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The Effect of Sevoflurane and Propofol on the Status of Renal Complications in Traumatic Injury Patients Following Laminectomy Surgery

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ABSTRACT

Objectives: Laminectomy is one of the most prevalent back surgeries. Considering the importance of controlling and minimizing surgical complications, this study was conducted to determine the effect of Sevoflurane and Propofol on the state of renal complications in patients undergoing laminectomy surgery.
Methods: This clinical trial was conducted in Ilam (Iran). The study used a double-blind random sampling procedure, and the patients were divided into three groups receiving Sevoflurane (n=25), Propofol (n=25), and the combination of Sevoflurane and Propofol (n=25). The research tool included a checklist of demographic characteristics as well as a clinical examination. Kidney complications were diagnosed based on history, clinical examinations, and laboratory test results. The obtained data were analyzed using SPSS software.
Results: In this study, the patient's mean age in the Propofol group was 52.4±5.6, the Sevoflurane group was 50.8±2.5, and Sevoflurane plus Propofol group was 53.5±3.4. The Sevoflurane plus Propofol group had the highest rate of urinary retention (n=7, 28%). In addition, there was no difference between laboratory results of creatinine and urinary retention in the studied groups (P>0.05). Besides, the comparison of the mean of renal laboratory indicators in the research patients indicated that the level of serum creatinine, and cystatin C of the patients had no significant change.
Conclusion: There was no significant difference between the complications in the three groups. Therefore, all three drugs can be administered to patients.

Keywords: Sevoflurane, Propofol, Laminectomy surgery.

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Introduction

Pain causes various complications for patients and has a negative effect on their quality of life [1-3]. Back pain is a prevalent condition with a high prevalence, ranking second only to headaches as the cause of chronic pain [4, 5]. Back pain can cause disability, impair the individual's performance and efficiency, impose a social and economic burden on the patient and society, limit activity and absence from the workplace, and reduce the patient's quality of life [6, 7]. Skeletal disorders cause damage to the lower back, cervical spine, and upper limbs. Most researchers believed that this complication could be related to the patient's type of occupation [8, 9].

The spine is biomechanically considered as a single organ. Degenerative diseases, especially in the elderly, cause scar changes in the lumbar spine and pelvis, which are required to be corrected during the patient's life [10-12]. Spinal canal stenosis is a widespread and well-known cause of back pain, and when it is surgically eliminated, the patient's disease-related restrictions are reduced [13-16].

Laminectomy is one of the most common back surgeries, and it is now generally performed under spinal anesthesia due to fewer post-operative complications, better tolerance of regional anesthesia in the elderly, and patient and surgeon satisfaction [17, 18]. Laminectomy is a surgical method for the treatment of spinal canal stenosis. In this method, the vertebral lamina is removed, which widens the spinal canal and relieves the pressure on the spinal cord. In fact, this surgical method is one of the most effective treatment methods for relieving severe back pain and spine problems [19, 20]. This type of surgery is performed to treat degenerative pathologies of the spine, including lumbar discopathy and spinal canal stenosis. After surgery, patients report a variety of issues, including pain, nausea, vomiting, changes in laboratory results, and urinary retention [21-23].

Urinary retention can be acute or chronic. In the acute type, the patient experiences excruciating, progressive pain in the suprapubic area, accompanied by a sense of great urgency, and only a small amount of urine may be excreted in drops. In the chronic type, there are no acute symptoms and mostly obstructive symptoms are present. It is even possible that in the chronic type, urine droplets are excreted continuously [24, 25]. One type of urinary retention is postoperative urinary retention (POUR). POUR is a condition in which the bladder is full after surgery, but the person is unable to pass urine. POUR can cause complications such as pain, prolonged hospitalization, infection, and mucosal trauma caused by catheterization, infection, and pain [25-27]. Furthermore, POUR affects the efficiency of health care, which extends the patient's stay in the hospital, causing suffering and several complications for the patient [28, 29]. Other side effects of anesthetics include laboratory changes. Consequently, alterations caused by these medicines may impact various laboratory indicators, such as serum creatinine and cystatin C levels, the amount of serum pro-inflammatory cytokines, and the amount of creatinine [30-32].

