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Comparison among Spinal, Epidural, and General Anesthesia for Knee Arthroscopy: A Study in a Tertiary Care Hospital, Chattogram, Bangladesh

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Abstract **Original Research Article**

Introduction: Basically, knee arthroscopy is a surgical procedure that allows doctors to view the knee joint without making a large incision through the skin and other soft tissues. It is used to diagnose and treat a wide range of problems in the knee joint. In this procedure, surgeons make a very small incision and insert a tiny camera, arthroscope into the knee. As it is a painful procedure so anesthesia is necessary here. ***Aim:*** The aim of the study was to compare among spinal, epidural, and general anesthesia for knee arthroscopy in adults. ***Methods:*** This prospective study was conducted in the department of Anesthesia, Chittagong Medical College, Chattogram, Bangladesh during the period from July 2019 to June 2020. In total 66 adult patients for arthroscopies were selected as the study population for the study. All the participants were randomly divided into 3 equal groups for using spinal, epidural, and general anesthesia separately. For collecting, processing, analyzing and disseminating data MS Excel and SPSS version 20 were used as per need. ***Result:*** In analyzing the major symptoms during follow up period we did not find any significant correlation among the groups (Group-I Vs Group II: P =0.54; Group-II Vs Group-III: P=0.37; Group-1 Vs Group-III: P=0.13). Finally in analyzing the satisfaction scores we found significant correlation between Group I and Group II where P value was 0.014. Comparatively the best results were found in Group I where 16 (73.73%), 3 (13.64%), 2 (9.09%) and 1 (4.55%) patient found Very satisfied, Satisfied, Neutral and Dissatisfied leveled outcomes. ***Conclusion:*** In our study comparatively the best results were found in general anesthesia group. So for good efficacy and for cutting the treatment duration general anesthesia may be the best choice. These findings may be helpful in further similar studies.

Keywords: Anesthesia, Knee arthroscopy, Spinal, Epidural, General.

INTRODUCTION

Basically, knee arthroscopy is a surgical procedure that allows doctors to view the knee joint without making a large incision through the skin and other soft tissues. It is used to diagnose and treat a wide range of problems in the knee joint. In this procedure, surgeons make a very small incision and insert a tiny camera, arthroscope into the knee. As it is a painful procedure so anesthesia is necessary here. In our study we compared general, epidural, and spinal anesthesia for knee arthroscopy excluding anterior cruciate ligament repairs. Forty-eight patients (ASA physical status I–III) [1] were randomized to receive either propofol nitrous oxide general anesthesia with a laryngeal mask airway with anesthetic depth titrated to a bispectral index level of 40-60, 15-20 mL of 3% 2-chloroprocaine epidural, or 75 mg of subarachnoid procaine with 20 µg fentanyl. All patients were premedicated with <0.035 mg/kg midazolam and <1 µg/kg fentanyl and received intra-articular bupivacaine and 15-30 mg of IV ketorolac during the procedure. Recovery times, operating room turnover times, and patient satisfaction were recorded by an observer using an objective scale for recovery assessment and a verbal rating scale for satisfaction. Statistical analysis was performed with analysis of variance and y2. We conclude that epidural anesthesia with 2-chloroprocaine provides comparable recovery and discharge times to general anesthesia provided with propofol and nitrous oxide. Spinal anesthesia with procaine and fentanyl is an effective alternative and is associated with a longer discharge time and increased side effects. Outpatient arthroscopic knee surgery can be performed with general or regional anesthesia. Epidural anesthesia [2] and peripheral nerve block [3] have both provided more rapid discharge than general anesthesia in previous reports, whereas spinal anesthesia with bupivacaine [4] has also been shown to provide discharge times comparable to general anesthesia. Recent data,

however, suggest that spinal and epidural anesthesia require longer discharge times than the newer shorter-acting general anesthetic drugs (propofol and sevoflurane) [5]. Regional techniques consistently provide superior postoperative analgesia when compared with general anesthesia [6]. Published reports have not compared optimal techniques in each category. We assumed that, the ideal selection of local anesthetic agents for either epidural or spinal anesthesia would provide recovery times comparable to those obtained with short-acting general anesthesia and result in equal patient satisfaction.

