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A Prospective Study of Combined Spinal And Epidural Anaesthesia For Hip And Major Lower Limb Surgeries In Elderly Patients

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Abstract:
INTRODUCTION:
The combined spinal epidural technique involves intentional subarachnoid blockade and epidural catheter placement during the same procedure. Ideally it combines the best features of spinal and epidural blockade and avoids their respective disadvantages. With the combined spinal epidural techniques, surgical anaesthesia was rapidly established saving 15 to 20 minutes, compared with epidural anaesthesia.
AIMS & OBJECTIVES:
1. *To evaluate the safety and efficacy of combined spinal-epidural anaesthesia in lower limb surgeries*
2. *To find the regional anaesthetic technique that provides adequate surgical anaesthesia and analgesia with minimal side effects.*

RESULTS:
The onset of analgesia was 3.4±1.0 min. The epidural dose caused further ascent of sensory analgesia by three to four segments with an average of 2.6 ± 0.9 segments. The time taken for the onset of the motor blockade was 5.8 ± 1.1 min. The time taken for the complete recovery from the C.S.E. was 291.3 ± 29.9 min.
CONCLUSION: Combined spinal-epidural technique provides an opportunity to utilize the major advantages of spinal and epidural anaesthesia. C.S.E. produces a multi compartment block, such that behavior of the spinal block may be modified by subsequent epidural injections. C.S.E. has been incorporated into the armamentarium of regional anaesthetic technique; it may be the optimum regional technique for lower limb orthopedic procedures.

Keywords: *BUPIVACAINE, BUTORPHANOL, FENTANYL, CSE.*

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I. Introduction

Most of the lower limb surgeries are conducted under spinal or epidural anaesthesia. The disadvantages of spinal (i.e. single shot nature, unpredictable level of blockade, time limit) and epidural anaesthesia (i.e. missed segments, incomplete motor block, poor sacral spread, local anaesthetic toxicity, time consuming) led to the development of combined spinal epidural anaesthesia.

The combined spinal epidural technique involves intentional subarachnoid blockade and epidural catheter placement during the same procedure. Ideally it combines the best features of spinal and epidural blockade and avoids their respective disadvantages.[1,2] With the combined spinal epidural techniques, surgical anaesthesia was rapidly established saving 15 to 20 minutes, compared with epidural anaesthesia.[3]

II. Aims & Objectives

3. To evaluate the safety and efficacy of combined spinal-epidural anaesthesia in lower limb surgeries.
4. To find the regional anaesthetic technique that provides adequate surgical anaesthesia and analgesia with minimal side effects.

III. Patients And Methods

This prospective study was conducted in the Department of Anaesthesiology in association with Departments of Orthopedics, Government General Hospital, is a tertiary teaching hospital affiliated to Guntur Medical College, Guntur from January2017 to January 2018.Clearance was obtained from hospital ethics committee for the study. Informed consent was obtained from all the patients. The study of 100 consecutive patients coming for elective Orthopedic, hip and major lower limb surgeries were included.

Exclusion criteria:

1) Patients who are known sensitive to bupivacaine
2) Patients on anticoagulant therapy.
3) Patients with bleeding diathesis
4) Patients with infections on the back
5) Patients with spinal deformities
6) Patients with history of peripheral neuropathy.
7) Patients with CNS disorders.

IV. Methodology

Procedure:

After infiltration of local anaesthetic, by using needle through needle technique, with a 18 gauge 'Tuohy' needle, epidural space was identified with loss of resistance to air technique and confirmed with a hanging drop technique. Then a 27 G long 'Whitacre' Spinal needle was introduced through the epidural needle, to locate the subarachnoid space and 10 mg of 0.5% bupivacaine (heavy) was deposited in the subarachnoid space. After withdrawing the spinal needle carefully a 20G epidural catheter was threaded through the epidural needle into the epidural space in cephalad direction up to about 3 to 5cm. The epidural needle was slowly pulled out without disturbing the catheter. The catheter was well secured with plaster and patient was positioned.
The following parameters are studied

1) Assessment of sensory blockade: Sensory blockade was assessed by pinprick and time noted for the block to reach different dermatomal level.

i) Onset of sensory block
ii) Maximum height reached and time required.
iii) Duration of analgesia
iv) Quality of analgesia

2) Assessment of motor block : Bromage scale.

