ORIGINAL ARTICLE

Rami Communicans Block Prior to Transforaminal Endoscopic Discectomy relieves Procedure Pain Significantly and adds Safety: A Case–control Study

[1]Gautam Das, [2]Samarjit Dey, [3]Ravi S Sharma, [4]Kanchan Sharma, [5]Debjyoti Dutta, [6]Chinmoy Roy

ABSTRACT

Background: The ability to isolate and visualize the "pain" generators in the foramen and treat persistent pain by visualizing inflammation and compression of nerves serves as the basis for transforaminal endoscopic (TFE) surgery.It provides a least invasive basic access to the disc. One of the important steps is the insertion of dilator and working sleeve followed by introduction of endoscope. Often this step is carried out with the help of a hammer, which is agonizing for the patients undergoing surgery. This study aims at analyzing the efficacy of the rami communicans nerve block in reducing the intraoperative pain in patients undergoing TFE discectomy.

Materials and methods: A total of 48 patients undergoing TFE discectomy were assigned into two groups. Group I (case, n = 27) received rami communicans block prior to endoscopic discectomy and for group II (control, n = 21), no rami communicans block was given. Under all aseptic precautions, the rami communicans block was given to group I patients after identification of corresponding level. After proper placement of block, lumbar TFE discectomy was performed using the "inside-out" approach. Pain was assessed using numerical rating scale (NRS) at different time intervals. Statistical analysis was carried out using independent Student's t-test, chi-squared test, and Mann–Whitney U test.

Results: While comparing NRS, group I showed significantly lower NRS when compared with group II and it was highly significant (p-value < 0.0001). The need for rescue analgesia was also compared and this difference was also found to be highly significant (p-value < 0.0001).

Conclusion: The rami communicans block is highly effective in reducing the intraoperative pain in patients undergoing TFE discectomy and thus, reduces the total dose of anesthetics and analgesics intraoperatively.

Keywords: Inside-out, Rami communicans block, Transforaminal endoscopic discectomy.

[1]Director, [2]Assistant Professor, [3]Fellow, [4]Consultant and Incharge, [5]Consultant, [6]Senior specialist

[1,3]Daradia: The Pain Clinic, Kolkata, West Bengal, India

[2]Department of Anesthesia, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong Meghalaya, India

[4]Aadhya Pain Management Center, Jaipur, India

[5]Pain & Pallliative Care, Narayana Superspeciality Hospital Howrah, Kolkata, India

[6]Pain Management division, Royal hospital, Muscat, Oman

Corresponding Author: Ravi S Sharma, Fellow, Daradia: The Pain Clinic, Kolkata, West Bengal, India, e-mail: drravishankarsharma4u@gmail.com,

INTRODUCTION

Percutaneous lumbar discectomies have been performed for over 30 years with overall results ranging from disappointing to good. The techniques and equipment used for percutaneous discectomy vary widely and have fallen in and out of favor. Hijikata first reported performing a percutaneous nucleotomy by means of an arthroscopy for disk removal for the treatment of posterior or posterolateral lumbar disk herniation under local anesthesia.[1-3] The theory was that the reduction of intradiscal pressure would reduce irritation of the nerve root and the nociceptive nerve receptors in the annulus.[4] Later, Kambin described the safe triangular working zone (Kambin's triangle) and results of arthroscopic microdiscectomy, in which arthroscopic visualization of the herniation via the posterolateral approach was used for discectomy of contained disk herniations. The technique of foraminal epidural endoscopic discectomy (FEES) was developed from epidural endoscopy. The FEES differs from other percutaneous discectomy procedures in that direct visualization of the epidural space, pathology, and neuroanatomic structures is possible.[5] These microendoscopic discectomies were developed to minimize the tissue trauma seen with open procedures, enabling cervical and lumbar discectomy through a tubular retractor, with endoscopic observation.[6] Traditionally, the whole procedure is carried out under local anesthesia and the patient is fully awake during surgery. An exact entry point is mapped on the patient's body using an image intensifier X-ray system followed by insertion of a long spinal needle and through this needle, a guidewire is passed, after which a dilator is inserted followed by insertion of a working cannula. This step is carried out with the help of hammer, and this leads to an intense painful episode. Conventionally, this pain was managed by injecting large amounts of local anesthetics at regular intervals or with
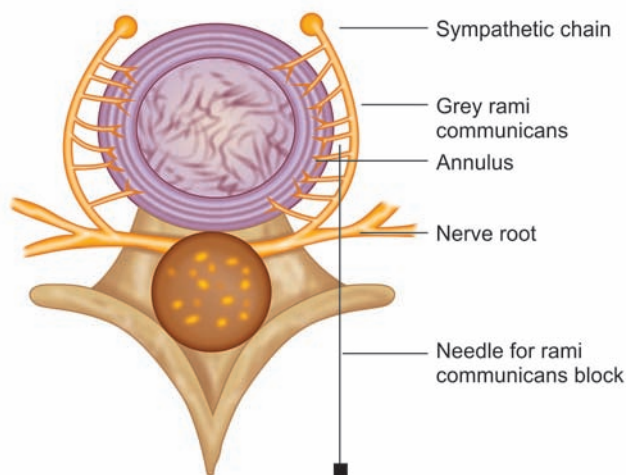
Fig. 1: Disk innervations

