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ORIGINAL ARTICLE

Evaluation of erector spinae plane block in patients undergoing percutaneous nephrolithotomy in terms of postoperative pain reduction and patient satisfaction

Perkütan nefrolitotomi uygulanan hastalarda erektör spina düzlem bloğun operasyon sonrası ağrıyı azaltma ve hasta memnuniyeti açısından değerlendirilmesi: Randomize klinik çalışma

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Summary

Objectives: Intravenous opioids and local anesthetic infiltrations are traditionally used to relieve postoperative pain. With developments in the field of regional anesthesia, several methods are now available for postoperative analgesia. This study aimed to investigate the efficacy of the erector spinae plane block (ESPB) in reducing both intraoperative opioid consumption and postoperative analgesic use in patients undergoing percutaneous nephrolithotomy (PCNL).

Methods: A total of 60 patients who underwent PCNL were divided into two groups: 30 patients who received ESPB (Group I) and 30 patients in the control group (Group II). Intraoperative and postoperative opioid usage were recorded for both groups. The pain levels of the patients were evaluated using visual analog scale (VAS) scores obtained at 1, 3, 6, 12, and 24 hours postoperatively. Postoperative satisfaction of the patients in both groups was also questioned and compared.

Results: A significant difference was detected between Group I and Group II patients in terms of intraoperative opioid requirements (p=0.00), analgesic requirements in the first 24 hours postoperatively (p=0.00), patient satisfaction status (p=0.00), and VAS scores obtained at 0, 3, 6, and 12 hours postoperatively. No significant difference was found in VAS scores at the 24th postoperative hour.

Conclusion: ESPB is a simple, convenient technique that can be performed under ultrasound guidance. It provides remarkable postoperative analgesia and satisfaction in patients undergoing PCNL.

Keywords: Erector spinae plane block; percutaneous nephrolithotomy; regional anesthesia.

Özet

Amaç: İntravenöz opioidler ve lokal anestezik infiltrasyonları, geleneksel olarak postoperatif ağrıyı gidermek için kullanılır. Rejyonel anestezi alanındaki gelişmelerle birlikte, artık postoperatif analjezi için çeşitli yöntemler kullanılabilmektedir. Bu çalışmanın amacı, perkütan nefrolitotomi (PCNL) uygulanan hastalarda hem intraoperatif opioid tüketimini hem de postoperatif analjezik kullanımını azaltmada erektör spina düzlem bloğunun (ESPB) etkinliğini araştırmaktır.

Gereç ve Yöntem: PCNL yapılan toplam 60 hasta, ESPB uygulanan 30 hasta (Grup I) ve kontrol grubundaki 30 hasta (Grup II) olmak üzere iki gruba ayrıldı. Her biri 30 hastadan oluşan iki grup için intraoperatif ve postoperatif opioid kullanımları kaydedildi. Ameliyat sonrası 1, 3, 6, 12 ve 24. saatlerde elde edilen görsel analog skala (VAS) skorları ile hastaların ağrı düzeyleri değerlendirildi ve her iki gruptaki hastaların ameliyat sonrası memnuniyetleri sorgulandı ve birbirleriyle karşılaştırıldı.

Bulgular: Grup I ve Grup II hastaları arasında intraoperatif opioid gereksinimi (p=0,00), postoperatif ilk 24 saatteki analjezik gereksinimi (p=0,00), hasta memnuniyet durumu (p=0,00) ve postoperatif 1, 3, 6 ve 12. saatlerde elde edilen VAS skorları açısından anlamlı bir farklılık tespit edildi. Postoperatif 24. saatte elde edilen VAS skoru açısından anlamlı bir fark bulunmadı.

Sonuç: ESPB, ultrasonografi (USG) rehberliğinde uygulanabilen, PCNL uygulanan hastalarda belirgin postoperatif analjezi ve memnuniyet sağlayan basit ve kullanışlı bir tekniktir.

Anahtar sözcükler: Bölgesel anestezi; erektör spina düzlem bloğu; perkütan nefrolitotomi.