3) Volume and dose :

I. Total volume (ml) of local anaesthetic (Initial dose + top-up doses]
II. Total dose(mg) of local anaesthetic

4) Duration of combined spinal epidural anaesthesia
5) Hemodynamic changes
6) Complications:

The following parameters were observed:

1) **Time of onset of analgesia:** This was taken as the time from the deposition of the drug to the feeling of tingling sensation in the legs.
2) **Time of onset of paralysis (motor blockade):** This was taken as the time from onset of paresis to the loss of power i.e. patient was not able to lift the legs (Bromage test).

- No block (0%): Full flexion of knees and feet possible.
- Partial block (33%): Just able to flex knees, still full flexion of feet possible.
- Almost complete (66%): unable to flex knees but flexion of feet possible.
- Complete (100%): unable to move legs or feet.

3) Duration to reach maximum height: This was taken as the time interval between the deposition of the drug and the loss of sensation at highest dermatomal level.

Complete recovery: This was taken as the time from the onset of paresis to complete recovery of sensations.

4) Quality of surgical analgesia and patient comfort:

Excellent - No supplementary drug required.

Good - Analgesic required.
Fair - More than one analgesic required
Poor - General anaesthesia required.

V. Observations And Results

Table : Age distribution

Age in Years	**Male**	**Female**	**Total**
60-65	44	28	72
66-70	11	10	21
71-75	0	1	1
76-80	3	3	6
Total	**58**	**42**	**100**
Mean age ± SD	**63.90 ± 4.916**YRS	**65.45 ± 5.478** YRS	**64.55 ± 5.190**YRS.

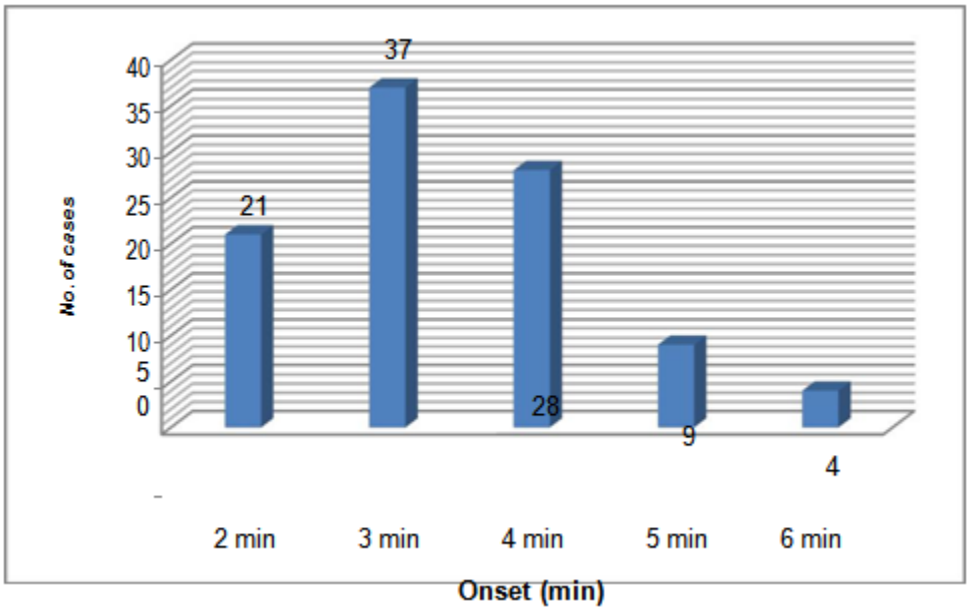
Table shows the age distribution in our study. It was observed that, the mean age for male was 63.90 ± 4.916 yrs and for the female was 65.45 ± 5.478yrs. The overall average age in our study was 64.55 ± 5.190 yrs. In our study male were 58% and female were 42%.

Table : Onset of sensory analgesia

Onset time (min)	**Number**
2	21
3	37
4	28
5	9
6	4
Failure	1
Mean time± SD	3.4 ± 1.0 min.

The above table and Graph shows the onset of sensory analgesia (min) in number of patients. Greater number of patients had onset of sensory analgesia was within 3 mins. The overall mean onset of sensory analgesia in our study was 3.4 ± 1.0 min. In our study one patient does not show the initial onset of sensory analgesia was considered that the failure of the spinal component of combined spinal epidural technique.