OBJECTIVES

a) General objective

- To compare among spinal, epidural, and general anesthesia for Knee Arthroscopy in adults.

b) Specific Objectives

- To know more about the effectiveness of spinal, epidural, and general anesthesia for Knee Arthroscopy in adults.
- To observe the final outcomes in using spinal, epidural, and general anesthesia for Knee Arthroscopy in adults.

METHODOLOGY & MATERIALS

This prospective study was conducted in the department of Anesthesia, Chittagong Medical College, Chattogram, Bangladesh during the period from July 2019 to June 2020. In total 66 adult patients for arthroscopies were selected as the study population for the study. All the participants were randomly divided into 3 equal groups for using spinal, epidural, and general anesthesia separately. For collecting, processing, analyzing and disseminating data MS Excel and SPSS version 20 were used as per need. After institutional review board approval, patients scheduled for elective unilateral knee arthroscopy, not including anterior cruciate ligament repair, were asked to participate in a prospective, randomized comparison of anesthetic techniques. The age of the participants 18 years and more, ASA physical status I–III, and <110 kg. All patients were pre-medicated with a maximum of IV 0.035 mg/kg midazolam and 1 µg/kg fentanyl. General anesthesia was performed with 2 mg/kg IV propofol induction and 60% nitrous oxide by laryngeal mask airway with a continuous infusion of propofol titrated to maintain the bi-spectral index monitor reading between 40 and 60. The infusion was discontinued when the trocars were removed from the knee. Epidural anesthesia was performed in a standard fashion at the L2-3 or L3-4 interspace with the operative knee in the dependent position. Skin infiltration was performed with 1% lidocaine, and a test dose of 3 mL of 1.5% lidocaine with 15 µg epinephrine was injected. If there was no evidence of IV or sub-arachnoid injection, 15 mL of 3% 2-chloroprocaine was injected in 5 mL increments, with an additional 5 mL added after 10 min, if the block height was lower T-10 (level needed to provide anesthesia for thigh tourniquet discomfort). Spinal anesthesia was applied at the L2-3 or L3-4 interspace with a 25-gauge Whitacre needle with the operative knee dependent. After free flow of cerebrospinal fluid, 75 mg of procaine plus 10–20 µg of fentanyl diluted with an equal volume of cerebrospinal fluid was injected, and the patient turned supine. Patients taking spinal or epidural anesthesia who requested sedation were given an intraoperative infusion of propofol. All patients took 15-30 mg IV ketorolac. The surgeon injected 50 mL of 0.25% bupivacaine into the knee joint at the completion of the procedure. When the surgical procedure was done by the same surgeon sequentially in the same OR, turnover time was assessed. This was defined as the time interval from the departure of the previous patient from the OR until the completion of anesthesia preparation. All patients were shifted by stretcher to the Phase I post-anesthesia care unit. When vital signs were stable for two measurements and block level (for regional block patients) was under T-8, they were shifted to the Phase II area. Discharge time was recorded as the time from admission to post-anesthesia care unit (PACU) the patient met all discharge criteria from Phase II. These included mental alertness, stable vital signs, absence of nausea, control of pain, ability to ambulate, and (for regional techniques) voiding. Side effects measured were the incidence of hypotension or bradycardia in either the OR or in the PACU, nausea or vomiting, pain severe enough to require IV narcotics in the PACU, or pruritus requiring treatment. Patient satisfaction (rated on a verbal scale of 5=very satisfied, 4=satisfied, 3=neutral, 2=dissatisfied, 1=very dissatisfied) and specific side effects were evaluated by follow-up phone call 24 h after the procedure. For data analysis, discharge time was considered the primary outcome variable, with a difference considered significant at the $P < 0.05$ level.

