Original Article

Evaluation and Comparison on the Results of Totally Extraperitoneal Laparoscopic Surgery under General and Spinal Anesthesia for Inguinal Hernia

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Abstract

Background: Totally extraperitoneal (TEP) hernia repair surgery is one of the recently considered hernioplasty methods. Here, in the current study, we aimed to compare the results of TEP hernia repair surgery in the two groups of general anesthesia and spinal anesthesia.

Materials and Methods: This is a randomized clinical trial that was performed in 2018–2019 in Isfahan on 106 patients undergoing TEP inguinal hernia repair. Patients were randomly divided into two groups. The first group underwent TEP inguinal hernia repair surgery under general anesthesia and the second group of patients underwent TEP inguinal hernia repair surgery under spinal anesthesia. Data regarding surgery duration, intensive care unit admission, pain of patients, mean of analgesic injections after the surgery, and complications such as urine retention, seroma, and hematoma, and wound infection were collected. Data were compared between two groups.

Results: We found significantly higher duration of surgery in the spinal anesthesia group (P = 0.02). Patients in the spinal anesthesia group had shorter duration of nutrition regime beginning (P = 0.002) and lower frequencies of urine retention (P = 0.001). Further analysis showed that the mean pain severity was significantly lower in spinal anesthesia group compared to general anesthesia during postoperation measurements (P = 0.001) and patients in spinal anesthesia group received less postoperation analgesics compared to the other group (P = 0.001).

Conclusion: TEP surgery under spinal anesthesia was associated with better clinical results such as lower postoperative pain and analgesics injections compared to general anesthesia.

Keywords: General anesthesia, inguinal hernia, spinal anesthesia, totally extraperitoneal

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Introduction

Hernia in general and inguinal in particular is one of the most common diseases in the world.[1,2] A hernia is an internal protrusion of one of the organs or fascia of the limb or part of it through an anatomical or acquired canal. Epidemiologic studies have declared that the prevalence rate of hernia is almost 15 in 1000 population.[3] In general, if the hernia is progressing inward, it is called an internal hernia, and if the protrusion of the viscera is outside the body, it is called an external hernia. There are various types of hernia including diaphragmatic, inguinal, and femoral.[4] The main treatment for hernias is hernioplasty surgery. Today, hernioplasty is performed in two ways: open (conventional) and laparoscopic (laparoscopic) surgery. Laparoscopic surgery, in addition to preventing large painful incisions, allows surgery to be performed with minimal trauma.[5] Other benefits of laparoscopy include reduction of postoperative pain, ileus and wound complications such as

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infection and hematoma, accelerated healing, better esthetic results, better examination of areas such as the pelvis and diaphragm.[6] Nowadays, laparoscopic hernioplasty is more recommended in two groups of patients: (1) in patients who have had a recurrence of hernia after previous surgery and because the anatomy of the area has been disrupted during the previous operation and it is possible to find less anatomical layers. (2) Patients with bilateral hernia. Because the amount of dissection is practically doubled, while in the laparoscopic method, the number and location of trocars are no different from one-sided operation.[7]

Totally extraperitoneal (TEP) hernia repair surgery is one of the recently considered methods. The most important characteristic of this technique is that in this method, no gas enters the abdomen and also because there is no damage to the peritoneum, there is no need to sew the peritoneum and other layers of the abdomen. In this method, the layers of the abdominal wall are dissected and repaired without finding a way to the peritoneal cavity.[8] Due to the lack of damage to the viscera and the lack of peritoneal involvement, this method has lower rates of postoperative injuries and adhesions compared to other methods.[9] Based on previous studies, TEP method was not associated with problems such as the possibility of adhesions and various obstructions and the need to sew peritoneum, and in this regard, TEP method can be preferable to conventional laparoscopic surgery.[10,11]

TEP could be performed under general or spinal anesthesia. Performing surgery in elderly patients under general anesthesia is one of the major problems that surgeons struggle with due to the high risk of cardiovascular problems and other issues in the elderly.[12] In patients with pulmonary problems, there is a possibility of lung damage or decreased respiratory volume due to the entry of gas into the abdomen during normal laparoscopic surgery.[13,14] Therefore, with the introduction of TEP method, the possibility of injury to these patients was greatly reduced. However, very few studies have evaluated and compared the results of TEP in patients under general or spinal anesthesia. Here, in the present study, regarding the prevalence and importance of hernia and beneficial results of TEP as the preferred surgical technique in our department, we aimed to compare the results of TEP hernia repair surgery in the two groups of general anesthesia and spinal anesthesia.

