

# Are there factors in the disease of peroneal necrotizing fasciitis which should be used when choosing the anesthetic technique?: Descriptive analysis of a cohort from two centers

Ömer Faruk Boran, M.D.,<sup>1</sup> Bülent Katı, M.D.,<sup>2</sup> Veli Fahri Pehlivan, M.D.,<sup>3</sup> Maruf Boran, M.D.,<sup>4</sup>

Evren Büyükfırat, M.D.,<sup>3</sup> Mehmet Buğra Bozan, M.D.,<sup>5</sup> Osman Barut, M.D.,<sup>6</sup>

Mehmet Kutlu Demirkol, M.D.,<sup>6</sup> Halil Çiftçi, M.D.<sup>2</sup>

<sup>1</sup>Department of Anesthesiology and Reanimation, Kahramanmaraş Sütçü İmam University Faculty of Medicine, Kahramanmaraş-Turkey

<sup>2</sup>Department of Urology, Harran University Faculty of Medicine, Şanlıurfa-Turkey

<sup>3</sup>Department of Anesthesiology and Reanimation, Harran University Faculty of Medicine, Şanlıurfa-Turkey

<sup>4</sup>Department of Intensive Care Unit, Amasya Şerefeddin Sabuncuoğlu Training and Research Hospital, Amasya-Turkey

<sup>5</sup>Department of General Surgery, Kahramanmaraş Sütçü İmam University Faculty of Medicine, Kahramanmaraş-Turkey

<sup>6</sup>Department of Urology, Kahramanmaraş Sütçü İmam University Faculty of Medicine, Kahramanmaraş-Turkey

## ABSTRACT

**BACKGROUND:** This study aims to examine the factors affecting the selection of anaesthesia method in Fournier's gangrene.

**METHODS:** A retrospective evaluation was made of 113 patients operated on because of Fournier's gangrene between January-May 2019. The operations were performed under spinal anaesthesia in 78 cases (Group S) and under general anaesthesia in 35 cases (Group G). The patients were evaluated regarding age, gender, the anaesthesia method used (spinal, general) anaesthetic agent applied, presence of sepsis, and biochemical, hematological and inflammatory parameters.

**RESULTS:** When the patients were evaluated regarding the Fournier Gangrene Severity Index (FGSI), patients in Group S had lower scores ( $p=0.001$ ). Examination of the tomography images revealed that in 13 (37.1%) patients, air values were seen in the right or left gluteal area, or both, extending to the subcutaneous tissue. In the evaluation of the factors affecting the selection of general anaesthesia, a positive correlation was determined between an increase in FGSI ( $r=0.482$ ,  $p=0.001$ ) and the presence of sepsis ( $r=0.485$ ,  $p=0.001$ ) and gluteal region involvement ( $r=0.628$ ,  $p<0.001$ ).

**CONCLUSION:** The selection of anaesthesia method in Fournier gangrene patients is a complex process affected by factors, such as the patients' general condition, sepsis, and whether or not there is bleeding diathesis. The risk-benefit balance in the selection of anaesthesia method should be evaluated individually for patients.

**Keywords:** Anaesthesia method; Fournier's gangrene; sevoflurane; TIVA; ultiva.

## INTRODUCTION

Fournier's gangrene, which was first described in 1883 by Jean Alfred Fournier as "gangraena acuta genitalium", is defined as

an infective necrotising fasciitis table, with an acute onset and progressive and potentially fatal course, affecting the external genital and/or perianal regions, usually of males. Despite improvements in intensive care conditions and the use of new

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Address for correspondence: Ömer Faruk Boran, M.D.

Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi, Anestezi ve Reanimasyon Anabilim Dalı, Kahramanmaraş, Turkey

Tel: +90 344 - 300 34 34 E-mail: ofboran@ksu.edu.tr

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generation antibiotic agents, mortality remains extremely high at 30%–40% due to the rapid spread of the disease by necrosis forming in the fascial planes and that it is generally caused by multiple micro-organisms.<sup>[1]</sup>

There are several reports in the literature that have evaluated factors related to the etiopathogenesis of the disease, treatment modalities, morbidity and mortality,<sup>[2–4]</sup> but there have been very few studies that have evaluated this particular patient group regarding anaesthesia method in the literature.<sup>[5–7]</sup>

