting condition is essential to prevent unnecessary diagnostic interventions and patient anxiety.

Case Presentation:

A 32-year-old multiparous woman (ASA II) with no comorbidities was admitted for an elective repeat cesarean section under spinal anaesthesia. She had previously undergone an uneventful cesarean delivery with spinal anaesthesia. Following informed consent, spinal anaesthesia was performed at L3–L4 with 12 mg hyperbaric bupivacaine and 10 mcg fentanyl. A T4 sensory block was achieved, and hypotension was managed with two 5 mg boluses of ephedrine. A healthy female neonate (3565 g) was delivered 3.5 minutes after skin incision, with Apgar scores of 9 and 10 at 1 and 5 minutes, respectively. Oxytocin infusion was started post-delivery. The intraoperative course was uneventful.

Five hours postoperatively, the patient developed bilateral, painless preauricular swelling without systemic symptoms. She denied fever, facial weakness, or history of autoimmune, allergic, or toxic exposures. Examination revealed symmetrical, firm, non-tender, slightly compressible, about 4×3 cm swellings with normal overlying skin and clear ductal discharge. Facial nerve function and laboratory tests, including CBC, amylase, and electrolytes, were normal.

Fig.-1: *Front view of the patients parotid swelling*

Fig.-2: *Side view of the patient's parotid swelling*

She received IV paracetamol, pheniramine, and dexamethasone. IV fluids were given at 5 mL/kg/h, and oral intake resumed at six hours post-op. By the twelfth hour, swelling had significantly reduced bilaterally without further intervention.

Review of Literature:

Postoperative parotid gland swelling, also known as "anesthesia mumps," is an infrequent and typically benign complication most commonly associated with general anaesthesia.[2] The exact incidence is unclear, but its occurrence following spinal anaesthesia—particularly in obstetric patients—is exceedingly rare, with only a handful of published case reports.[1,4-6] Proposed mechanisms include autonomic imbalance due to sympathetic blockade, perioperative dehydration leading to transient salivary duct obstruction, and drug-induced reactions, including opioids or oxytocin-related fluid shifts. In 2002, Shinoda and Shimizu reported parotid swelling with hyperamylasemia after cesarean section under regional anaesthesia.[1] More recent reports, including those describe similar presentations in otherwise healthy parturients undergoing spinal anaesthesia[3,6,8]. These cases, like ours, presented with painless[5,6], non-infectious, and self-limiting gland swelling. Management in the literature is generally conservative[4-6], involving hydration, corticosteroids, and antihistamines, with rapid resolution[4-6]. These findings support the need for increased awareness among anesthesiologists and obstetricians to avoid unnecessary investigations or antibiotic use in the absence of infection and to provide reassurance and appropriate supportive care.

Conclusion:

Postoperative acute parotitis following spinal anaesthesia is a rare but benign condition that can occur after cesarean delivery[1,3-6]. Conservative management is usually sufficient. Anaesthesiologists should include this entity in the differential diagnosis of postoperative facial swelling to ensure appropriate and timely care[2-7].

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Case Report

A Successful Reconstruction of Iatrogenic Buried Penis due to Repeated Circumcision with full Thickness Hairless Skin Graft

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Abstract

Iatrogenic buried penis is an uncommon but distressing complication that may occur following circumcision, particularly when performed by untrained practitioners. It results in concealment or shortening of the penis due to cicatricial or anatomical factors. A 10-year-old boy from Jamalpur presented with complaints of apparent penile shortening following two previous circumcisions - the first performed by a traditional practitioner (hajam) and the second at a government hospital. On examination, an iatrogenic buried penis was diagnosed. A full-thickness, hairless skin graft harvested from the right upper thigh was grafted to cover the entire penile shaft. The postoperative period was uneventful, and the patient was discharged on the 5th postoperative day.

