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Original Article

Anesthetic and analgesic approach in total knee arthroplasty: A national survey study

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Abstract

Aim: Although the optimum anesthetics and analgesic choice for total knee arthroplasty is a heavily debated topic in recent years, the failure to reach any ideal consensus on this topic leads clinicians to adopt different approaches. This study was conducted to assess differences in general anesthetic and analgesic approaches toward the total knee arthroplasty across Turkey.

Materials and Methods: Our 28-item survey was presented online to physicians who work as Anesthesiology and Reanimation specialists in Turkey and agreed to participate in the study. The survey includes questions about the techniques preferred by the clinicians in the management of anesthesia and postoperative analgesia in TKA and the main reasons underlying their preferences.

Results: 255 anesthesiologists, i.e. 72 (28.1%) faculty members and 183 (71.9%) specialists, completed the study in full. According to our survey, spinal anesthesia (61.3%) comes first in the selection of an anesthetic method in TKA, followed by the Combined Spinal-Epidural Anesthesia (32.4%). The spinal anesthesia is the most frequently preferred method in training and state hospitals and Combined Spinal-Epidural Anesthesia is the most frequently preferred method in private hospitals. The use of peripheral nerve blocks is 49.8% (127). Femoral nerve block is preferred with 79.7%, followed by adductor canal block with 36.1%. The rate of use of intravenous patient-controlled analgesia is 38.1% and the most commonly preferred analgesia is Tramadol (69.1%). 63.1% of those using epidural anesthesia do not use any epidural patient-controlled analgesia device. The physicians reported that the lack of a team to follow up epidural patient-controlled analgesia device (50.9%) as the most common reason for not choosing epidural patient-controlled analgesia.

Conclusion: Regional anesthesia is the first preference in the anesthesia management of total knee arthroplasty in our country. In postoperative analgesia practice, peripheral nerve blocks are preferred at a higher rate than epidural and intravenous patient-controlled analgesia.

Keywords: Anesthesia; postoperative analgesia; total knee artroplasthy

INTRODUCTION

Total knee arthroplasty (TKA) is a painful procedure and effective postoperative analgesia has a significant impact on the postoperative outcomes. With effective pain control, fast recovery, low complication rates, low care costs and high patient satisfaction are achieved. In cases where sufficient pain control cannot be achieved, prolongation of hospital stay, cost increases in health care services and an increased risk in developing chronic pain occur (1-3).

Opioids hold a historically important place in postoperative pain control in the total knee arthroplasty. Although they are effective analgesics, opioids may cause serious gastrointestinal, urinary, cardiac and respiratory complications, which has limited their use (4). Multimodal analgesia regimens have recently gained popularity due to the reduced need for opioids (5). Multimodal analgesia techniques include oral medications, regional anesthesia techniques, periarticular injections and cryotherapy (6,7). Although the multimodal analgesia is shown to be effective in the postoperative pain control, any consensus is not reached on the ideal regimen. A meta-analysis study reports that 17 different analgesia modalities were applied in TKA. The combinations of peripheral nerve blocks are suggested as one of the best approaches (8). Although the multimodal analgesia in TKA has been drawing increasing interest, clinical approaches are quite diverse in our country, similar to the rest of the world.

This study was carried out to determine the anesthetic and analgesic methods preferred by anesthesiologists at the national level for TKA.

MATERIALS and METHODS

The ethics committee approval of the study was obtained from the Local Ethics Committee of Selcuk University Medical Faculty with protocol number 2019/357. Our

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28-item survey was presented online to physicians who work as Anesthesiology and Reanimation specialists in Turkey and agreed to participate in the study. The survey, which was conducted in December 2019 - March 2020, was delivered electronically to 900 participants. The survey includes questions about the techniques preferred by the clinicians in the management of anesthesia and postoperative analgesia in TKA and the main reasons underlying their preference.

In the first part of the survey, socio-demographic data such as age, gender, years of medical specialty, educational institution, workplace, job title and the annual number of cases are included. In the second part of the survey, questions were asked about preemptive analgesia, general anesthesia, regional anesthesia, peripheral nerve blocks, local anesthetic medication and patient-controlled analgesia.

The survey consists of multiple choice questions. The data obtained were evaluated with the SPSS Statistics V21.0 program. Frequency distributions were calculated and Chi-Square test was used to analyze the categorical data. A value of p <0.05 was considered statistically significant.

RESULTS

A total of 259 anesthesiologists participated in the study, 255 of whom completed the survey in full. The demographic characteristics of 255 anesthesiologists who completed the survey in full are shown in Table 1.