Materials and Methods

This is a randomized clinical trial that was performed in 2018–2019 in Kashani and Alzahra hospitals in Isfahan. The study population consisted of patients undergoing TEP inguinal hernia repair surgery using general or spinal anesthesia. The current study was approved by Research committee of Isfahan University of Medical Sciences and the Ethics committee has confirmed it (Ethics code: IR.MUI.MED.REC.1398.066, Iranian Registry of Clinical Trials [IRCT] code: IRCT20200217046523N6).

The inclusion criteria were diagnosis of inguinal hernia by expert surgeons, age more than 50 years, no contraindications for spinal anesthesia or general anesthesia and laparoscopic surgery, and signing the written informed consent to participate in this study. The exclusion criteria were lack of proper follow-up, patient's will for exiting the study, having a history of cardiovascular disease, any contraindications for spinal anesthesia, having a history of single or multiple surgeries in the lower abdomen, complicated inguinal hernia (irreducible, obstructed, or strangulated), recurrent hernias, coagulopathies, having musculoskeletal deformity, having a history of any cancers and having immunodeficiency. We estimated 55 patients in each group and as a result, 110 patients were planned to enter the study.

Patients were entered based on inclusion and exclusion criteria. All patients were examined by an expert surgeon for definite diagnosis of inguinal hernia. The demographic data including age, gender, and occupation of patients gathered using checklists. The ultrasound imaging was also conducted for all patients before surgeries. Patients were then randomly divided into two groups using random allocation software. The first group underwent TEP inguinal hernia repair surgery under general anesthesia and the second group of patients underwent TEP inguinal hernia repair surgery under spinal anesthesia. The preoperative preparations were the same in all patients starting with injection of single-dose prophylaxis with a combination of amoxicillin (1000 mg) and clavulanic acid (200 mg; augmentin 1.2 g intravenous flac). It should also be noted that the same surgical team and anesthesiologist performed all surgical operations.

The anesthesia procedures are explained below

General anesthesia

Induction was performed using 2–2.5 mg/kg of propofol and 1 μg/kg of fentanyl intravenously followed by 0.6 mg/kg of rocuronium injection for achieve muscle relaxation necessary for intubation. Mechanical ventilations were performed for all patients by using an automated anesthesia device (Dräger Primus®; Dräger Medical Systems, Inc., Danvers, MA, USA) on volume control ventilation (VCV) mode. In VCV mode, tidal volume was set to 6–8 mL/kg, and respiration frequency was set to PetCO2 32–36 mmHg. Anesthesia was maintained with sevoflurane (1.5%–2%), an oxygen–air mixture (FiO2 = 0.4), and repetitive rocuronium doses (0.015 mg/kg). At the end of the surgery, neostigmine (2–2.5 mg) and atropine (1 mg) were given IV to antagonize residual neuromuscular block.

Spinal anesthesia

The patients were placed in a sitting position. The lower back was scrubbed with povidone-iodine solution and draped in a sterile manner. Xylocaine (1%) was infiltrated subcutaneously, followed by an 18-gauge introducer needle. A 25-gauge Whitacre needle was advanced until cerebrospinal fluid appeared. The patients randomly received either the hyperbaric bupivacaine (0.5%, 15 mg) or preservative-free fentanyl (10 μg) introduced intrathecally as the primary anesthetic. Then, the

patients were placed in a supine position till the completion of the procedure. No additional local anesthetic was used for the port sites or instilled extraperitoneally. Sedation was provided with midazolam (2 mg), fentanyl (100 μg), and a propofol infusion ranging from 0 to 100 μg/kg/min. Then, the patients were placed in a 15° Trendelenburg position, and sensorial block was examined by using the pinprick test at 1 min intervals. The surgery was begun after the sensorial block reached level T4. The surgery can be converted to GA if anesthesia was insufficient or if shoulder pain, abdominal discomfort, or anxiety was unresponsive to medical treatment. Additional support with other drugs, such as ephedrine and fentanyl, was available, if needed.