Keywords*: Circumcision, Full thickness skin graft, reconstructive surgical procedure, Penile skin shortening, Iatrogenic complications, buried penis.*

Citation: *Tawhid KMH, Khan MMR, Sharker RA, Sumsuzzaman M, Ahmed TU, Ahmed N. A Successful Reconstruction of Iatrogenic "Buried Penis" due to Repeated Circumcision with Full Thickness Hairless Skin Graft. Journal of the Bangladesh Society of Anaesthesiologists. 2023;36(2): 40-44.*

Introduction:

Over-resection of penile shaft skin during circumcision can cause skin deficiency, retraction, and buried penis. Recognition of pre-existing concealed penis before circumcision is essential to avoid such iatrogenic complications.[1] Circumcision performed by untrained practitioners increases the risk of postoperative deformities and penile concealment.[2] Acquired buried penis in children often results from excessive skin removal during circumcision, postoperative scarring, or abnormal fascial tethering.[3] Clinical manifestations include apparent penile shortening, difficulty in micturition, poor hygiene, recurrent balanitis, and psychological distress.[4] Full-thickness skin grafts (FTSG) provide durable coverage required during sexual intercourse, minimal contraction, and good color/texture match, making them ideal for single stage penile reconstruction where mobility and elasticity are required.[5] A case with excessive resection of the penile skin and reconstruction with the full thickness skin graft is discussed.

Case Report:

A 10-year-old boy from Jamalpur presented with complaints of penile shortening. He had a history of two circumcisions — the first performed by a traditional practitioner (hajam), and the second in a government hospital.

On examination, an iatrogenic buried penis was noted. The patient and his guardians were properly counselled, and he was admitted to KPJ Hospital for surgical correction.

Operative Findings and Procedure

Under general anesthesia, a circumferential incision was made at the level of the corona. Only the glans penis and corona were visible beyond the skin of pubis. A 3/0 Prolene suture was placed on the glans penis to provide traction. Complete

degloving and mobilization of the penile shaft were performed. The suspensory (penopubic) ligament was incised, allowing full release of the penis.

After adequate traction and artificial erection (using saline), the penile length was found to be approximately **3 cm** from the pubic symphysis to the tip of the glans. The dartos fascia was fixed to the subcutaneous tissue at the level of the symphysis pubis at the **6, 12, 3**, and **9** o'clock positions to prevent retraction.

The penile surface area was measured using a sterile paper template and a metallic scale. A full-thickness, hairless skin graft was harvested from the right upper thigh just below the inguinal region and was grafted over the entire penile shaft. The graft was secured with ***3/0*** monofilament sutures (cutting needle). A sterile "daisy" dressing with minimal pressure was applied, and a **10Fr** silicone catheter was inserted.

The donor site was closed with ***2/0*** and ***3/0*** cutting sutures and dressed with sterile dressing.

Postoperative Course

The postoperative period was uneventful, and the patient was discharged on the 5th postoperative day.