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Introduction

Percutaneous nephrolithotomy (PCNL) is one of the important surgeries in the treatment of large kidney stones. However, patients may suffer from severe pain after PCNL. Intravenous opioids and local anesthetic infiltrations are traditionally used to relieve postoperative pain. With developments in the field of regional anesthesia, several postoperative analgesia methods are available. Consequently, epidural, paravertebral, and intercostal blocks have been tried before, and numerous positive results have been obtained.[1] However, due to the difficulty of application, complications, and side effects of these methods, researchers have begun searching for alternatives. Erector spinae plane block (ESPB), first described by Mauricio Forero et al.,[2] is a new paraspinal regional anesthesia technique that provides both effective visceral and somatic analgesias after lung carcinoma surgeries. Subsequent studies have stated that ESPB is simpler than the aforementioned methods. In addition, it has been reported that ESPB provides effective analgesia after thoracic and abdominal surgeries.[2,3] The main sources of acute pain after PCNL are visceral pain originating from the kidneys and ureters and somatic pain at the site of incision. While renal and ureteral pains are transmitted via the T10–L2 spinal nerve,[4] the cutaneous innervation of the incision site is predominantly provided by the T10–T11 (T8–T12) spinal nerve roots. This is because the incision site and the canal for PCNL are usually established at the 10th to 11th intercostal space or from the subcostal space.[4] Based on this information, we investigated both intraoperative opioid consumption and postoperative analgesic efficacy of ESPB in patients undergoing PCNL after receiving ESPB.

Material and Methods

This study was approved by the Institutional Review Board (Harran University Ethics Committee) (date: 08.07.2019 and approval number: 19.07.03). Our study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all subjects. Sixty patients, aged 18–65, who had undergone PCNL between 01.01.2019 and 01.07.2019 with an American Society of Anesthesiologists Physical Status Classification of I–III were divided into two equal groups. Since the patients included in the study had similar characteristics, Group I consisted of 30 patients who received ESPB before PCNL, whereas Group II (control group) included 30 patients who underwent PCNL but did not receive ESPB. No patients were excluded from the study, as the patients were selected according to the criteria set at the beginning and no failure was observed in any of the patients.

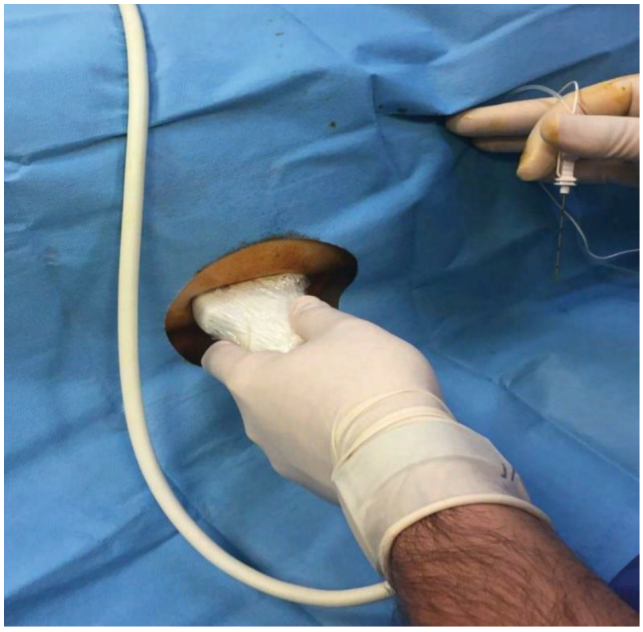

Figure 1. Preparation for erector spinae plane block (ESPB).

In our hospital, after the patients are taken to the preparation room, intravenous access is achieved and a 10 ml/kg saline (0.9% NaCl) infusion is provided for maintenance purposes. All patients are routinely monitored (noninvasive blood pressure, continuous electrocardiogram, and pulse oximetry). Again, if there is no contraindication, 0.02–0.03 mg/kg midazolam (5 mg/mL Zolamide) is administered intravenously to all patients for sedation. By communicating with the patients, they are routinely administered nasal oxygen at a rate of 3–4 L/min during the block procedure and followed up. In case of need for general anesthesia for complications that may arise, general anesthesia conditions are kept ready in the operating room.