Surgical procedures

Surgical procedures were performed in supine position. A 15-mm incision was made in the skin below the umbilicus. The anterior rectus fascia was thereby rendered visible, and a horizontal 10 mm incision was made through it. After the rectus muscle was exposed, the preperitoneal area behind the muscle was dissected bluntly by using a Kelly clamp. The preperitoneal area was insufflated by using a 10 mm balloon trocar. Then, the balloon was removed, and carbon dioxide gas was insufflated into the extraperitoneal space at a pressure of 10 mmHg. A zero-degree videoscope was inserted through the port, a 5 mm trocar port was placed 3 cm above the symphysis pubis, and another 5 mm trocar was placed between the camera port and the suprapubic port. The inferior epigastric vessels were identified along the lower portion of the rectus muscle and protected. The anterior superior iliac spine was laterally dissected. The preperitoneal space was dissected, and the herniated sac was retracted by using atraumatic forceps. A 10 cm × 15 cm prosthetic graft was inserted through the camera port and placed on the anterior abdominal wall covering the Hesselbach's triangle, the internal inguinal ring. The graft was fixed to the pubic tubercle with an absorbable Tacker™ fixation device (Covidien) in all the patients. Surgery was performed by the same surgical team in both the groups. Surgery time was measured as the duration between beginning of the skin incision and skin closure.

Patient monitoring and data collection

All the patients were closely monitored with continuous electrocardiography, noninvasive arterial blood pressure, heart rate (HR), and peripheric oxygen saturation (SpO2). All these parameters were recorded in both the groups after the patients had entered the operation theater during the preoperative volume replacement for baseline levels (these parameters were recorded 3 times at 1 min intervals at rest.) These parameters were also recorded while inducing anesthesia for Group I and after the anesthesia procedure for Group II. The patients were monitored continuously during the surgery and for 24 h afterward in the patient room. All the demographic features, the American Society of Anesthesiologists (ASA) classification, comorbidities, the hospitalization period, the surgery time (from incision to last suture), and the total time (from anesthesia induction for Group I and from spinal puncture for Group II to recovery room) were recorded. In addition, maximum sensory block level was also recorded for Group II. Patients with intraoperative hypotension (a decrease of >30% in baseline mean arterial pressure or systolic arterial pressure <90 mmHg), bradycardia (HR <50 beats/min), and hypoxemia (SpO2 <90%) were searched for in both the groups. In Group II, any complaints such as nausea/vomiting, right shoulder pain, anxiety, and abdominal discomfort were also recorded. The surgical field pain level was evaluated with visual analog scale (visual analog scale [VAS]; 0 = No pain to 10 = Severe pain). First, VAS levels were recorded in the postoperative recovery room in cooperation with the patients 1 h after surgeries and at 3 h after surgeries and 6 h after surgeries. Mean postoperation analgesics (mg morphine) were also recorded for each patient. Undesirable postoperative events, such as urine retention, headache, nausea/vomiting, right shoulder pain, anxiety, abdominal discomfort, and urinary retention, were recorded in both the groups. An independent anesthesiologist working in intensive care unit (ICU) who was unaware of the groups and not included in the study recorded all the data.

Any intraoperative complications such as vascular or nerve injury, peritoneal laceration, and visceral injuries, hematoma, seroma, and wound infection were recorded. Any conversions from TEP to transabdominal preperitoneal or from laparoscopic to open repair were recorded, along with the specific reason for conversion.

Results

A total number of 110 patients entered the study and were divided randomly into 2 groups each containing 55 patients. Four patients were excluded (2 patients in each group) due to lack of proper follow-up. Finally, 53 patients from each group were included in the final analysis. The CONSORT flow diagram of patients is illustrated in Figure 1.