conscious sedation or combination of both, but most of the pain still persisted and also the purpose to use local anesthetics was also lost during the procedure, since large amounts of local anesthetics may anesthetize the exiting as well as traversing nerves.

It is well known that the ramus communicans nerve (Figure 1) provides the greatest source of disk innervations, and traditionally the ramus communicans block has been effective in managing the pain arising as a result of multiple disk pathologies. The aim of our study was to analyze the efficacy of the rami communicans block in providing intraoperative pain relief in the patients undergoing TFE discectomy via an "inside-out" approach.

MATERIALS AND METHODS

It had been seen that the ramus communicans nerve provides the greatest source of disk innervations (90% of disk innervations) and the ramus communicans block has been recommended as the best form of treatment to take care of pain coming from disk annulus due to degeneration and internal leaking of nucleus material, a condition known as internal disk disruption. It is also used for the treatment of symptomatic Schmorl's nodes[7] and painful osteoporotic vertebral compression fracture.[8] So, blocking the rami communicans can take care of pain arising from the annulus as a result of instrumentation, in patients undergoing endoscopic discectomy. This rami communicans block not only provides pain relief, but also adds to the safety, because it is away from the foramen and there is no chance of leakage of local anesthetic into the nerve roots. Rami communicans block was done as part of endoscopic discectomy to reduce procedural pain with proper informed consent.

Conventionally, endoscopic discectomy cases are performed under a local anesthetic injection in the wakeful condition. This adds to the safety because touching or damaging nerve root in wakeful patients is not possible.

However, when we enter the annulus with the dilator and sheath along with hammering in to reach inside the disc, patients feel an intense pain. Additional local anesthetic drugs are injected at the foramen or systemic opioids like Fentanyl is given to take care of this pain. Both these procedures may be unsafe as patient's feedback of touching the nerve root may be jeopardized. In these patients, the procedure was carried out through in a conventional manner, and the patients who underwent discectomy under local anesthesia were kept in control group, i.e., group II.

This study was planned as a retrospective or case–control study to compare the procedural pain in patients where rami communicans block was performed with procedural pain where no rami communicans block was done and conventionally local anesthetics were injected. The patients were divided into two groups, group I, where rami communicans block was done and group II where no rami block was done. Data were observed retrospectively.

After the approval of the institutional ethics committee and informed written consent from the patients was received, this retrospective study was carried out in Daradia – The Pain Clinic and associated hospitals, Kolkata, India. Sample size was calculated assuming the difference between two groups is more than 50%. Alpha error was taken as 0.05 and beta error as 0.2 (power of the study – 0.8). This revealed that our minimum sample size should be 13 in each group.

Taking all those points into consideration, a total of 48 patients of either sex, undergoing endoscopic discectomy were assigned into two groups fulfilling the following inclusion and exclusion criteria.

