ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 10 | October - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A COMPARATIVE STUDY OF COMBINED SPINAL EPIDURAL FOR SINGLE TKR WITH SINGLE SPACE DOUBLE NEEDLE TECHNIQUE, AND DOUBLE SPACE DOUBLE NEEDLE TECHNIQUE

Anaesthesiology

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KEYWORDS

SED, PED, SSD, TKR, CSE

INTRODUCTION:

Total knee replacement (TKR) is a common operative procedure to improve pain, function, and quality of life in patients with severe grade knee osteoarthritis (OA)[1]. Different anesthetic approaches and combinations such us general anesthesia (GA), neuroaxial anesthesia (epidural or spinal) and/or peripheral nerve blocks have been used in TKA [2]. Combined spinal-epidural anesthesia can be performed either as a single-space (needle through needle or separate needle) or double-space technique [3].

The combined spinal–epidural (CSE) technique produces reliable and rapid onset of spinal anesthesia which is commonly performed "needle-through-needle" in which the spinal needle is advanced through the lumen of the epidural needle and double barrel needle technique designed with two barrels: one for the performance of the spinal component and the other for the passage of the epidural catheter. [4-6].The most commonly used opioids for CSE anesthesia were fentanyl and sufentanil to supplement low-dose local anesthetic (e.g., isobaric/hyperbaric bupivacaine, ropivicaine or levobupivacaine) [7]. Estimation of the skin to subarachnoid space distance (SED) and, the posterior epidural space distance (PED) reduces complications related to spinal anesthesia [8, 9]. We conducted the study to compare both single needle through needle and, double space double needle CSE anesthetic technique and to correlate the Skin to epidural space distance (SED), Skin to subarachnoid space distance (SSD) and Epidural to subarachnoid space distance (ESD) difference based on patient characteristics.

AIM:

For combined spinal epidural anaesthesia which technique is better between single space needle through needle and double space double needle technique.

MATERIALS AND METHODS:

It is a randomized control observational study conducted at a tertiary care hospital among patients undergoing Single TKR surgery with CSE anesthesia. Patients were classified into two groups based on the anesthetic procedure. Each group consists of 50 participants. Participants in Group A undergone surgery using single needle through needle anesthesia and, participants in Group B were undergone surgery using double space double needle technique for CSE anesthesia.

The Skin to epidural space distance was measured by loss of resistance detection using air and saline filled syringes from skin , in lumbar vertebral space Skin to subarachnoid space distance is measured by depth of needle insertion to reach CSF and the epidural to subarachnoid distance is calculated by the difference of epidural space and subarachnoid space

Inclusion Criteria:

- Patients undergone single TKR surgery with single needle through needle and double space double needle CSE anesthesia techniques
- Patients above the age of 30 and .ASA 1,2,3A

Exclusion Criteria:

- Patients who previously undergone knee replacement surgery
- Patients below the age of 30.Patients not consented for CSE.

The study was initiated after taking approval from the ethics committee and the importance of study was thoroughly explained to the patients and their caretaker in their own language. Informed and consent were taken from patients willing to be included in the study. The details of the patients were taken and results were interpreted.

Statistical Analysis:

The statistical analysis was performed using IBM SPSS Statistics v23.0. The qualitative variables were expressed as numbers and percentage. Chi Square test were used to analysis the results. $P \leq 0.05$ was considered statistically significant. The qualitative variables were described as mean ± standard deviation. Analysis of variance is used in determining the correlation between BMI and gender with SED, SSD and ESD. $P \leq 0.05$ was considered statistically significant.

Procedure: ASA 123A grade patients planned for TKR Total knee replacement selected random and divided into two groups . Group A 50 patients combined spinal epidural anasthesia given with single space needle through needle technique .Grop B 50 patients combined spinal and epidural anaethesia given double inter vertebral space with two different needles one Touhy and one subarachnoid needles. While doing on these patients measured the Skin to epidural space distanceSED ,then Skin to sub arachnoid space distance and calculated the epidural to subarachnoid distances in both groups .Results discussed with the charts and conclusion given from the study.

RESULTS:

The mean age of patients admitted for Single TKR surgery undergoing single space needle through needle anesthesia were 59.36 ± 8.23 and double space double needle were 57.88 ± 6.78 and most of them were females in both groups with an average BMI of 24.6 ± 3.64 and 25.58± 3.09. Most participants were ASA Grade 2 and 3 in both groups. The ratios of OA, RA, and TOA for patients admitted for single TKR in Group A were 7.25:4.25:1 and, 11:4.67:1 in Group B.