Table 1. Demographic Data

Age	**n (%)**
<30	5 (2)
30-35	69 (27.1)
36-45	121 (47.5)
>45	60 (23.5)
Gender	
Male	119 (46.5)
Female	136 (53.5)
Year of specialty	
0-5	68 (26.8)
6-10	70 (27.6)
11-15	65 (25.2)
16-20	52 (20.5)
Educational Institution	
Education Research Hospital	73 (28.6)
University Hospital	182 (71.4)
Hospital Characteristics	
Training Hospital	115 (45.1)
State Hospital	95 (37.3)
Private Hospital	45 (17.6)
Title	
Faculty Members	72 (28.1)
Specialist Physician	183 (71.9)

136 (53.5%) participants were female and 119 (46.5%) were male. 182 of the participants (71.4%) received their medical specialty training in a university hospital and 73 (28.6%) at a training and research hospital. 72 (28.1%) faculty members and 183 (71.9%) specialist physicians answered our survey and 115 (45.1%) work in a training hospital (TH), 95 (37.3%) in a state hospital (SH) and 45 (17.6%) in a private hospital (PH). The vast majority of the participants (47.5%) accept <500 cases a year.

According to our survey, spinal anesthesia (61.3%) ranks first in the selection of anesthetic method in TKA, followed by the Combined Spinal-Epidural Anesthesia (CSEA) (32.4%). Anesthesiologists working in THs (63.7%) and SHs (66.3%) preferred spinal anesthesia most frequently, while anesthesiologists working in PHs (51.1%) preferred CSEA (Table 2).

Table 2. The Effect of the Hospital Characteristics

	Training Hospital n (%)	State Hospital n (%)	Private Hospital n (%)	p
Preempitive Analgesia	24(20.7)	14(14.6)	12(25.5)	0.261
PNB	66(56.9)	39(40.6)	25(53.2)	0.056
Anesthesia Choice				0.059
General Anesthesia	8(7.1)	2(2.1)	2(4.3)	
Spinal Anesthesia	72(63.7)	63(66.3)	20(42.6)	
Epidural Anesthesia	2(1.8)	1(1.1)	1(2.1)	
CSEA	31(27.4)	29(30.5)	24(51.1)	
NA Adjuvan Drug	38(34.2)	22(23.9)	20(43.5)	0.055
IV PCA	43(37.7)	30(31.6)	23(51.1)	0.086
Epidural PCA	44(38.9)	27(29.0)	23(51.1)	0.039

PNB: Peripheric Nerve Block; CSEA: Combine Spinal Epidural Anesthesia; PCA: Patient Control Analgesia; NA: Neuraxial Anesthesia

Table 3. The Effect of Anesthesia Specialty Duration

	I (68)	II (133)	III (54)	p
Preempitive Analgesia	9(13)	24(17.8)	17(30.9)	0.035
PNB	31(44.9)	71(52.6)	28(50.9)	0.581
Anesthesia Choice				0.23
General Anesthesia	2(2.9)	7(5.3)	3(5.6)	
Spinal Anesthesia	44(64.7)	86(64.7)	25(46.3)	
Epidural Anesthesia	2(2.9)	1(0.8)	1(1.9)	
CSEA	20(29.4)	39(29.3)	25(46.3)	
NA Adjuvan Drug	16(24.2)	40(30.8)	24(45.3)	0.045
IV PCA	19(28.4)	56(42.4)	21(38.2)	0.154
Epidural PCA	22(33.3)	46(35.4)	26(47.3)	0.225

I: ≤ 5 years, II: 6-15 years , III: ≥16; PNB: Peripheric Nerve Block; CSEA: Combine Spinal Epidural Anesthesia; PCA: Patient Control Analgesia; NA: Neuraxial Anesthesia

The majority of the participants do not use adjuvant drugs in neuraxial anesthesia (NA) (67.5%) and participants who use it mostly prefer Fentanyl. A statistically significant difference was found when the administration of adjuvant drugs in NA was compared by years of medical specialty (p =0.045) (Table 3). The administration of adjuvant drugs in NA is higher among anesthesiologists whose medical specialty exceeds 15 years. 27.8% of specialist anesthesiologists and 43.5% of faculty members administer adjuvant drugs in NA (p = 0.018) (Table 4).