The Group I patients were placed in the lateral decubitus position on the opposite side of the operating side. After the applicator was placed close to the patient's back for the block, the area to be blocked was sterilized using povidone iodine (Fig. 1). The 12th thoracic vertebra (T12) was located using the 1st thoracic vertebra countdown approach under ultrasonography (USG) guidance (Esaote My Lab 30 Gold

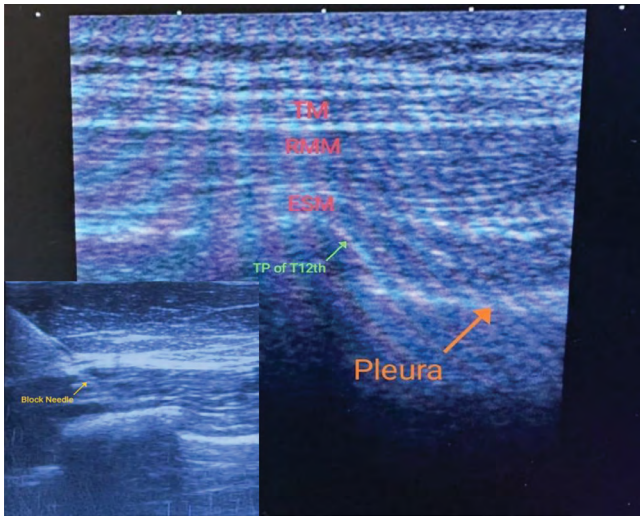

Figure 2. Ultrasonography image of erector spinae plane block (ESPB).

(USA)) and marked on the skin. After placing a 10–18 MHz linear probe parallel to the vertebral axis at the T12 level, the transverse process (TP) of T12 was detected by moving the probe from the medial position to the lateral position. Further, with a 22 G, 50 mm, insulated facet-type (B. Braun Stimuplex, Melsungen AG, Germany) needle was moved toward the place where the erector spinae muscle attaches to the TP of T12 (from caudal region to cephalic region) under USG guidance. After the needle came into contact with the TP, 2 ml of saline was injected to confirm that this fascial plane was well separated (Fig. 2). In order to maintain a long block time, 1 ml of 1/200000 epinephrine was added to 20 ml of 0.5% bupivacaine (10 ml), (20 ml of 5mg/ml Buvacin, Vem İlaç, Türkiye) and lidocaine (10 ml) (100 mg/5ml Lidon, On Farma, Türkiye), and the mixture was injected into the desired area.

After the block procedure was completed, the patients were placed in the supine position, the pin-prick and the cold sense tests were performed 30 min after the procedure, and the results were recorded to determine the effectiveness of the block. The absence of prick and cold sensations in the relevant dermatome area after the tests was interpreted in favor of a successful block. Although it was stated in the literature studies that the pin-pirck test was more successful in showing the success of the block than the non-invasive tests, we used the pin-pirck test in our study to show whether the block was successful and supported it with the cold sense test. Heart rate, mean arterial pressure, and SpO_2 were monitored in the block room, starting at 5 min before the block procedure for every 5 min until the 30th minute after the block.

After these tests and follow-ups, the patients were taken to the operating room and the operation was initiated under general anesthesia. For general anesthesia, the patients were anesthetized using bolus doses of 2.5 mg/kg propofol, 1 mcg/kg remifentanil, and 0.5 mg/kg rocuronium. After the patients were connected to the ventilator, the operation was continued with 2% sevoflurane. During the operation, the patients' heart rate and mean blood pressure were continuously monitored. Remifentanil was administered to patients in the event of a >20% increase in heart rate and mean blood pressure, and the use of additional doses intraoperatively was recorded.

The patients who were extubated at the end of the operation were taken to the postoperative care unit. The patients were followed up here for 30 minutes, and the visual analog scale (VAS) score was obtained at the 1st postoperative hour. Later, patients with stable vital signs were transferred to the Urology Ward for follow-up. Postoperative pain was assessed using VAS with scores ranging from 0 to 10, where a score of 0 indicated no pain and a score of 10 indicated the most severe pain. In the preoperative period, the patients were explained how to use VAS for assessing pain. According to the creatinine status of the patients transferred to the Urology Ward, paracetamol or diclofenac was initiated routinely as a postoperative analgesic (diclofenac was initiated if creatinine was normal and paracetamol [4×1] was initiated if creatinine was abnormal). VAS scores were recorded in the Urology Clinic at the 3rd, 6th, 12th, and 24th postoperative hours. If the patient's resting VAS score was >4, salvage analgesia with intravenous tramadol (2 mg/kg) was provided, and the same was noted down.