Sevoflurane is a versatile inhalation anesthetic, with rapid recovery and limited respiratory stimulation, which has been used in various studies to assess its effectiveness on patients. On the other hand, among the side effects of Sevoflurane in recovery are blood pressure drop, nausea, arrhythmia, vomiting, and tachycardia [33, 34]. Propofol is the most commonly prescribed anesthetic medicine for inducing anesthesia, as well as for maintaining anesthesia. It is also a popular choice for calming patients in the operating room and intensive care units. Propofol has anti-nausea properties and can effectively reduce nausea and vomiting in patients [35, 36]. Opioid drugs that are added to Propofol enhance its sleepy effect. Propofol is considered the leading anesthetic agent due to its pharmacokinetic and pharmacodynamic properties [37].

Considering the importance of controlling and minimizing surgical complications, the present study aimed to determine the effect of Sevoflurane and Propofol on the state of renal complications in patients undergoing laminectomy surgery.

Materials and Methods

This clinical trial was conducted in Ilam. The study was approved by the Ethics Committee of Ilam University of Medical Sciences (EC/94/H/280) and also registered at the Iranian Registry of Clinical Trials (IRCT2015071122870N2). The study comprised patients who were hospitalized in Imam Khomeini Hospital (Ilam, Iran), which was the only referral hospital for surgical patients in the province. In fact, the study included individuals who presented with severe symptoms to the clinic as outpatients or to the emergency department of the hospital.

The study population included patients undergoing laminectomy surgery in the age range of 20-70 years, who consented to participate in the study. If the patient had an underlying disease, died, provided incomplete information for any reason, or had any related complication affecting urinary retention, the patient was excluded from the study.

The research tool included a checklist of demographic characteristics and clinical examination. Kidney complications were diagnosed based on history, clinical examinations, and laboratory test results. The investigated variables included urinary retention status, serum creatinine and cystatin C levels, serum pro-inflammatory cytokines, and creatinine levels.

In this study, all patients had the same surgical team, including a neurosurgeon and an anesthesiologist. In addition, the patients and surgical team were blinded to the type of study groups. This study used a double-blind randomized sampling method, and the patients

were divided into three groups receiving Sevoflurane (25 people), Propofol (25 people), and a combination of Sevoflurane and Propofol (25 people). Since this study was a double-blind study, a nurse assisted in the data collection procedure.

The randomization method was done sequentially (numbered, sealed, opaque envelopes). In the SNOSE method, a random sequence was first generated using one of the mentioned methods, and then based on the sample size of the research, a number of envelopes were prepared, and each of the generated random sequences was recorded on a card.

Patients receiving Sevoflurane were given "a dose of 2 to 3% of inhaled Sevoflurane with 50% nitrogen gas and 50% oxygen gas", and the patients receiving Propofol were given "2 to 3 mg per Kg of Propofol, 50% oxygen, and 50% nitrogen gas". Finally, in the group with a combination of two drugs, Sevoflurane and Propofol, a dose of "2 to 3 mg per Kg of Propofol along with 2 to 3% of inhaled Sevoflurane" was prescribed.

All ethical considerations, including obtaining written informed consent, random allocation of patients using sealed envelopes, being free for participation with charging no additional costs to the patients, and maintaining the confidentiality of patients' information, were considered.

The data were analyzed using SPSS software version 16. The data were analyzed using descriptive and analytical statistical tests. The mean and standard deviation were used to examine variables such as age and surgery duration (min). Analytical statistical tests were also used to assess the severity of kidney complications. $P<0.05$ was considered statistically significant.

Results

In this study, the mean age of the patients in the Propofol group was 52.4±5.6, the Sevoflurane group was 50.8±2.5, and the Sevoflurane plus Propofol group was 53.5±3.4. Furthermore, the surgery duration was 128± 28.9 (min) in the Propofol group, 130±33.8 (min) in the Sevoflurane group, and 130±31.2 (min) in the Sevoflurane plus Propofol group. The anesthesia duration (min) was 151.6±23.5 in the Propofol group, 150.4±43.4 in the Sevoflurane group, and 152.3±27.2 in the Sevoflurane plus Propofol group.

The Sevoflurane with Propofol group had the highest rate of urinary retention, which was 7 (28%). In addition, there was no difference between laboratory results of creatinine and urinary retention in the studied groups ($P>0.05$). Also result showed presents the comparison of mean±SD of renal laboratory indicators in the studied patients. As a result, the patient's serum creatinine and cystatin C levels indicated no significant difference between the different studied groups (Table 1).