Table 1: Baseline Characteristics Of Patients Undergoing Single TKR Surgery:

Baseline Characteristics	Group A Single space (N = 50)	Group B Double space (N = 50)	P value
Age	59.36±8.23	57.88±6.78	0.3288
Sex (Male/Female)	15/35	18/32	0.523
BMI	24.6 ± 3.64	25.58 ± 3.09	0.1499
ASA (1/2/3)	5/23/22	2/24/24	0.498
Reason for Surgery (OA/RA/TOA)	29/17/4	33/14/3	0.708

Participants with complication mentioned in table 2 undergoing single TKR surgery should undergo following monitoring process and preoperative optimization to reduce the risk during surgery.

The single space needle through needle anesthesia procedure takes a mean time of 10.42 ± 1.26 minutes and, costs up to 4000 INR. The double space double needle technique takes a mean time of 15.02 ± 1.79 minutes and, cost up to 3500 INR. The injection sites of both procedures were L2- L3-4 interspaces with SAB 27 Gauge, epidural 18/G needles. The mean time for a single TKR surgery in group A and group B were 90.34±6.15 minutes and, 91.24±6.72 minutes with a mean anesthesia time of 161.4 ± 8.4 minutes and 157.58 ± 10.78 minutes. The numbers of failed lumbar puncture attempts were higher in Group B. The drug and dosing of both groups were same with an additional Intravenous Preloading of Hart man solution ½ liter pre procedure in group A. ECG, NIBP, SpO2,RR and Hourly urine output ECG, NIBP, SpO2,RR and Hourly urine output were monitored in both groups during and O_2 by mask with ET CO_2 was used for Spontaneous ventilation during surgery. On statistical analysis we found a significant difference between anesthesia procedure duration and cost.

Table 2: Monitoring Parameters And Preoperative Optimization For Patients With Complications:

Co- morbid diseases undergoing Single TKR in our population--	Monitoring Parameters & Preoperative optimization	
	Group A Single space (N = 50)	Group B Double space (N = 50)
Diabetes Mellitus Hypertension Hypothyroidism	**Monitoring Preoperative Parameters** Pre Routine haemogram ,renal	**Monitoring pre operative Parameters -** Routine haemogram ,renal , Liver
Renal impairment under control AKD/CKD control POST CABG Valve replacement CAD – CAG h/o DVT etc	parameters, ECG, Echo heart, C- X-ray PA, cardiac ,renal ,Liver parameter, **Preoperative optimization – euglycaemics,** Stoppage of oral anticoagulants in case of DVT and prosthetic cardiac valve replacement and starting on LMWH and stopping LMWH 12 hrs before CSE,	parameters, ECG, Echo heart, C- X-ray PA, renal **Preoperative optimization** Stoppage of oral anticoagulants in case of DVT and prosthetic cardiac valve replacement and starting on LMWH and stopping LMWH 12 hrs before CSE

Table 3: Comparison Of Single Space Needle Through Needle And Double Space Double Needle Anesthesia Techniques In Patients.

Parameters	Group A Single space (N = 50)	Group B Double space (N = 50)	P Value
Procedure Duration (min)	10.42 ± 1.26	15.02 ± 1.79	<0.001*
Cost of procedure (Rupees)	4000	3500	<0.001*
Injection Site	L2-L3-4 interspaces Sitting , midline approach	L2-L3–4 interspaces. Sitting, Midline approach	-
Number of failed lumbar puncture attempts	5	11	0.1336
Operation Time (mins)	90.34±6.15	91.24±6.72	0.4864
Anesthesia time	161.4 ± 8.4	157.58 ± 10.78	0.0509
Drugs and dosing	Intravenous Preloading of Hart man solution ½ liter pre procedure Bupivacaine 0.5% 3ml + Fentanyl (0.25 µg intrathecal IV fentanyl 75 µg, 45 minutes Epidural activated with 5 ml 0.5% bupivacaine	Bupivacaine 0.5% 3ml + Fentanyl 25 µg intrathecal IV fentanyl 75 µg, 45 minutes Epidural activated with 5ml bupivacaine 0.5%	-
Needle size	SAB 27 Gauge , epidural 18/G	SAB 26Guage, 27 Gauge, Epidural18/G	-
Monitoring	ECG, NIBP, SpO2, RR and	ECG, NIBP, SpO2, RR and	
Parameters	Hourly urine output.	Hourly urine output.	-
Ventilation	O_2 by mask with ET CO_2 tube connection spontaneous	O_2 by mask with ET CO_2 tube connection spontaneous	-

On assessment on side effects due to anesthesia we found occurrence of side effects in both groups. The incidences of side effects were bradycardia (2% vs. 2%), hypotension (16% vs. 10%), backache (8% vs. 14%), headache (4% vs. 4%), dizziness (6% vs. 8%) and, nausea (2% vs. 4%). The occurrence of side effects is slightly higher in patients undergoing double space double needle anesthetic procedure. On statistical analysis there is no significant difference in occurrence of side effects between groups.