RESULT

In demographic data analysis of study people, we found, in Group-I (General Anesthesia Group) the mean age was 42±3.7 years, in Group-II (Epidural Anesthesia Group) it was 41±6.8 years and in Group-III (Spinal Anesthesia Group) it was 42±5.6 years. The mean weight of the participants of Group-I, Group-II and Group-III were 77±5.4, 76±6.6, and 76±8.3 Kg respectively. The ratios of male participants of Group-I, Group-II and Group-III were 61%, 65% and 62% respectively. The ratios of female participants of Group-I, Group-II and Group-III were 39%, 35% and 38% respectively. On the other hand, according to ASA classification (American Society of Anaesthesiologists physical status classification) the ratios of ASA-I graded participants of Group-I, Group-II and Group-III were 88%, 91% and 89% respectively. Besides these, the ratios of ASA-II graded participants of Group-I, Group-II and Group-III were 12%, 9% and 11% respectively. In our study, we found turnover time of anesthesia 24 ± 2.9, 24 ± 2.11 and 26 ± 2.86 minutes in

Group I, Group II, and Group III respectively. (Group-I Vs Group II: P =1.0; Group-II Vs Group-III: P=0.01; Group-1 Vs Group-III: P=0.01). Here we found significant correlations between Group II and Group III as well as between Group I and Group III. The time of void was 84 ± 7.66 and 133 ± 7.62 minutes in Group II and Group III respectively. We found a significant correlation between the Group II and Group III in time to void where the p <0001. The discharge time were significantly lower in Group II and in Group I than that of in Group III. We found significant correlation of using Antipruritic as additional drug between Group I and Group III as well as Group II and Group III (Gr.-I Vs Gr. II: P =1.00; Gr.-II Vs Gr.-III: P=0.02; Gr.-1 Vs Gr.-III: P=0.02). But in analyzing the major symptoms during follow up period we did not find any significant correlation among the groups (Gr.-I Vs Gr. II: P =0.54; Gr.-II Vs Gr.-III: P=0.37; Gr.-1 Vs Gr.-III: P=0.13). Finally in analyzing the satisfaction scores we found significant correlation between Group I and Group II where P value was 0.014. Comparatively the best results were found in Group I (General anesthesia) where 16 (73.73%), 3 (13.64%), 2 (9.09%) and 1 (4.55%) patient found Very satisfied, Satisfied, Neutral and Dissatisfied leveled outcomes.

Table-I: Demographic data of participants (N=66)

Components	**Group-I**		**Group-II**		**Group-III**	
	General		**Epidural**		**Spinal**	
	(n=22)		**(n=22)**		**(n=22)**	
Age (Years)	42±3.7		41±6.8		42±5.6	
Weight (Kg)	77±5.4		76±6.6		76±8.3	
Male (%)	40	60.61	42	63.64	41	62.12
Female (%)	26	39.39	24	36.36	25	37.88
ASA-I (%)	58	87.88	60	90.91	59	89.39
ASA-II (%)	8	12.12	6	9.09	7	10.61

Table-II: Final outcome of the study (N=66)

Component	**Group I**		**Group II**		**Group III**	
	n	**%**	**n**	**%**	**n**	**%**
Time of procedures (Mean ± SD)						
Turnover time (min.)	24±2.09		24±2.11		26±2.86	
	(Gr.-I Vs Gr. II: P =1.0; Gr.-II Vs Gr.-III: P=0.01; Gr.-1 Vs Gr.-III: P=0.01)					
Time to void (min.)	NA		84±7.66		133±7.62	
	Gr.-II Vs Gr.-III: P < 0.0001					
Time to discharge (min.)	101±11.81		91±10.05		144±13.72	
	(Gr.-I Vs Gr. II: P =0.004; Gr.-II Vs Gr.-III: P<0001; Gr.-1 Vs Gr.-III: P < 0.0001)					
Additional drugs used						
IV Narcotics	5	22.73	2	9.09	3	13.64
	(Gr.-I Vs Gr. II: P =0.22; Gr.-II Vs Gr.-III: P=0.64; Gr.-1 Vs Gr.-III: P=0.44)					
Antiemetics	2	9.09	2	9.09	5	22.73
	(Gr.-I Vs Gr. II: P =1.00; Gr.-II Vs Gr.-III: P=0.22; Gr.-1 Vs Gr.-III: P=0.22)					
Antipruritic	1	4.55	1	4.55	7	31.82
	(Gr.-I Vs Gr. II: P =1.00; Gr.-II Vs Gr.-III: P=0.02; Gr.-1 Vs Gr.-III: P=0.02)					
Major symptoms during follow up						
Hypotension	3	13.64	3	13.64	3	13.64
Headache	1	4.55	3	13.64	4	18.18
Pain (General)	2	9.09	2	9.09	3	13.64
Back/leg pain	1	4.55	1	4.55	2	9.09
Total	7	31.82	9	40.91	12	54.55
	(Gr.-I Vs Gr. II: P =0.54; Gr.-II Vs Gr.-III: P=0.37; Gr.-1 Vs Gr.-III: P=0.13)					
Satisfaction scores						
Very satisfied (5)	16	72.73	14	63.64	11	50.00
Satisfied (4)	3	13.64	3	13.64	7	31.82
Neutral (3)	2	9.09	4	18.18	2	9.09
Dissatisfied (2)	1	4.55	1	4.55	2	9.09
P values	(Gr.-I Vs Gr. II: P =0.014; Gr.-II Vs Gr.-III: P=0.37; Gr.-1 Vs Gr.-III: P=0.13)					