The general satisfaction level of the patients postoperatively at 24 hours was determined using a Likert-type verbal rating scale with scores ranging from 1 to 5, where 1 represented an extremely dissatisfied patient, 2 represented a slightly satisfied patient, 3 represented a moderately satisfied patient, 4 represented a satisfied patient, and 5 represented a very satisfied patient.

Table 1. Demographic data

Variables	Descriptive statistics (n=60) (Mean±SD)	t	df	p
Age	42.93±15.20 (range: 18–65)	0.813	47.021	0.42
	Group I (mean 41.7), Group II (mean 44.1)			
Height	170.37±6.11 (range: 158–183)	0.971	39.793	0.338
	Group I (mean 170.9), Group II (mean 169.8)			
Weight	76.12±9.139 (range: 56–110)	1.89	37.36	0.66
	Group I (mean 77), Group II (mean 75)			
	n	**%**	**t**	**df**	**p**
Gender			1.351	57.264	0.182
Male	39	65			
	Group I (19), Group II (20)				
Female	21	35			
	Group I (11) Group II (10)				
ASA			1.89	37.36	0.66
1	10	16.7			
	Group I (5) Group II (5)				
2	47	78.3			
	Group I (23) Group II (24)				
3	3	5			
	Group I (1) Group II (2)				
Comorbidity			-0.255	57.997	0.799
No	33	55			
	Group I (17) Group II (16)				
Yes	27	45			
	Group I (13) Group II (14)				

P<0.05; ASA: American Society of Anesthesiologists; SD: Standard deviation.

Statistical Analyses

The Shapiro–Wilk test was performed to check whether numerical variables complied with normal distribution. The Mann–Whitney U test was used to compare the mean values of two independent groups that did not have a normally distributed set of variables. The Wilcoxon test was used to compare the means of two dependent groups that were not normally distributed. Mean±standard deviation values, differences between means, and 95% confidence intervals were provided for numerical variables, and numbers and % values were provided for categorical variables. SPSS Windows version 26 was used in the analysis, and a p-value of <0.05 was considered significant.

Results

The demographic data of the 60 patients who underwent PCNL are shown in Table 1.

Investigation of the Significant Difference between Group I and Group II in Terms of VAS Scores Obtained at the Postoperative 1st, 3rd, 6th, 12th, and 24th Hours.

A significant difference was found between Group I and Group II in terms of VAS score obtained at the 1st postoperative hour (p=0.00), 3rd postoperative hour (p=0.00), 6th postoperative hour (p=0.00), and 12th postoperative hour (p=0.002). However, there was no significant difference in VAS score obtained at the 24th postoperative hour (p=0.179) (Table 2). Investigation of the Significant Difference between Group I and Group II in Terms of Intraoperative Opioid Requirement, At What Postoperative Hour the First Analgesic Was Required (HFAR), How Many Times the Analgesic Was Required at the End of the Postoperative 24th Hour (HAREP24th), and the Postoperative Satisfaction Status of the Patients. A significant difference

Table 2. Evaluation of group I and Group II VAS scores

	Variable	n	p	95% confidence interval		
				Mean	Minimum	Maximum
VAS1	Group I	30	0	0.93	0.54	1.32
	Group II	30		6.63	6.15	7.1
VAS3	Group I	30	0	1.4	0.94	1.85
	Group II	30		2.8	2.45	3.14
VAS6	Group I	30	0	1.63	1.08	2.18
	Group II	30		5.26	4.81	5.71
VAS12	Group I	30	0.002	2.06	1.39	2.73
	Group II	30		3.86	3.13	4.59
VAS24	Group I	30	0.179	1.56	1.08	2.04
	Group II	30		1.96	1.51	2.42

P<0.05 significant: Wilcoxon test was used for intergroup comparisons; VAS: Visual analog scale.