Analysis of demographic data indicated no significant differences between two groups regarding age, sex, body

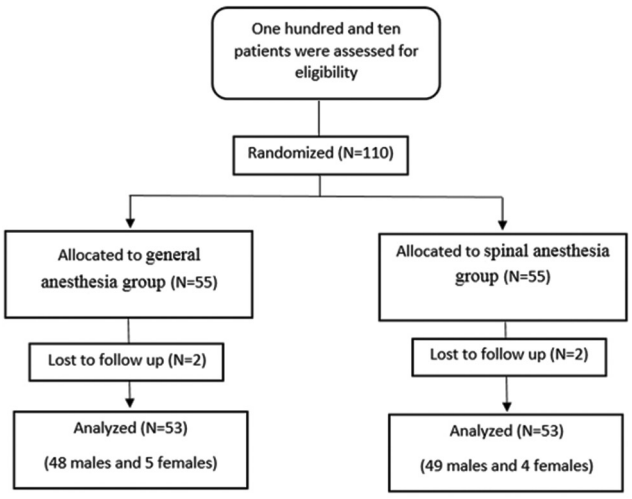

Figure 1: CONSORT flow diagram of patients

mass index, and ASA classification ($P > 0.05$). These data are summarized in Table 1.

We also showed significantly higher duration of surgery in the spinal anesthesia group ($P = 0.02$), but the duration of hospitalization was not significantly different between groups ($P = 0.08$). We also indicated that patients in the spinal anesthesia group had shorter duration of nutrition regime beginning ($P = 0.001$) and lower frequencies of urine retention ($P = 0.001$). Further analysis showed that the mean pain severity was significantly lower in spinal anesthesia group compared to general anesthesia during postoperation measurements ($P = 0.001$) and patients in spinal anesthesia group received less postoperation analgesics compared to the other group ($P = 0.001$) [Table 2].

Further evaluations showed that none of the patients in spinal anesthesia group required general anesthesia during the surgery and the open surgery or transversus abdominis plane was performed for none of the patients in both groups. Based on our data, no patient required ICU admission after the surgeries were observed in all patients after the surgeries.

Evaluation of patients within 1 month after the surgeries showed no hematoma, seroma, and wound infection in patients. Any recurrence of hernias was not noticed during the immediate postoperative period in either group.

Table 1: Demographic characteristics in study groups

Variable	General anesthesia (*n*=53)	Spinal anesthesia (*n*=53)	*P*
Age (years)*	55.64±10.74	54.81±9.9	0.68
BMI (kg/m^2)*	23.64±2.38	23.69±1.7	0.88
ASA**, *n* (%)			
I	45 (84.9)	47 (88.7)	0.85
II	8 (15.1)	6 (11.3)	

*Results were reported as mean±SD, **Results were reported in number and percentage. ASA: American Society of Anesthesiologists, BMI: Body mass index, SD: Standard deviation

Table 2: Comparison of pain severity and other characteristics between groups

Variable	General anesthesia (*n*=53)	Spinal anesthesia (*n*=53)	*P*
Surgery duration (min)*	42.90±9.71	38.60±9.3	0.02
Duration of hospitalization (h)*	28.36±2.25	29.41±3.83	0.08
Duration of nutrition regime beginning (h)	21.33±2.14	19.22±2.14	0.001
Urine retention, *n* (%)	4 (7.5)	1 (1.8)	0.001
Mean pain severity			
1 h postoperation	6.22±2.32	4.60±1.70	0.001
3 h postoperation	5.10±1.9	3.52±2.2	0.001
6 h postoperation	4.80±2.07	3.36±1.82	0.001
Mean postoperation analgesics (mg morphine)	6.15±2.13	3.26±1.89	0.001

Discussion

Here, in the present study, we evaluated and compared data of 106 males that underwent TEP using spinal or general anesthesia. We indicated that patients in the spinal anesthesia group had significantly higher surgery duration, and shorter duration of nutrition regime beginning. We also showed that patients undergoing TEP using spinal surgery had lower frequencies of urine retention and significantly lower amount of postoperation pain. Based on our data, mean injected postoperation morphine was significantly higher in patients in the general anesthesia group. We also reported no cases of ICU admission after the surgeries, no hematoma, seroma, and wound infection.