Inclusion Criteria

- Age – 20 to 60 years
- Paracentral disk herniation
- Magnetic resonance imaging revealing a single level of disk herniation of recent origin

Exclusion Criteria

- Patients having coagulopathy
- Migrated disc
- Sequestrated disc
- Recurrent disk herniation at the same level
- Inability to provide consent

Group I (Case, n = 27): Received rami communicans block prior to endoscopic discectomy

Group II (Control, n = 21): No rami communicans block was given prior to endoscopic discectomy

Procedure Details

Before commencement, details of the procedure were explained to all patients, and informed written consent
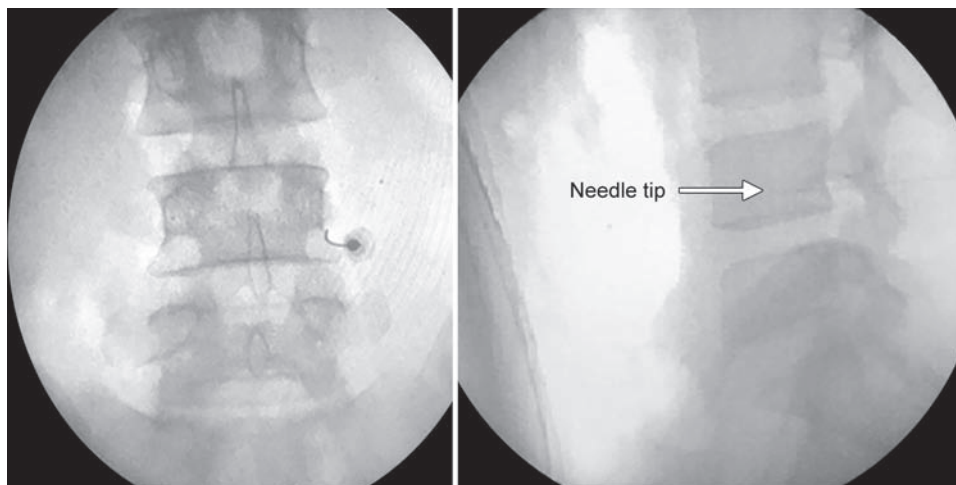
**Fig. 2:** Rami communicans block via c-arm (AP/lateral view)

was obtained. All preprocedural protocols were followed and all the necessary requirements were fulfilled. Thereafter, patients were brought in to the procedure room and placed in the prone position. A pillow of appropriate size was placed under the abdomen to correct lordosis. All procedures were done under standard basic monitoring as recommended by the American Society of Anesthesiologists. Site of procedure was prepared by using betadine/chlorhexidine solution and, thereafter, draping was done with sterile sheets. The C-arm image obtained was started in anteroposterior (AP) view and side and level of vertebral body to be targeted was identified. The AP image was taken with spinous process in exact midline. Alignment of the end plate of target vertebral body was done by using cranio-caudal tilt, followed by oblique tilt of image intensifier to ipsilateral side until anterolateral part of vertebral body was seen. Needle entry point was marked below the transverse process and just medial to the lateral border of the vertebral body, targeting the middle of vertebral body. Needle entry point was infiltrated with 1% lignocaine. After 1 minute, a 15-cm 22G quincke needle was inserted on end on view below the transverse process toward middle of vertebral body. Needle tip was directed toward just medial to lateral part of the vertebral body and needle was advanced until the vertebral body was in contact. Afterward, the needle tip was turned laterally and slipped off through the vertebral body. Thereafter, the C arm was repositioned to visualize the lateral view and needle was advanced accordingly. Final position of needle was confirmed with lateral, oblique, and AP views. A 0.5 mL of dye was injected to confirm the needle position. After ruling out intravascular and intraspinal needle positions, 2 mL of 1% lignocaine was injected to conclude the rami communicans block. It was assumed that acute painful conditions like patients undergoing endoscopic discectomy can be managed by a single-level unilateral

ramus communicans nerve block. Thus, in our study, we used single needle for placement of ramus communicans nerve block at a level above the corresponding disc.

After proper placement of rami communicans block, lumbar TFE discectomy was performed (Figures 2-6) through "inside-out" approach. The "Inside-out" technique provided the basic access to the disk and foramen to cover a large spectrum of pathology.[9] Using fluoroscopy, the posterior portion of the disk was targeted with a spinal needle and guidewire. A skin incision was made and dilator was inserted over the guidewire down to the annulus. A mallet was used to advance the dilator through the annulus and finally into the disc. A working sleeve was placed over the dilator. As the dilator was removed, the spine endoscope was inserted and nuclear material was resected.

Thereafter, the tip of the working sleeve was withdrawn slightly to the exterior of the disk to visually confirm the decompression of neural structures and to address any extradiscal pathology.