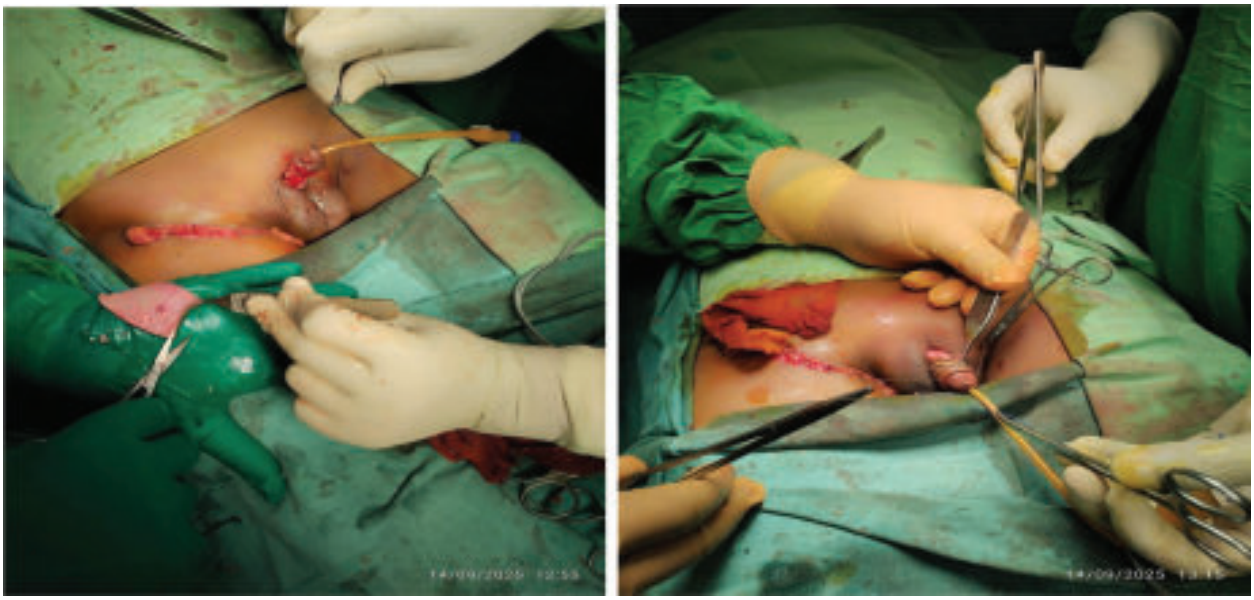

Figure (A,B): A- full thickness skin graft from upper thigh; B- Initial stage of suturing graft over penis.

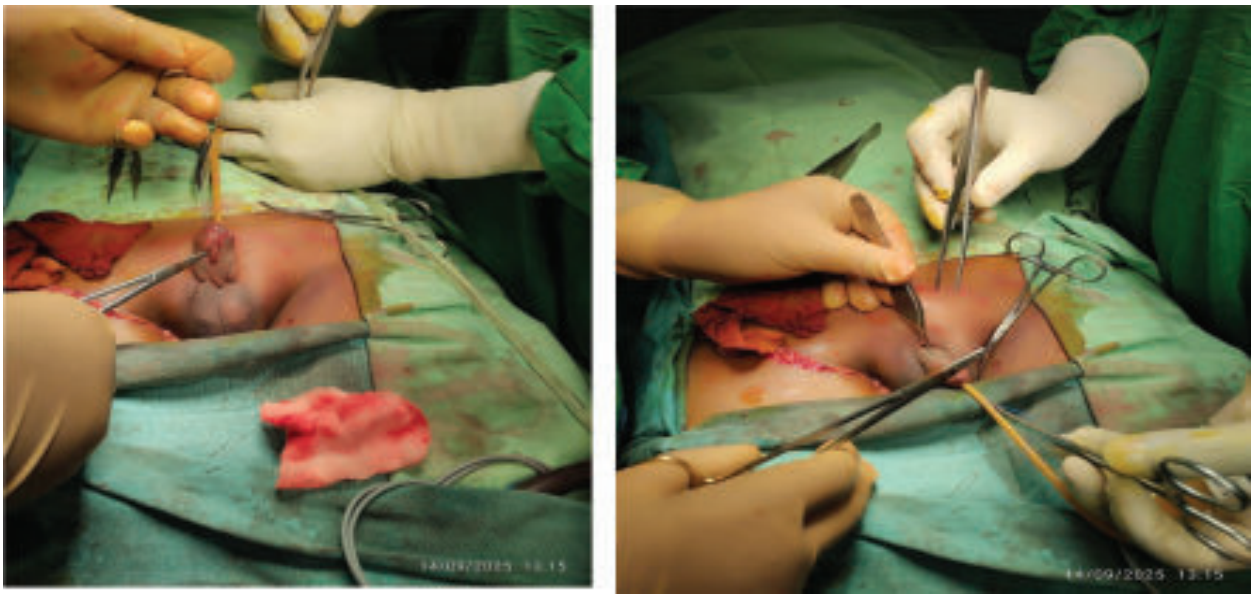

Figure (C,D) : Fixation of graft over dorsal & ventral surface of penis.