Table 4. The Effect of Duty Title

	Specialist Physician (187)	Faculty members (72)	p
Preempitive Analgesia	33 (17.6)	17(23.6)	0.276
PNB	85(45.5)	45(62.5)	0.014
Anesthesia Choice			0.028
General Anesthesia	5(2.7)	7(10.0)	
Spinal Anesthesia	120(64.9)	35(50.0)	
Epidural Anesthesia	2(1.1)	2(2.9)	
CSEA	58(31.4)	26(37.1)	
NA Adjuvan Drug	50(27.8)	30(43.5)	0.018
IV PCA	67(36.6)	29(40.8)	0.532
Epidural PCA	60(30.3)	34(47.9)	0.032

PNB: Peripheric Nerve Block; CSEA: Combine Spinal Epidural Anesthesia; PCA: Patient Control Analgesia; NA: Neuraxial Anesthesia

Table 5. The Effect of The Specialty Training Institution

	University Hospital n (%)	Education Research Hospital n (%)	p
Preempitive Analgesia	38(20.5)	12(16.2)	0.42
PNB	91(49.2)	39(52.7)	0.609
Anesthesia Choice			0.23
General Anesthesia	6(3.3)	6(8.1)	
Spinal Anesthesia	110(60.8)	45(60.8)	
Epidural Anesthesia	3(1.7)	1(1.4)	
CSEA	62(34.3)	22(29.7)	
NA Adjuvan Drug	65(36.5)	15(21.1)	0.019
IV PCA	65(36.1)	31(41.9)	0.388
Epidural PCA	66(36.9)	28(38.9)	0.765

PNB: Peripheric Nerve Block; CSEA: Combine Spinal Epidural Anesthesia; PCA: Patient Control Analgesia; NA: Neuraxial Anesthesia

Pre-emptive analgesia administration rate is 18.9% (n = 50) and opioid, nonsteroid antiinflamatuar drug (NSAID) and paracetamol are the primary choices. A statistically significant difference was found when the use of pre-emptive analgesia was compared by years of medical specialty (p =0.035). The use of pre-emptive analgesia is higher among anesthesiologists whose medical specialty exceeds 15 years. The effect of the institution where the anesthesiologists received their specialty training, the institution where they are currently working and their job titles on the use of pre-emptive analgesia was not statistically significant (Table 5).

The use of peripheral nerve blocks (PNBs) is 49.8% (127). The administration frequency of PNB in training hospitals, state hospitals and private hospitals is 56.9%, 40.6% and 53.2%, respectively. The effect of the years of medical specialty, the institution where they received their specialty training and the current workplace on the administration of PNBs was not found to be statistically significant. 45.5% of specialists and 62.5% of academician administer PNBs in TKA (p =0.014) (Table 4). The most common reasons for not administering PNBs are lack of education (22%) and preference for CSEA (10.6%). In PNB practices, femoral nerve blocks (FNBs) (without catheter insertion) rank first with a rate of 79.7%, followed by the adductor canal blocks (ACBs) (without catheter insertion) with %36.1 (Table 6). The most common reason for preferring FNB is its easy-to-apply nature (64.8%). The rate of administering FNBs is 60%, 32% and 8%, respectively for TH/SH/PHs. 93% of participants in TH, 100% in SH and 86% in PH administer FNBs without catheter. Any difference was not found between hospitals in the administration of FNB without catheter (p =0.29). Sensory block enabling characteristic of ACB is the primary reason (66.7%) why it is preferred. The administration of ACB in TH/SH/PH is 72%, 16% and 12%, respectively. Bupivacaine (67.5%), followed by a combination of bupivacaine and lidocaine (28.5%) are the primary choices as local anesthetic in peripheral nerve blocks.

Table 6. Peripheric Nerve Block Choice

PNB	n (%)
FNB (without catheter)	106 (79.7)
FNB (catheter)	12 (9)
ACB (without catheter)	48 (36.1)
ACB (catheter)	5 (3.8)
Other blocks	14 (10.5)

PNB: Peripheric Nerve Block; FNB: Femoral Nerve Block; ACB: Adductor Canal Block

32% of clinicians prefer to administer PNB before surgery, 38% post-surgery, and 29% in both time frames. The most dominant reason for administering PNB before surgical intervention is to provide pre-emptive analgesia (46.4%). Among the reasons for the post-surgery administration of PNB, the most common reason is the desire to extend the duration of analgesia for a few hours and prevent loss of time (53.5%). The administration of PNB is most frequently performed in operation rooms at 62% (n = 98) and in recovery rooms at 31.3% (n = 50). The majority of those who use the recovery room prefer to administer nerve block post-surgical. The demand by orthopedists to administer PNB is 33.7%.