After disk resection and final visual inspection, the endoscope and working sleeve were removed, and
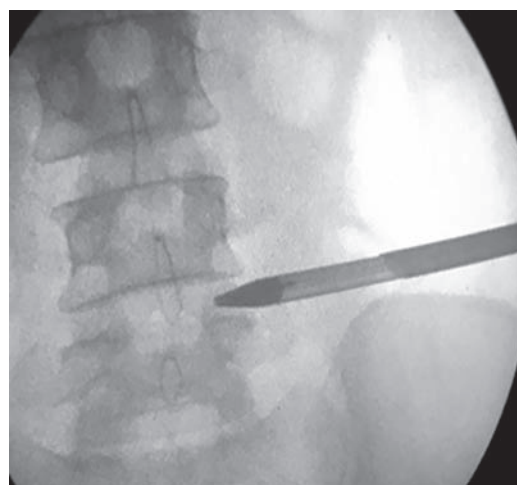
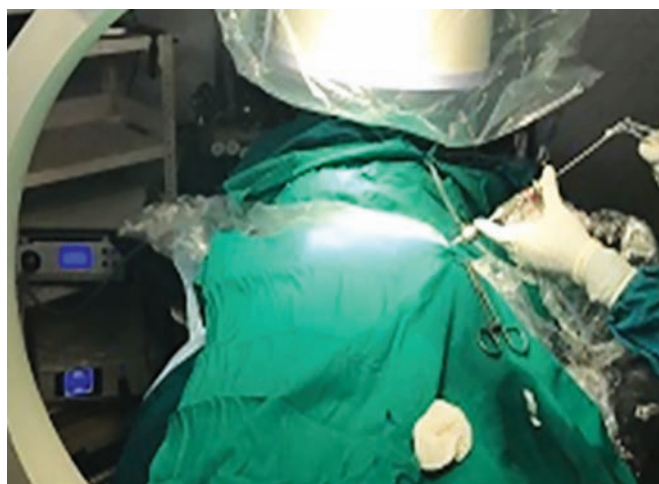**Fig. 3:** Placement of endoscopic sleeve

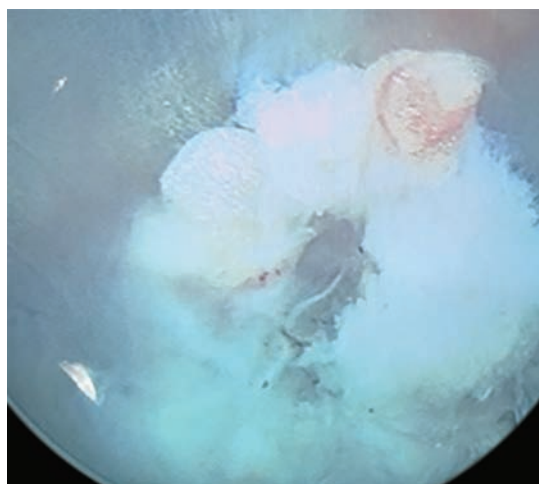**Fig. 4:** Surgeon performing endoscopic discectomy under fluoroscopic guidance
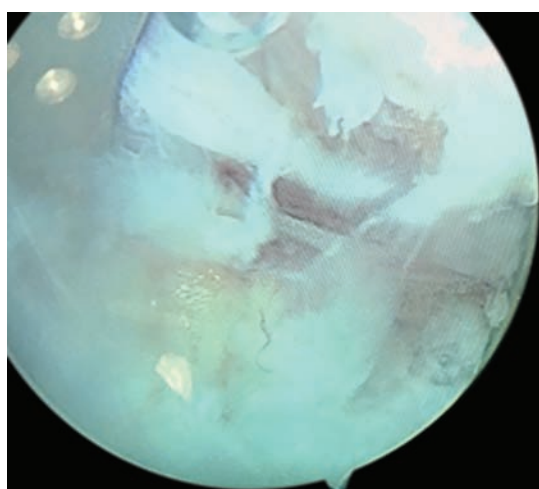

Fig. 5: Nuclear material through the scope

Fig. 6: Neural structures through the scope

the incision was closed with a suture and bandage. Pain was assessed numerically using numerical rating scale (NRS), at different time intervals during the procedure and whenever patient felt intense pain, rescue analgesia in the form of IV fentanyl 50 µg was given. In few patients where general anesthesia (GA) was required, Propofol was given intravenously.