Discussion

Laminectomy surgery could have various complications for patients. Nausea, vomiting, kidney complications, urinary retention, lung complications, and infection are among these complications [38]. This study aimed to determine the effect of Sevoflurane and Propofol on the retention status of kidney and urinary complications in patients after laminectomy surgery. Propofol increases the antioxidant capacity in different tissues and protects the kidney by modulating systemic inflammatory responses [39].

Ammar *et al.,* investigated the effect of Propofol versus Sevoflurane on kidney damage in patients. 50 patients were divided into two groups (n=25), receiving Propofol or Sevoflurane. According to the findings, the status of S-cystatin C (mg/L) in the Propofol group was equal to 0.96±0.13, and in the Sevoflurane group was 0.93±0.22, the amount of Beta-blocker (%) in the Propofol group was 19 (76), and in Sevoflurane group was 20 (80). Moreover, serum creatinine (µmol/L) was 101 (19) in the Propofol group and 102 (17) in the Sevoflurane group [40]. In a study by Song *et al.,* 82 patients (41 patients in the Sevoflurane group and 41 in the Propofol group) underwent kidney surgery. According to their findings, one hour after the procedure, the rate of catheter-related bladder discomfort (CRBD) in the Sevoflurane group was lower than in the Propofol group [41].

In another study, Li *et al.,* studied the effect of Propofol versus Sevoflurane on the state of kidney damage in patients who underwent liver transplantation procedures. In the Sevoflurane group, the state of urine volume (mL) was equal to 449.50±72.82, the state of operation time (h) was

Table 1. The Comparison of mean±SD of renal complications in the studied patients

Variables		Sevoflurane group	Propofol group	Sevoflurane plus Propofol group	*P* value
Serum creatinine	Before surgery	68 (11)	67 (11)	68 (12)	P>0.05
	After surgery	67 (10)	67 (12)	69 (11)	P>0.05
Cystatin C	Before surgery	0.268 (0.29)	0.265 (0.26)	0.271 (0.25)	P>0.05
	After surgery	0.253 (0.31)	0.259 (0.25)	0.175 (0.33)	P>0.05
Creatinine	Before surgery	0.98 (0.31)	0.96 (0.34)	0.90 (0.29)	P>0.05
	After surgery	0.95 (0.26)	0.93 (0.32)	0.94 (0.31)	P>0.05
Urinary retention		6 (0.24%)	5 (20%)	7 (0.28%)	P>0.05

equal to 8.41±1.38, the pre-Scr (µmol/L) state was 6.02±16.79, PELD status was 3.41±16.08, and INR (IU) status was 0.32±1.42. Besides, in the Propofol group, urine volume (mL) was 65.39±460.17, operation time (h) was 1.19±8.74, pre-Scr (µmol/L) was 5.51±17.80, PELD was 2.42±17.13, and INR (IU) was 1.52±0.29 [42]. Sondekoppam *et al.,* conducted a meta-analysis of 41 randomized clinical trials. According to their findings, there was no difference between creatinine and creatinine clearance in the first 24 hours. In fact, no correlation was observed between the use of Sevoflurane and postoperative renal failure compared to other drugs [43].

Röhm *et al.,* compared the anesthetic drugs Sevoflurane and Propofol on the surgical complications of patients undergoing thoracic surgery, abdominal surgery, and patients undergoing vascular surgery and found that anesthetic drugs had no negative effect on the performance of all patients [44]. Other studies compared these drugs [45-47]. For instance, Franzén *et al.,* compared this drug on kidney function. Their findings indicated that Sevoflurane anesthesia reduced sodium excretion, decreased urinary output, and increased plasma renin levels compared to Propofol anesthesia. Patients who utilize anesthetic medicines might have a variety of negative effects. Side effects might include fever, chills, nausea, vomiting, and changes in laboratory parameters [45-47].

One of the limitations of this study was the small number of investigated variables. For this reason, it is recommended that another study be conducted to investigate and report on various variables. Besides, one of the strengths of this study was the examination of patients undergoing laminectomy.

According to the findings, there was no significant difference between the complications in the three studied groups. Consequently, all three drugs could be administered to patients.

Declaration

Ethics approval and consent to participate: The study was approved by the Ethics Committee of Ilam University of Medical Sciences (EC/94/H/280).

Consent for publication: All authors expressed their consent to the publication of this study.

Conflict of Interest: The authors declared that there was no conflict of interest.

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Authors' Contribution: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed, draft of the manuscript was written, commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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