NB: Significant indicates P < 0.05

DISCUSSION

The aim of the study was to compare among spinal, epidural, and general anesthesia for knee arthroscopy in adults. In a study they claimed, regional anesthesia is safer for the mother than general anesthesia and the most common method of anesthesia for delivery because it allows the mother to be awake and immediately interact with her baby [7]. But there are some traditions of using anesthesia as combined therapy. So in some study we found some information regarding combined anesthesia. Spinal and combined spinal epidural anesthesia are more frequently used than epidural anesthesia because it has a more rapid onset and lower incidence of failed block than pure epidural techniques. The use of spinal anesthesia for cesarean delivery was facilitated by the popularization of pencil-point needles, which dramatically reduced the incidence of postdural puncture headache [8]. In contrast to regional anesthesia, general anesthesia ensures a very rapid and reliable onset, control over the airway and ventilation and potentially less hypotension. The major adverse fetal effect of regional anesthesia and its sympathetic blockade is utero-placental hypo-perfusion which leads to an acute fall in intervillous blood flow with the potential for fetal academia [9]. To date, however, there has not been a direct comparison of the new general anesthetics to ideal regional anesthetic techniques. Parnass et al. [2] used isoflurane for general anesthesia, rather than the newer short acting anesthetics. New general anesthetics including propofol, desflurane, and sevoflurane allow for faster emergence after general anesthesia than thiopental and isoflurane, and the potential for earlier discharge in the outpatient setting. Pavlin et al. [5] reported that general anesthesia with these drugs allowed an earlier discharge compared with spinal and epidural anesthesia in her practice (184 vs 202 minutes for men, 185 vs 213 minutes for women), but she did not specifically study knee arthroscopy, nor the use of short duration neuraxial regional anesthesia techniques. Luttropp et al. [6] reported that for knee arthroscopy, general anesthesia with either propofol or sevoflurane provides faster recovery than spinal anesthesia (116 and 141 vs 176 minutes), although with a higher frequency of postoperative nausea and vomiting with sevoflurane. In our study, the time of void was 84 ± 7.66 and 133 ± 7.62 minutes in Group II and Group III respectively. We found a significant correlation between the Group II and Group III in time to void where the p <0001. The discharge time were significantly lower in Group II and in Group I than that of in Group III. We found significant correlation of using Antipruritic as additional drug between Group I and Group III as well as Group II and Group III (Gr.-I Vs Gr. II: P =1.00; Gr.-II Vs Gr.-III: P=0.02; Gr.-1 Vs Gr.-III: P=0.02). Regional anesthesia has been used successfully for outpatient knee arthroscopy. Peripheral nerve block of the lumbar plexus block at the groin provides satisfactory anesthesia and rapid discharge3, as is consistent with other comparisons of peripheral nerve blocks to general anesthesia [5]. Peripheral nerve blocks, however, may take longer to perform, be less familiar to the practitioner, have a higher failure rate [8], and may have a slow onset of anesthesia [9]. Neuraxial blocks are simpler to perform and are used more often in the outpatient setting. Epidural anesthesia allows the titration of short duration local anesthetics to provide potentially rapid discharge. Parnass et al. [2] demonstrated faster discharge with lidocaine epidural anesthesia than general anesthesia with isoflurane (159 vs 208 minutes). Dahl et al. [10] compared general anesthesia with propofol to spinal and epidural anesthesia, but did not report actual discharge times and used the longer-acting mepivacaine to provide epidural anesthesia. Epidural anesthesia with chloroprocaine provides faster resolution compared with lidocaine (127 vs 195 minutes) [11], and may be a superior choice. Although back pain has been reported with this drug, it appears to be related to the use of large doses [12], and may not be a problem when doses of 25 mL or less are used. In our study, in analyzing the major symptoms during follow up period we did not find any significant correlation among the groups (Gr.