Statistical Analysis

Demographic parameters were evaluated and compared using independent samples Student's t-test and chi-squared test. Level of procedure (spinal level) was compared using chi-squared test. Comparison of NRS between two groups was made using Mann–Whitney U test. The need for rescue analgesia and GA was compared using chi-squared test.

RESULTS

Demographic parameters (Table 1) were evaluated and compared using independent samples Student's t-test and chi-squared test. No statistical difference (p-value > 0.05) was observed in terms of age and gender. Both groups were comparable in terms of demographic parameters (Table 2).

Level of procedure (spinal level) was compared using Chi-squared test. The p-value was observed as 0.9112. So the variable, spinal level will not interfere with results, and, hence, the two groups were comparable (Table 3).

While comparing NRS (Table 4 and Graph 1) among the groups using Mann–Whitney *U* test, group I shows significantly lower NRS when compared with group II, and it was clinically and statistically highly significant (p-value < 0.0001).

Table 1: Age distribution among the groups

	Group I (with rami block)	Group II (without rami block)
Sample size (n)	27	21
Range	21–55 yrs	25–58 yrs
Arithmetic mean	39.7407 yrs	40.8571 yrs
95% CI for the mean	36.2581–43.2234	36.7044–45.0099
Median	38 yrs	42 yrs
95% CI for the median	34.0000–45.0472	34.0000–45.4399
Standard deviation	8.8038	9.1230
Statistical difference between two groups*	p = 0.6699	

*Using independent samples Student's t-test after assuming equal variances (equal variances assumed since p = 0.852 while testing for equality of variances using F-test); CI: Confidence interval

Table 2: Gender distribution among the groups

	Group I (with rami block)	Group II (without rami block)
Sample size (n)	27	21
Male	17 (62.96%)	14 (66.67%)
Female	10 (37.04%)	7 (33.33%)
Statistical difference between two groups*	p = 0.9700	

*Using chi-squared test for the comparison of two proportions (from independent samples)

Table 3: Spinal level among the groups

	Group I (with rami block)	Group II (without rami block)
Sample size (n)	27	21
Level : L4-5	17 (62.96%)	14 (57.14%)
Level : L5-S1	10 (37.04%)	7 (42.86%)
Statistical difference between two groups*	p = 0.9112	

*Using chi-squared test for the comparison of two proportions (from independent samples)

Table 5: Need for rescue analgesia (Injection fentanyl)

	Group I (with rami block)	Group II (without rami block)
Sample size (n)	27	21
Yes	2 (7.41%)	20 (95.24%)
No	25 (92.59%)	1 (4.76%)
Statistical difference between two groups*	p < 0.0001	

Table 6: Need for GA (Injection propofol)

	Group I (with rami block)	Group II (without Rami block)
Sample size (n)	27	21
Yes	0 (0%)	2 (9.52%)
No	27 (100%)	19 (90.48%)
Statistical difference between two groups*	p = 0.3631	

*Using chi-squared test for the comparison of two proportions (from independent samples)

Table 4: Comparison of NRS between two groups

	Group I (with Rami block)	Group II (without Rami block)
Sample size (n)	27	21
NRS range	0–6	3–8
Median NRS	1	5
95% CI for the median	1.0000 –1.0472	4.5601–6.0000
Interquartile range	1.0000–2.0000	4.0000–6.0000
Statistical difference between two groups*	p < 0.0001	

*Using Mann–Whitney U test (independent samples) – Lentner's normal approximation applied; CI: Confidence interval

Graph 1: Box and Whisker plot showing distribution of NRS between two groups

While comparing the need for rescue analgesia (Table 5) between the two groups, it was observed only 2 out of 27 patients in the group required rescue analgesia in the form of injection fentanyl as compared with 20 patients out of 21 in group II. This difference was calculated using chi-squared test and found to be highly significant (p-value < 0.0001).