Graph : Onset of sensory analgesia



Onset of motor blockade(Bromage classification)

Bromage grade	Range in min	Mean ± SD in min
I (0%)	1-5	2.9 ± 1.0
II (33%)	1.5-6	3.9 ±1.0
III (66%)	2-8	4.7± 1.2
IV (100%)	3-8	5.8 ± 1.1

Table shows the onset of motor blockade by Bromage classification. The mean duration to achieve 100% (grade IV) motor blockade was 5.8 ± 1.1 min.

TABLE: The mean pulse rate

Time min	Pulse rate + SD/min
0	85.7 ± 9.8
5	85.8 ± 10.2
10	83.2 ± 14.5
15	81.2 ± 12.3
45	81.3 ± 9.5
60	80.2 ± 8.3
90	80.8 ± 9.4
120	81.2 ± 9.6

150	79.9 ± 9.1
180	79.3 ± 8.7
210	79.7 ± 7.5

There is no significant change in the pulse rate.

Mean of systolic BP readings

Time in min	Systolic BP mm/Hg mean ± SD
0 min	121.8 ±9.7
5 min	122.0 ± 7.5
10 min	118.2 ± 11.3
15min	114.4 ± 11.3
45 min	115.0 ± 9.6
60 min	113.1±8.2
90 min	113.4 ± 7.8
120 min	115.7 ± 9.0
150 min	117.6 ± 10.3
180 min	119.9 ± 10.5
210 min	120.2 ±11.3

Table shows the intraoperative mean systolic pressure ± SD mm Hg. Intraoperative systolic pressure shows a decline to 113.1 ± 8.2 mm Hg.

Mean of diastolic pressure readings		
Time in min		**Diastolic BP mm/Hg mean ± SD**
0 min		79.8 ± 7.1
5 min		78.6 ± 5.5
10min		75.4 ± 7.2
15min		72.3 ± 4.8
45 min		74.8± 4.6
60 min		75.2 ± 4.4
90 min		77.0 ± 5.5
120 min		78.1 ± 3.8
150 min		78.2 ± 4.3
180 min		77.4 ±6.5
210 min		77.4 ± 6.5

The above Table shows the intraoperative mean diastolic pressure changes. The mean of diastolic BP at the start of procedure was 79.8 ±7.1 mm Hg. The intraoperative mean of diastolic BP show a decline of 72.3 ± 4.8mm Hg.

Average extension of sensory blockade after epidural top up

Increase of segments	**No. of cases**
1	4
2	57
3	22
4	11
5	5

The above table shows the extension of sensory blockade after administration of the epidural drug. In our study 57patients shows the extension of two segments after epidural injection followed by 22 patients shows 3 segments extension. The overall average extension of sensory blockade after epidural top up was 2.6 ± 0.9 segments.The extent of sensory blockade under spinal dose range from T7 to T11 with the average of T10. The extent of blockade showed a definite cephalad rise under the influence of epidural drug. The level of sensory blockade after epidural top up range from T_5 to T_9 with the average of T_7.

Total duration of C.S.E. (complete recovery)

Time duration min	**No. of patients**
200-250	13
251-300	63
301-350	20
351-400	4
Total	100

The above table shows time taken for complete recovery.

In our study 63% of patients had complete recovery from the blockade in 251-300 min. 20% of patients had complete recovery from the blockade in 301-350 min. 13% of patients had complete recovery from the blockade in 200-250 min and 4% of patients had complete recovery from the blockade in 351-400 min. The mean ± SD of time required for complete recovery from the blockade was 291.3 ± 29.9 min.

Postoperative pain relief (By patient feedback)

Comfort	No. of patients (%)	
Excellent	42	(42%)
Good	53	(53%)
Fair	5	(5%)

In the present study we are using 0.125% bupivacaine in 4 hourly interval upto 72 hours for postoperative pain relief. By patient feedback questionnaire by using VAS score, 53% of patient's opinion was good and 42% of patient's opinion was excellent regarding postoperative pain relief. Only 5% of patient experience fair regarding postoperative pain relief.