Inguinal hernia repair using TEP method is a novel technique that has been used in recent years. Based on former reports, TEP technique using spinal anesthesia could be a valuable and beneficial surgical method in patients that could not tolerate general anesthesia or those patients with higher risks of complications during the surgeries. Our study showed that inguinal hernia repair using TEP through spinal anesthesia led to beneficial clinical data, less pain, lower frequencies of urine retention, and also no postoperative recurrent hernia or complications. In a study by Donmez *et al*. in 2016, outcomes and complications of TEP inguinal surgery were evaluated and compared between spinal and general anesthesia groups. They showed that patients in the spinal anesthesia group experienced less pain 1 h after the surgeries, but factors such as complications, hospital stay, recovery, or surgery time were the same among patients. They also showed that patients in the spinal anesthesia group were more satisfied with their surgeries. Totally, they suggested that TEP inguinal hernia repair through spinal anesthesia is safe and has beneficial outcomes.[15] Another study was performed by Sunamak *et al.* in 2018. They also compared the results of TEP inguinal hernia repair between spinal and general anesthesia groups. They showed that laparoscopic TEP surgical technique using spinal anesthesia is totally safe and beneficial and also had lower frequencies of pain, shorter hospital stay, and less recurrence rate compared to general anesthesia or open mesh repair.[13] Our data were in line with the findings of previous studies emphasizing the beneficial effects of TEP technique using spinal anesthesia.

Beneficial effects of TEP inguinal hernia repair using spinal anesthesia were also discussed and indicated in a study by Yildirim *et al.* in 2017. They examined 80 patients and concluded that spinal anesthesia TEP is significantly less painful in the early postoperative period, leading to earlier ambulation than general anesthesia. In addition, spinal anesthesia TEP results in significantly less need for analgesics and better patient satisfaction results.[12] Our data are also in line with these findings. We believe that inguinal hernia repair using TEP technique through spinal anesthesia could be accounted as a novel beneficial surgical approach for patients with risks of

complications during general anesthesia. Based on the results of former studies, TEP inguinal hernia repair through spinal anesthesia is also associated with less pain and less surgical site scars compared to previously used techniques.

There have been also some former studies comparing the results of TEP surgical technique using spinal or general anesthesia. Most of these studies declared that spinal anesthesia is associated excellent clinical results with fewer recurrence time and complications compared to general anesthesia.[16,17] Sürek *et al.* also suggested that TEP surgical technique using spinal anesthesia should be considered as an effective method in patients and patients with risks of complications during general anesthesia should undergo spinal anesthesia.

On the other hand, Hajibandeh *et al.* also discussed that TEP inguinal hernia repair under spinal anesthesia may reduce pain in early postoperative period, it seems to be associated with increased postoperative morbidity and longer procedure time.[18] Our data are not in line with these findings. We indicated that the surgery duration was significantly lower in spinal anesthesia group and none of the patients had any complications and morbidities. We believe that these differences could be due to limited number of patients in our study and suggest that more studies should be performed in this regard. Another limitation of this study was that we did not evaluate and consider the baseline medical problems of patients that could play roles as confounding parameters.

A key point of the current study was that we compared the results of spinal and general anesthesia during TEP surgical technique for the first time in Isfahan. Our data showed that using spinal anesthesia, patients are faces with fewer pain and less postoperative analgesics injections. These data were in line with the most of the previous studies. As Li *et al.* showed that TEP could be used as a significantly beneficial technique in patients with inguinal hernia and spinal anesthesia is an acceptable method for patients with older ages and contra-indications of general anesthesia.[19]

Conclusion

Here, we showed that inguinal hernia using TEP surgical technique was associated with beneficial results and no complications. We showed that spinal anesthesia was associated with better clinical results such as lower postoperative pain and analgesics injections compared to general anesthesia.

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Conflicts of interest

There are no conflicts of interest.

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