Table 3. Intraoperative opioid requirement, HFAR, HAREP24th, and patient satisfaction

	Variable	n	p	95% confidence interval		
				Mean	Minimum	Maximum
Intraopioid requirement	Group I	30	0.00	0.1333	0.0042	0.2624
	Group II	30		0.7	0.526	0.874
HFAR	Group I	30	0.00	5.43	3.00	7.87
	Group II	30		1	1.00	1.00
HAREP24th	Group I	30	0.00	0,7	0.37	1.03
	Group II	30		2.53	2.28	2.79
Satisfaction status	Group I	30	0.00	3.97	3.59	4.34
	Group II	30		2.7	2.42	2.98

P<0.05 significant: Wilcoxon test was used for intergroup comparisons; Intraopioid requirement: Intergroup opioid requirement during the operation; HFAR: The hour of first analgesic requirement; HAREP24th: How many times the analgesic was required at the end of the postoperative 24th hour.

was found between Group I and Group II patients in terms of intraoperative opioid requirement (p=0.00).

While 14 patients in Group I required rescue analgesia, the remaining 16 patients did not need rescue analgesia within the first 24 hours postoperatively. All the patients in Group II required rescue analgesia. After the operation, a significant difference was found between Group I and Group II patients in terms of HFAR (p=0.00) (Table 3). While this period was 8.7 hours on average for Group I patients who required a rescue analgesic dose, it was 0.6 hours for Group II patients.

The total rescue analgesic dose required in the first 24 hours postoperatively in Group I was much lower than that in Group II. While an average of 1 rescue analgesic dose was required in the 24th postoperative hour in Group I, this rate was 3.3 doses in Group II. Therefore, a significant difference was found between Group I and Group II in terms of total analgesic requirement in the first 24 hours postoperatively (p=0.00) (Table 3).

After the operation, a significant difference was found between Group I and Group II in terms of patient satisfaction (p=0.00) (Table 3).

Discussion

Although the surgical approach for kidney stones varies according to the size of the stone, PCNL is preferred over open surgery due to its lower morbidity and earlier mobilization.[5] Despite being less invasive

than open surgery, it still causes severe postoperative pain. While intravenous opioids and local anesthetic infiltrations have traditionally been used to relieve postoperative pain after PCNL, many methods for postoperative analgesia are now available with developments in the field of regional anesthesia. For this purpose, spinal epidural, paravertebral, and intercostal blocks have been tried before, and numerous positive results have been obtained.[6,7] Although spinal epidural anesthesia provides analgesia after PCNL, it causes long-term motor blockade, impairs bowel movements, and leads to nausea and vomiting.[8] Because of these undesirable effects, ESPB was used in our study for effective pain management after PCNL. ESPB involves a USG-guided local anesthetic injection into the paraspinal interfascial plane. The local anesthetic is injected deep into the erector spinae muscle, causing the muscle to separate from the posterior surface of the TP.[9] In this way, the local anesthetic can affect the ventral and dorsal branches of the spinal nerves. The benefits of using this technique include a lower risk profile and fewer contraindications compared to neuraxial techniques.[10] ESPB is an effective pain management method used after PCNL, but its effectiveness is limited to a very short time after surgery.[11] To increase the postoperative analgesic effectiveness of ESPB, the local anesthetic solution used in the block procedure was combined with 1/200000 epinephrine in our study.

Mostafa S. et al.[12] (2019) performed USG-guided ESPB for postoperative analgesia in 30 pediatric splenectomy patients and compared these patients with control subjects. They reported that 7 patients (23.3%) in the block group and 25 patients (83.3%) in the control group required intraoperative fentanyl. Resnick et al.[13] reported that intraoperative opioid use decreased in the group in which ESPB was applied via a catheter in patients undergoing PCNL. Similar to these studies, in the present study we observed a significant difference between Group I and Group II in terms of intraoperative opioid use (p=0.00). In this study, an additional intraoperative opioid dose was administered to 5 patients (16.7%) in Group I and 26 patients (86.6%) in Group II.

In case reports as well as case series, the use of bilateral ESPB resulting in decreased opioid requirements after cervical, thoracic, and lumbosacral spinal surgeries has been reported in both the perioperative and postoperative periods.[14–16] In a literature review including 13 different studies on multiple patients undergoing different surgical procedures that examined the effect of ESPB on postoperative opioid use, it was found that ESPB caused a significant decrease in opioid use until the 6th postoperative hour, and this effect disappeared by the 12th postoperative hour.[17] Sharma et al.[18] reported that 24-hour opioid use was 42% less in the block group compared to that in the control group. Singh S. et al.[19] conducted a study on 40 patients who had undergone modified radical mastectomy (MRM) surgery to evaluate the postoperative analgesic efficacy of ESPB for up to 24 hours and reported that only 3 of 20 patients in the block group required additional morphine. In the present study, we found that 13 (43.3%) Group I patients required an additional dose of opioids within 24 hours of operation, while all (100%) patients in Group II required an additional dose of opioid.