VI. Discussion

The combined spinal epidural technique involves intentional subarachnoid blockade and epidural catheter placement during the same procedure. C.S.E. allows a rapid onset of neuraxial blockade, which can subsequently be prolonged or modified.

Onset of block:

The mean time of onset of analgesia in C.S.E. observed by various authors ranged from 2 to 15 min.

Author	C.S.E. (min)	Drug used
Holmstrom.B et al (1993)[4].	4.5 ± 2.0	0.5% Bupivacaine
Hamdani .et al (2002)[12]	3.8 ± 2.6	0.5% Bupivacaine
Present study	3.4±1.0	0.5% Bupivacaine

Holmstrom B. et al 1993[4] found the mean onset time of sensory-blockade was 4.5 ± 2.0 min and in another study, Hamdani et al 2002[12] found the mean onset time of sensory blockade was 3.8 ± 2.6min. In the present study, 95% of the patients mean onset time of sensory analgesia was 3.4 ±1.0 min. In all the studies, the drug used was 0.5% bupivacaine. The significant faster onset in C.S.E. was due to intrathecal bupivacaine, which helps, in early optimal conditions for surgery.

Maximum Height reached after subarachnoid block.

Nightingale et al (1981) found the maximal level of analgesia in the range of $T_4$to $T_{12}$with mean level of T_8. Veering et al (1988) found the maximal level of analgesia in the range of T_8 to T_{10} with an average of T_9. In the present study, we used 2 ml of 0.5% hyperbaric bupivacaine. The maximal level of analgesia achieved was in the range of T_7 to T_{11} with an average of T_9.

Enhancement of sensory block by epidural dose in C.S.E.

Several studies have shown that analgesia levels obtained after subarachnoid injections of a hyperbaric local anaesthetic solution followed by minimal dose of epidural drug are higher than when performing either technique individually.

Enhancement of block after epidural dose

Author	**Spinal**	**Epidural**				
KeshavSharm	2.5ml	8ml	of	2% lidocaine	T_8	T_5
a et al(1994)[6]	0.5%Bupivacaine(	withadrenaline				
	Heavy).					
Stienstra et	2ml of	10ml	of	0.5%Bupivacaine	T10	T_5
al(1996)[7]	0.5%Bupivacaine					
Steinstra et	2ml of	5ml	of	0.5%Bupivacaine	T_8	T_5
al(1999)[7]	0.5%Bupivacaine					
Sivasenthil(20	2ml of	10ml of		0.5%Bupivacaine	T_8	T_3
00)[8]	5%lidocaine					
Hamdani etal	1ml of	2ml	of	0.5%Bupivacaine or	T10	T6
(2002)[12]	0.75%Bupivacaine	even[1] unblocked segment				
Present study	2ml of 0.5%	8ml	of	0.5% Bupivacaine	T10	T_7
	Bupivacaine					

Keshav Sharma et al found the average mean segmental sensory level after spinal was T_8. In our study the mean segmental sensory level after spinal was T_{10}. The difference in attaining the average segmental sensory level may be due to the difference in the volume of drug used for intrathecal injection. The average increase in the segmental sensory level after epidural top up was found to be three segments in both the studies, as the volume of the drug used for the epidural top up was same. This clearly shows, the volume of the drug used for epidural top up helps in cephalad increase in segmental sensory level.

Stienstra R. et al(1996) found the maximal sensory level after spinal anaesthesia was T10. In our study the mean segmental sensory level after spinal was T10. The segmental sensory levels attained in both the studies were same because the volume of drug used for intrathecal injection was same. They found an increase of five segments after epidural top up of 10ml of 0.5% bupivacaine. In our study, the mean increase in sensory level was three segments after epidural top up of 8ml of 0.5% bupivacaine. The difference in attaining the segmental sensory level of blockade was due to difference in volume of drug.

Stienstra R et al reported that not only the volume but also the local anaesthetic by themselves contribute to an increase in dermatomal level of block in C.S.E..

Stienstra R et al(1999) in another study found the maximal sensory level after spinal block was T_8 and the increase in sensory level upto T_5 segment after epidural top up of 5ml of 0.5% bupivacaine. While comparing this study with his previous study, he failed to attain the same dermatomal level of analgesia after the epidural top up. This may be due to the decrease in the volume of drug used for epidural top up.