Intravenous patient-controlled analgesia (IV PCA) is used at 38.1%, and the IV PCAs are used at 37.7%, 31.6% and 51.1% for TH/SH/PH, respectively. The effect of the years of medical specialty, the institution where they received their specialty training, the current instutiation and title on the administration of IV PCA was not found to be statistically significant. Tramadol (69.1%) and morphine (35.1%) are the most preferred analgesics in IV PCA.

37.5% of those using epidural anesthesia use a PCA device. Epidural PCA device is most commonly used in private hospitals (p = 0.039). The effect of the years of medical specialty and the institution where he received his specialty training on the administration of Epidural PCA was not found to be statistically significant. The combination of Bupivacaine + Fentanyl is the most preferred agent (55.6%) for epidural PCA. The physicians reported that the lack of a team to follow up epidural PCA (50.9%) as the most common reason for not preferring epidural PCA and this answer was provided at the highest rate by the physicians working in a state hospital (58%).

DISCUSSION

Total knee arthroplasty is an operation that can be performed under both general anesthesia (GA) and regional anesthesia (RA) (9). The administration of GA or RA may vary depending on the anesthesiologists, surgeon and patient's choice. Since RA is associated with decrease in blood loss, surgical site infections, admission rate to intensive care, hospital stay and postoperative mortality rate, it is also associated with lower morbidity compared to general anesthesia (10-12). According to the results of our study, RA is preferred in our country with a rate of 93.7% (237), 61.3% (155) of this figure is spinal anesthesia (SA) and 32.4% (82) is combined spinal epidural anesthesia (CSEA). The general anesthesia rate is 4.7% (12) and very low. According to the survey study conducted by Hannon et al., SA ranks first with a rate of 74.4% in the USA, while the rate of GA is much higher (23%) and the rate of CSEA (1%) is very low (13). In a national survey study conducted in France in 2010, the GA is the first preference and the GA/SA ratio is 60%/41% (14). According to a national survey conducted in France in 2020, the GA/SA ratio showed an increase (64.1% / 35.9%) (15). In a meta-analysis study, the RA rate in TKA was reported to be 58.8% (SA ratio: 51.1%) and the GA rate to be 33.5% (8). Today, the tendency in regional anesthesia practice shifted towards peripheral nerve blocks rather than the central blocks. PNBs provide analgesia equivalent to epidural anesthesia with fewer side effects. Thus, CSEA, which is a central block, is globally losing its former importance (16). Despite this, they are still highly preferred in our country compared to other countries, which may be linked to the fact that the administration of PNBs in our country does not go a long way back. CSEA is preferred to a higher extent among physicians working in private hospitals.

For many years, opioids have been used as adjuvant drugs in neuraxial anesthesia. The effects of intrathecal opioids such as accelerating the onset of block, increasing the quality of preoperative and postoperative analgesia as well as side effects such as respiratory depression, itching, nausea and vomiting limit their use (17-19). According to our study, the majority of the participants do not use adjuvant drugs in neuraxial anesthesia (67.5%) and participants who use it mostly prefer Fentanyl. Hannon et al. reports that the rate (91%) of those who did not use adjuvant drugs is quite high (13). One of the purposes of use of intrathecal opioids is to prevent hemodynamic instability by reducing the required dose of local anesthetic. We think that intrathecal opioids are preferred in these surgeries at a lower rate because low-level spinal anesthesia, which is sufficient for TKA, usually does not result in hemodynamic instability. In the literature, intrathecal morphine is administered at higher rates in TKA, contrary to the higher preference for Fentanyl in our study (20-22).

The purpose of pre-emptive analgesia is to modulate the sensitivity of peripheral and central pain pathways by reducing the production of inflammatory chemicals associated with surgery (23). As part of the ERAS (Enhanced recovery after surgery) protocol, preemptive oral analgesia has been supported as a part of the multimodal approach to optimize post-TKA outcomes (24,25). Acetaminophen, opioid, NSAIDs, pregabalin and gabapentin are among the commonly used drugs. According to our study, preemptive analgesia is not used frequently (81.1%), and those who use it mostly prefer opioid, NSAID and Paracetamol. Hannon et al. reports that preemptive analgesia is used with 93.2% and acetaminophen, celecoxib, gabapentin and controlled-release oxycodone are the most frequently preferred medicaments (13).