None of the patients in group I received GA as compared with 2 patients in group II in the form of IV propofol (Table 6). The comparison for the need of GA was made between the groups using chi-squared test. No statistically significant difference was observed as observed p-value< 0.05 (0.3631).
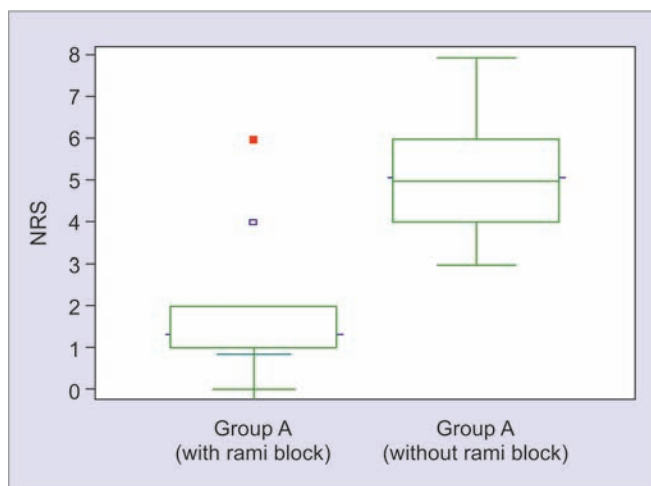
DISCUSSION

Percutaneous discectomy for herniated nucleus pulposus was developed by Hijikata. The technique is minimally invasive; however, under image intensifier guidance alone, percutaneous discectomy was not reliable for removal of the extruded fragment. To overcome such shortcomings in the percutaneous discectomy procedure, percutaneous endoscopic discectomy (PED) was developed. Minimally invasive PED with a transforaminal approach under local

anesthesia was started in the late 20th century. The great efforts by Yeung et al[10-12] established the current system of transforaminal PED. To avoid surgery-related complications,[13] the inside-out transforaminal technique through the safety triangle is recommended.[14]

The PED is usually performed under local anesthesia.[11,14,15] The GA and sedation are usually avoided, so that the patient remains conscious and can report of pain occurrence caused by instrumentation in the area surrounding the exiting nerve root thus, preventing nerve injury. In the literature, many PED-related complications have been reported. Among them, exiting nerve root injury is a particular complication in the transforaminal approach. Nerve damage by the cannula occurs when the patient is under GA and the patient does not feel any pain. The advantage of local anesthesia is that this kind of complication can be avoided. However, this procedure usually requires 10 to 15 mL of lidocaine and using this volume of local anesthetic increases the exposure of the exiting nerve root to local anesthetics and can lead to accidental nerve injury. Hence, a better approach is to block the sympathetic innervations to the disk via ramus communicans block.

Disk innervations are mostly via the sympathetic nervous system. A meningeal branch of the spinal nerve,

better known as the recurrent sinuvertebral nerve, innervates the area around the disk space. This nerve exits from the dorsal root ganglion and enters the foramen, where it then divides into a major ascending and lesser descending branch.[16] It has been shown in animal studies that further afferent innervation to the sinuvertebral nerve arises via the rami communicans from multiple superior and inferior dorsal root ganglia.[17] In both human and animal studies, the outer annular regions are innervated, but the inner regions and nucleus pulposus are not innervated.[18,19] In addition, studies have demonstrated that the anterior longitudinal ligament also receives afferent innervation from branches that originate in the dorsal root ganglion.[20] The posterior longitudinal ligament is richly innervated by nociceptive fibers from the major ascending branch of the sinuvertebral nerve. These nerves also innervate the adjacent outer layers of the annulus fibrosus.[18,20] While managing chronic patients, usually we require four needles for blocking the pain arising as a result of disk pathologies, but it was seen throughout the study that in acute painful conditions like patients undergoing endoscopic discectomy, a unilateral ramus communicans block at a level above the corresponding disk provided good pain relief. Mechanism of pain relief in patients undergoing endoscopic discectomy is via blocking the sympathetic supply to the corresponding disc, thereby also preventing damage to exiting nerve and, at the same time, patient remains conscious and oriented. In the past, the ramus communicans block has been used for the treatment of symptomatic Schmorl's nodes[7] and painful osteoporotic vertebral compression fracture.[8] However, until date, no study has been carried out with respect to abolition of pain during endoscopic discectomy via rami communicans block.

CONCLUSION

Performing the rami communicans nerve block prior to percutaneous TFE discectomy provides excellent pain relief without hampering the patient's consciousness during the intraoperative period, thereby, avoiding damage to the exiting nerve roots. Also, there is reduction in anesthetic and analgesic use.

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