Sivasenthil et al (2000) found the mean sensory level after spinal was T8, in our study mean segmental sensory level after spinal was T10. The difference in attaining the segmental sensory level was due to use of different drug for intrathecal injection, as they used 2ml of 5% lidocaine (Heavy) for intrathecal injection but in our study, we used 2ml of 0.5% bupivacaine (heavy) for intrathecal injection.

Sivasenthil et al, found the increase sensory level of 5 segments after the epidural top up of 10ml 0.5% bupivacaine. In our study, we found the increase in sensory level of three segments after the epidural top up of 8ml of 0.5% bupivacine and this difference in attaining the sensory level may be due to the difference in volume of drug injected into the epidural space.

Blumgart et al[9] postulated that the extension of sensory blockade is caused by an epidural volume effect in which dural sac in compressed by the injected solution, resulting in a cephalad shift of C.S.E. containing local anaesthetic.

Suzuki et al[10] reported that a small amount of local anaesthetic spread into subarachnoid space through the dural puncture after epidural top up blocked the caudal nerves. But in our study, there is a definite cephalad rise in sensory level of block under the influence of epidural top up.

There was no incidence of the hemispinal block or patchy distribution Epidural local anaesthetic solution.

Onset of Motor blockade: Time of onset of Motor blockade

Author	C.S.E. min	Drug used
Nickalls RWD (1994)[11]	3.7±1.9	5% lidocaine and
		0.5% Bupivacaine
Present study	5.8±1.1	0.5% bupivacaine (H)
		0.5% bupivacaine

Bromage classification was used to assess the motor blockade. In our study the duration of onset of motor blockade was from 3to 8 min with an average of 5.8 ± 1.1 min. **Nickalls RWD et al**[11], reported the onset time of motor blockade was 3.7 ±1.9min as they used 5% lidocaine (heavy) for intrathecal injection. While comparing our study with his study, the onset time of motor blockade was prolonged as we used 0.5% bupivacaine (heavy) for intrathecal injection.

DURATION OF ANALGESIA

In the present study, 2 ml of 0.5% Bupivacaine (heavy) was used for intrathecal and 8 ml of 0.5% Bupivacaine for epidural blockade. The analgesia lasted from 250-350 minutes. In most of the studies of C.S.E., the authors have used 0.5% bupivacaine (heavy) for spinal and further epidural top-up was continued with 0.5% bupivacaine.

Duration of analgesia (C.S.E.)

Author	Spinal	Epidural	Duration in Minutes
Stienstra et al (1996)[7]	2ml of 0.5% Bupivacaine.	10ml of 0.5% Bupivacaine.	230 ±10.2
Sivasenthil (2000)[8]	2ml of 5% lidocaine (heavy)	10ml of 0.5% Bupivacaine.	130±18.2
Hamdani et al (2002)[12]	1ml of 0.75% Bupivacaine	2ml of 0.5% Bupivacaine for every unblocked segment	210±6.7
Blumgart et al (2002)[9]	2.5ml of 0.5% Bupivacaine (H)	8ml of 2% lidocaine with adrenaline	107±13.8
Present study	2ml of 0.5% Bupivacaine (H)	8ml of 0.5% Bupivacaine	291±29.9

This clearly shows that, there is definite increase in the duration of analgesia with C.S.E.

Volume and dose of drug:

The volume of drug used in C.S.E. by various authors for epidural top up was 8 to 10ml after the intrathecal injection of 2-2.5ml of local anaesthetics. In our study, the volume of drug used for epidural top up was 8ml of 0.5% bupivacaine after the intrathecal injection of 2ml of 0.5% bupivacaine (heavy) For one case we used 8±8 ml of 0.5% bupivacine epidurally due to failure of spinal component of C.S.E. This clearly shows that the smaller total volume of drug is a definite advantage in favour of C.S.