Table 4: Post Anesthesia Side Effects

Incidence of Side effects	Group A Single space single needle N = 50	Group B Double space double needle N = 50	P Value
Bradycardia	1(2%)	1(2%)	0.7518
Hypotension	8(16%)	5(10%)	
Backache	4(8%)	7(14%)	
Headache	2(4%)	2(4%)	
Dizziness	3(6%)	4(8%)	
Nausea	1(2%)	2(4%)	

There is a correlation of Age and, BMI with the distance from the skin to the epidural space (SED) and, distance from skin to subarachnoid space. The distance from the skin to the epidural space (SED) and, distance from skin to subarachnoid space were significantly higher in males. As BMI increases, the distance from skin to the epidural space and distance from skin to subarachnoid space also increases. There is no significant correlation between Age and, BMI with epidural space to subarachnoid space distance.

Table 5: Association Between Epidural And Subarachnoid Distances With Patients Characteristics:

	Epidural and Subarachnoid space	Patients From both Single space and double space	P value
Skin to epidural space distance (SED) (in cm)			
Mean	4.46 ± 0.68		
Sex	Male	4.57 ± 0.39	<0.0001*
	Female	4.24 ± 0.38	
BMI	Underweight	3.58 ± 0.31	
	Normal	4.27 ± 0.43	
	Overweight	4.53 ± 0.48	
	Obese	5.25± 0.85	
Skin and subarachnoid space distance (SSD) (in cm)			
Mean	5.44 ± 0.42		
Sex	Male	5.61 ±0.35	<0.0001*
	Female	5.21 ± 0.43	
BMI	Underweight	4.55 ± 0.31	
	Normal	5.16 ± 0.39	
	Overweight	5.5 ± 0.48	
	Obese	6.18 ± 0.90	
Epidural space and subarachnoid space distance (ESD) (in cm)			
Mean	0.976 ± 0.09		
Sex	Male	0.986 ± 0.08	
	Female	0.965 ± 0.091	0.2233
BMI	Underweight	0.97 ± 0.078	
	Normal	0.969 ± 0.092	
	Overweight	0.99± 0.07	
	Obese	0.967 ± 0.1	

DISCUSSION:

This study aims to compare both types of techniques and, to see the anatomical distances from skin to epidural, skin to subarachnoid space and epidural to subarachnoid space. The mean age of patients admitted for Single TKR surgery undergoing single space needle through needle anesthesia were 59.36 ± 8.23 and double space double needle were 57.88 ± 6.78 and most of them were females in both groups with an average BMI of 24.6 ± 3.64 and 25.58 ± 3.09.. The average age of patients undergoing unilateral total knee replacement (TKR) varies between 63.00 ± 6.17 years old and prevalence was higher among women than among men with an increase in incidence of TKR in patients from obese class III [10-12]. The ratios of OA, RA, and TOA for patients admitted for single TKR in Group A were 7.25:4.25:1 and, 11:4.67:1 in Group B.

Routine haemogram, renal parameters, ECG, Echo heart, C-X-ray PA, cardiac fitness if necessary and renal parameter were monitored before

surgery and preoperative optimization was performed by stoppage of oral anticoagulants in case of DVT and prosthetic cardiac valve replacement and starting on LMWH and stopping LMWH 12 hrs before CSE.

The mean time of single space needle through needle anesthesia procedure was 10.42 ± 1.26 minutes and, costs up to 4000 INR and, double space double needle anesthesia is.

CONCLUSION:

1. Our study concludes While performing combined spinal and epidural(CSE) 1. posterior epidural distance (PED) , is around 4-6Cm in majority. Skin to Epidural space in majority (SED) 3.5 to 5cm and gradual careful insertion of epidural needle which helps to avoid inadvertent 8dural puncture.
2.CSE- needle through needle technique offers to finish CSE procedure slightly in lesser duration of time when compared to two space different needles technique in majority in trained hands
3. Both techniques costs nearly same with marginal difference
4.During single space needle through needle technique after identifying epidural space subarachnoid space reached by subarachnoid spinal needle by further advancing through epidural needlle 4 to 10 mm (less than 1 cm) in majority.

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