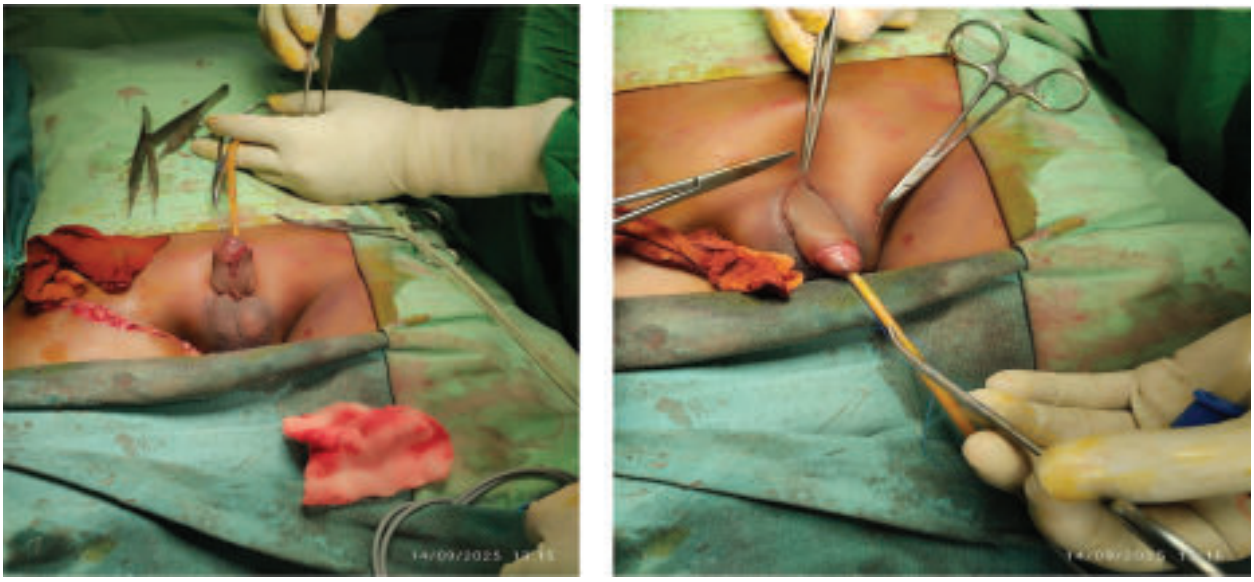

Figure (E,F): Post fixation status.

Discussion:

The goal of the treatment, after extensive loss of the penile skin, is to achieve good cosmetic appearance of the penis and restoring adequate sexual function. Multistage operations with a significant time delay can lead to secondary sexual dysfunction due to psychological phenomena so, less aggressive approach performed as a single act surgery is preferable.[6]

Non-hirsute FTSG should be harvested from thin, elastic areas. Donor site requires primary closure. Proper hemostasis and atraumatic handling preserve dermal vascularity, ensuring graft take[7]. Hairless donor skin prevents postoperative hair growth on the penile shaft, which can cause irritation, hygiene issues, and poor cosmetic outcomes. Preferred sites are the innerthigh, groin crease, or lower abdomen[8]. The penis should be completely degloved, with release of dartos fascia and suspensory ligaments to prevent tethering. Adequate hemostasis and a well-vascularized bed are essential for graft survival[9]. The graft should be secured with fine monofilament sutures, tie-over or "daisy" dressings to prevent hematoma. Catheterization and immobilization for several days support graft adherence[10].

Conclusion:

This case highlights the importance of proper surgical technique during circumcision and demonstrates successful reconstruction of an iatrogenic buried penis using full-thickness skin grafting. Early recognition and appropriate surgical management are essential to achieve satisfactory functional and cosmetic outcomes.

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JOURNAL OF THE BANGLADESH SOCIETY OF ANAESTHESIOLOGISTS

VOLUME - 36 **NUMBER - 2** **July 2023**

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