Volume of drug :

	C.S.E.	
Author	Spinal dose	Epidural dose
Keshav Sharma et al (1994)[6]	2.5 ml of 0.5% Bupivacaine (H)	8ml of % Lidocaine with adrenaline.
Stienstra et al (1996)[7]	2ml of 0.5% Bupivacaine	10ml of 0.5% Bupivacaine
Sivasenthil (2000)[8]	2 ml of 5% Lidocaine	10 ml of 0.5% Bupivacaine
Hamdani et al (2002)[12]	1ml of 0.75% Bupivacaine (H)	2ml of 0.5% Bupivacaine for every unblocked
Present study	2ml of 0.5% Bupivacaine (H)	8ml of 0.5% Bupivacaine

HEMODYNAMIC CHANGES:

The common cardio vascular changes noted during central neuraxial blockade are hypotension and bradycardia which directly attributes to higher level of sympathetic block causing blockade of the cardio acceleratory fibers resulting in bradycardia and causing peripheral vasodilatation leading to hypotension. In our study 2% of patients developed hypotension and 5% of patients developed bradycardia. In those patients the blockade height reached the T5 segmental level. The rest of the patients were haemodynamically stable. Thus the C.S.E. technique offers an advantage of haemodynamic stability.

POST OPERATIVE PAIN RELIEF: Various authors studied the pain relief during postoperative period in C.S.E. using different drug concentration.

Author	**C.S.E. Epidural top up for postoperative analgesia**	**Analgesic score**
Gaushar et al (2002)[13]	Bupivacaine	Poor-Nil.
	0.125% 8 to 10 ml	Fair. 3(10%)
	4^{th} hr.	Good. 20(67%)
		Excellent 6 (20%)
Present Study	Bupivacaine	Poor-Nil
	0.125% 10 ml 4^{th} hr.	Fair. 5%
		Good 53%
		Excelient-42%

VII. Summary

The clinical study was conducted on ASA I and II adult patients of both sexes in the age group of more than 60 years posted for various lower limb operations. All patients were premedicated orally with 0.25mg alprazolam. Patients were preloaded with 500ml Ringer lactate. After aseptic precautions, local infiltration of local anaesthetic was carried out at appropriate lumbar interspace. In present study, we used a needle-through-needle technique (B. D. Durasafe whitacre spinal needle (27G) through Touhy epidural needle 18G and polymide closed end 20G). 2ml of 0.5% bupivacaine was deposited intrathecally and epidural catheter threaded into epidural space after removal of spinal needle. After patients were turned to supine 8 ml of 0.5% bupivacaine was injected into epidural space. After ascertaining the establishment of neuraxial block, the patients were submitted to lower limb operations. The patients were continuously monitored for pulse, NIBP. Spo_2. and ECG. The various parameters studied were onset of sensory blockade, motor blockade, haemodynamic changes, complications, duration of C.S.E., opinion feedback, and postoperative pain. The results were statistically analyzed The onset of analgesia was 3.4±1.0 min. The epidural dose caused further ascent of sensory analgesia by three to four segments with an average of 2.6 ± 0.9 segments. The time taken for the onset of the motor blockade was 5.8 ± 1.1 min. The time taken for the complete recovery from the C.S.E. was 291.3 ± 29.9 min.

Only 5% of patients developed bradycardia and 2% of patients developed hypotension. The remaining patients were haemodynamically stable throughout the study period. There were no untoward effects except shivering in 3% patients and nausea in 5% patients in our study. 53% of patients experienced good, 42% experienced excellent and 5% experienced fair overall postoperative pain relief. 59% of patients and 71% of surgeons gave very good feedback about C.S.E in terms of postoperative pain relief, speed of onset and relaxation. Combined Spinal Epidural is an useful technique with good operating conditions, with minimal complications and patient comfort for lower limb orthopedic procedures.

VIII. Conclusion

Combined Spinal Epidural by needle-though-needle technique is a better technique. It is an useful regional anaesthetic technique combining the reliability of spinal block and versatility of epidural block. It offers the many advantages over the other central neuraxial blockade like

1. Onset of action was significantly faster.
2. The total volume of the Local anaesthetic drug required was very less.
3. The duration of analgesia was longer and superior.
4. Patients were haemodynamically more stable.
5. Complications were minimal.
6. Higher satisfaction rate among patients and surgeon.

Combined spinal-epidural technique provides an opportunity to utilize the major advantages of spinal and epidural anaesthesia. C.S.E. produces a multi compartment block, such that behavior of the spinal block may be modified by subsequent epidural injections. C.S.E. has been incorporated into the armamentarium of regional anaesthetic technique; it may be the optimum regional technique for lower limb orthopedic procedures.

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