In total knee arthroplasty, postoperative pain varies between moderate and severe. Insufficient postoperative analgesia disrupts rehabilitation, prolongs hospital stay and increases the risk of adverse events such as myocardial ischemia/infarction, pulmonary dysfunction, paralytic ileus, urinary retention and thromboembolism. Chang and Cho reported that the analgesia protocols for TKA considerably vary in the literature. The ideal approach is to provide excellent analgesia that minimizes opioid consumption and increases rehabilitation (26,27). Thanks to the innovations brought by the use of ultrasound to RA, PNB is increasingly administered for postoperative analgesia. According to our study, approximately half of the participants administer PNB, and it is predominantly performed in training hospitals. Participants most frequently stated that they could not administer PNB due to "lack of education". Gurkan et al. report in their study titled "Changing trends and regional anesthesia in Turkey" that 54% of participants found the pre-graduation training on PNB insufficient, similar to the results in our study and 60% reported that they participated in a training activity after graduation (28). The rates of PNB were 96.2% in the study by Aveline et al. and 68.7% in the study by Hannon et al., which are considerably higher than the rate found in our study (13, 15). A large number of training modules have been organized for a long time in order to expand the administration of PNB across Turkey. In their survey, Gurkan et al. report that the PNB administration rate in

2011 was only 12% for all blocks in our country; however, when we consider the femoral nerve blocks and adductor canal blocks, this rate increases to 49.8% in our study (28).

Peripheral nerve blocks are an essential part of multimodal analgesia in TKA. Femoral nerve block (FNB), sciatic nerve block, obturator nerve block, fascia iliaca compartment block and adductor canal block (ACB) are among the blocks administered in TKA (8). FNB is among the oldest blocks used in TKA and is frequently administered as it is easy to apply and provides good analgesia in the anteromedial part of the leg. Any combination with other blocks provides a more effective analgesia compared to monoblock. The combination of femoral-sciatic nerve blocks is emphasized in several studies as the optimum analgesic approach (8). The primary disadvantage of FNB is the risk of falling due to motor block (29, 30). While ACB provides analgesia of the anteromedial part of the leg similar to FNB, it preserves, unlike FNB, the function of the quadriceps muscle and facilitates postoperative rehabilitation by allowing patients to actively participate in knee movement (23,31). According to our survey, the majority of those who administer PNB prefer FNB (FNB/ACB: 88.7%/39.9%) and state that they prefer FNB because they find FNB easier to administer. The most important advantage of ACB over FNB is that it allows early mobilization, which is a key parameter in ambulatory surgery (AS). In countries where TKA is performed in the form of AS, the preference for ACB (90.9%) is significantly high (13). One of the possible reasons why the administration rate of ACB is lower in our country is that TKA is not performed as an ambulatory surgery.

PNB administration can be performed as single-shot or continuous infusion via a catheter. CPNB (Continuous Peripheral Nerve Block) is used at a lower rate due to various reasons such as technically difficulties, high cost, duration (time-consuming), infection risk and catheter displacement (32). According to our study, the rate of catheter insertion (11.4%) in PNB is considerably low. Similar to our study, the rate of catheter insertion (19%) was found to be low in the study conducted by Hannon et al. Aveline et al. reports that this rate is considerably high (99.4%) and the femoral nerve block (57.9%) and adductor canal block catheters (42.1%) are mostly preferred (13, 15). Bouaziz et al. reports that the rate of administering femoral nerve block catheter was 80% (14).

Participants stated that they administered PNB frequently in the operating rooms (62%), followed by the recovery rooms (31.6%). Contrary to our study, Bouaziz et al. reported that they administered PNB most frequently in the recovery rooms (43%), which were followed by pre-induction anesthesia rooms (28%) and operating rooms (16%) (14). In our country, since "pre-induction anesthesia rooms" are not widely used in the anesthesia practice, the rate of administering regional anesthesia in the operating rooms is high. This may limit anesthesia applications in clinics with high patient circulation. After the comfort brought by PNB administration to the surgeon in postoperative pain relief was understood, any time pressure on anesthesiologists was relieved and surgeons can demand from anesthesiologists to administer PNB. According to our study, one third of the participants stated that the orthopedist requested from the anesthesiologist to administer PNB. TKA, which is administered as AS in many countries, still requires 2-3 days of hospitalization in our country. We believe that if TKA is administered in the form of AS, an orthopedist is more likely to demand the administration of PNB.

LIMITATIONS

In our survey, questions focused on the femoral nerve blocks and adductor canal blocks, which are preferred the most for TKA. Questions could also cover other blocks administered in TKA such as sciatic nerve block, obturator nerve block, fascia iliaca compartment block, IPACK block or any combination thereof.

CONCLUSION

Postoperative analgesia practice in total knee arthroplasty varies in our country, similar to the rest of the world. We witness that the administration of PNB, which holds an important place in the postoperative analgesia, is administered at a lower rate in our country compared to other countries and we think that further training is required on this subject.

****The number of participants may be inadequate to reflect the overall situation in Turkey.*

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