-I Vs Gr. II: P =0.54; Gr.-II Vs Gr.-III: P=0.37; Gr.-1 Vs Gr.-III: P=0.13). Spinal anesthesia is also advocated for outpatient surgery because of its reliability and simplicity, but suffers the limitation of a single injection technique. Larger doses may be required for adequate anesthesia, but may be associated with longer duration of action. Luttropp et al.'s [6] relatively large dose of spinal anesthesia with 70 – 80 mg of lidocaine may account for longer discharge time compared with general anesthesia. Besides these, selection of an optimal drug and dose is problematic because of a dearth of comparative studies. Lidocaine has been the traditional "short-acting" spinal anesthetic. Small-dose (40 mg) subarachnoid lidocaine provides discharge times equivalent to epidural chloroprocaine [12], but with a 10% failure rate. Reports of TNS after use of lidocaine for lithotomy and arthroscopy procedures have led to a search for alternative spinal anesthetics [13]. Ben-David et al. [14] found that 5 mg bupivacaine with 10 µg of fentanyl avoided TNS and provided satisfactory anesthesia for knee surgery, but with discharge times comparable to reports of duration of spinal anesthesia with 50 mg lidocaine [15]. Procaine has been regarded as a shorter-acting spinal anesthetic, and has been studied recently as an alternative to lidocaine. Hodgson and Liu [7] reported that subarachnoid 100 mg hyperbaric procaine is associated with less TNS, but a higher failure rate and longer discharge time than 50 mg lidocaine. Axelrod et al. [16] have reported shorter recovery times with doses of 60 and 80 mg procaine when fentanyl is added, but block heights below T-10 with the 60 mg dose. From these data, we estimated that a 75 mg dose of procaine with fentanyl might provide less risk of TNS and the best chance of a reliable block above T-10 with optimal discharge duration for outpatient spinal anesthetic. In our study of the three techniques, propofol/ nitrous oxide general anesthesia provided a duration of recovery similar to that after epidural anesthesia with 2-chloroprocaine. Spinal anesthesia

required on average 43 to 53 minutes longer for recovery than the general or epidural group. The spinal group also had a higher incidence of side effects, specifically pruritus, which was attributed to the addition of the fentanyl to the procaine, as well as one occurrence of positional headache in the 15 patients in group III. Room turnover times were not different among the groups, although the number of procedures performed sequentially in the same or was small in our study, and does not allow significant conclusions. In our study, finally in analyzing the satisfaction scores we found significant correlation between Group I and Group II where P value was 0.014. It seems that, the use of either propofol general anesthesia or chloroprocaine epidural anesthesia provide rapid discharge for outpatient knee arthroscopy. The choice between these two may be based on the patient's desire to be awake and alert during the surgical procedure.

CONCLUSION AND RECOMMENDATIONS

The aim of the study was to compare among spinal, epidural, and general anesthesia for Knee Arthroscopy in adults. In our study comparatively the best results were found in general anesthesia group. So for good efficacy and for cutting the treatment duration general anesthesia may be the best choice. These findings may be helpful in further similar studies. But this was a single centered study with small sized samples. So the findings may not reflect the exact scenario of the whole country. So, to get more specific findings about the effectiveness of these three anesthetic procedures we would like to recommend for conducting more study with larger sized samples in several places.

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