Sharma et al.[18] examined the efficacy of ESPB in 60 total mastectomy patients. They divided the patients into two equal groups (30 patients in each group) and stated that 14 patients in the block group required rescue analgesia in the first hour of the operation, while 26 patients in the control group required rescue analgesia. In the study by Mostafa S. et al.,[12] the time of first rescue analgesic was 508±194 min (5–11.6 hours) in the ESPB group and 33.6±31.8 min in the control group. In the present study, the time of first rescue analgesic use was 522±222 min (5–12.4 hours) in Group I patients and 36.0±32.5 min in Group II patients. In other words, a significant difference was found between Group I and Group II in terms of the first rescue analgesic use time (p=0.00).

In the study by Sharma et al.,[18] the postoperative pain measured at 0, 1/2, 1, 2, 4, 6, 12, and 24 hours was lower in the block group (p<0.05), and only the postoperative 8th-hour pain score was insignificant (p>0.05). In the study by Prasad et al.,[8] it was found that the postoperative pain score was significantly lower in patients undergoing PCNL who received ESPB. In the present study, a significant difference was found between Group I and Group II in terms of VAS scores obtained at the postoperative 1st, 3rd, 6th,

and 12th hours (p<0.05), and there was no significant difference between the two groups in terms of the VAS score obtained at the 24th postoperative hour (p>0.05) (Table 3). This lack of significant difference at the 24th postoperative hour was attributed to the relief of postoperative pain in both groups rather than the diminishing effect of ESPB. However, there are limited studies in the literature comparing ESPB and other techniques with respect to postoperative analgesia after PCNL. Therefore, more studies are required to determine the superiority of ESPB over other techniques.

In the study conducted by Prasad et al.,[8] general satisfaction scores were found to be significantly higher in the group that also received ESPB. Again, in the case series of Ahmed DG et al.,[20] similar to patients receiving ESPB, patients receiving paravertebral block were found to be satisfied in the postoperative period. In the present study, there was a significant difference in terms of patient satisfaction between Group I and Group II (p=0.00) (Table 3). Although limited, there are studies in the literature comparing ESPB with postoperative conventional opioid-based therapies, and all these studies reported the superiority of ESPB over conventional therapy. The present study also supports these findings in this respect.

Many features of ESPB differ from those of other regional pain relief techniques; the first of which is that it is an easy, safe, and effective method applied under USG guidance. The second is that it is a muscle–fascial plane block, making this method even safer since the injection point is far from the pleura and large vascular structures. Furthermore, since the erector spinae muscle travels along the cervical, thoracic, and lumbar vertebrae, single-injection local anesthetic application can spread over a wide area.[21,22] Because of these advantages, ESPB was preferred in our study.

In the present study, we did not encounter any side effects, such as itching, local anesthetic toxicity, nausea, and vomiting, that can be attributed to ESPB in Group I patients. Furthermore, no side effects, such as hypotension, bradycardia, respiratory depression, and urinary retention, were observed in any of the patients.

Limitations

One of the most significant limitations of this study was that it was conducted in a single center. Another limitation was not using a patient-controlled pain pump in the postoperative follow-ups. A more comprehensive study could have been conducted with a larger sample size to reach a definitive conclusion from the results. Since the determination of the VAS score was entirely left to the patients, they may have reported a slight pain as a high score. This could be considered a shortcoming of the study. Furthermore, we believe that the low level of education and the prevalence of histrionic personality traits in the patient population in which the study was conducted may have influenced these results. Perhaps a more objective scale should have been used, rather than a subjective one like the VAS.

Conclusion

ESPB is a simple and convenient technique that can be performed under USG guidance, providing remarkable postoperative analgesia in patients undergoing PCNL. Additionally, it ensures general patient satisfaction due to its low complication rates and minimal disturbance to patients' hemodynamics.

Peer-rewiew: Externally peer-reviewed.

Ethics Committee Approval: The Harran University Clinical Research Ethics Committee granted approval for this study (date: 08.07.2019, number: 19.07.03).

Conflict-of-interest issues regarding the authorship or article: None declared.

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