Anaesthesia management for patients undergoing surgery because of Fournier's gangrene is usually challenging due to the destructive nature of the disease, significant comorbid diseases, the need for repeated operations and the possibility of an accompanying septic table.<sup>[8]</sup> There are some studies in the literature related to the effects on the immune system functions of general and spinal anaesthesia applications, and there are also some studies that have evaluated the effects of different volatile general anaesthesia agents on the immune system functions.<sup>[9]</sup> If there is any infectious state in the area where anaesthesia is to be applied, there may be severe complications, including spread to the intraspinal canal and hemodynamic and cardiac function instability, so spinal anaesthesia is another method that can be safely used in FG patients. From a scan of the literature, three studies have been found that have evaluated anaesthesia applications in FG patients and all of these publications are in the form of case reports.<sup>[5–7]</sup>

It has been understood from these articles that clinicians may select general, regional or local anaesthesia methods in the anaesthesia management of FG patients. However, to our knowledge, there is no study in English that has evaluated the factors affecting the clinician's decision of which method to apply. It can be considered that an evaluation of the factors affecting the selection of anaesthesia method in these particular types of cases will contribute to the literature, be of guidance in the selection of the anaesthesia method and could be useful in reducing anaesthesia complications that may develop.

The present study aims to examine the factors which could affect the choice of anaesthetic method to be used in patients with Fournier's gangrene.

## MATERIALS AND METHODS

### Setting and Patients

Approval for this study was granted by the Local Ethics Committee (2019/04/12). A retrospective evaluation was made of 128 patients treated surgically for Fournier's gangrene between January 2014 and May 2019. The patients were from two separate tertiary level anaesthesia intensive care units, each of which has 20 beds and treat an average of 1200 patients per year, and from tertiary level general surgery and

urology clinics where an average of 800 emergency operations per year are performed. The data were collected from patient files, computer records, surgical records and anaesthesia forms.

After the exclusion of 15 patients with unavailable data, 113 patients were included in this study. Patients were classified as those with operations performed under spinal anaesthesia (n=78, Group S) or general anaesthesia (n=35, Group G). The patients in Group G were then separated into two subgroups according to the type of general anaesthesia; TIVA, Group T (n=24) and Ultiva-sevoflurane, Group US (n=11). All procedures were performed under emergency conditions. Informed consent was obtained from the patients and first-degree relatives before the procedures were applied.

### Preoperative Evaluation, Anaesthesia Application and Surgical Procedure

All the patients were evaluated in the Emergency Polyclinic by a general surgeon and/or a urologist. In the preoperative and postoperative periods, evaluations were made regarding inflammatory markers, hematological parameters and biochemical parameters. Radical surgical excision was made of tissues seen to be necrotic macroscopically with a debridement process until healthy tissue was reached (Table 2).

Depending on the severity and spread of the disease during the operation, colostomy procedures were applied to patients requiring colostomy by the general surgery team. Tissue cultures taken interoperatively were sent immediately to the microbiology laboratory. For patients who were not hemodynamically stable, fluid replacement was started preoperatively and was continued via a central venous catheter placed intraoperatively to maintain urine output at 0.5–1 cc/kg/hour, mean arterial pressure at 65 mmHg and/or central venous pressure 8–12 mmHg. Vasopressor and inotropic agents were used in patients where the target values could not be reached with sufficient crystalloid solution. In patients with hematocrit values <30%, erythrocyte suspension was administered to try to raise the hematocrit value to >30%.

In the postoperative period, empirical ceftriaxone at 4 gr/day and metronidazole at 1.5 gr/day were administered until the culture results were received. The antibiotic treatments were then revised according to the culture results. In cases where wound site infection spread was observed or for those who were not hemodynamically stable, surgical resection was applied again under operating room conditions.

The Fournier Gangrene Severity Index (FGSI) is a scoring system, including different clinical and laboratory parameters, such as temperature, pulse, respiratory count, sodium, potassium, creatinine, leukocyte, hematocrit and bicarbonate. Within this scoring system, points are given from 0–4 ac-

**Table 1.** Preoperative and postoperative values of the hematological, biochemical and inflammatory parameters of the patients applied with spinal anaesthesia and general anaesthesia

Variables	Group S (n=78)	Group G (n=35)	p	Group S (n=78)	Group G (n=35)	p
	Preoperative value	Preoperative value		Postoperative value	Postoperative value	
WBC	16.46±6.63	16.36±10.31	0.822	12.58±4.70	14.75±8.26	0.043
Hb	13.97±11.01	11.76±2.58	0.277	11.62±2.29	11.01±2.26	0.247
Plt	311.02±156.13	237.11±142.48	0.019	345.29±147.45	253.53±145.68	0.003
CRP	182.36±114.50	128.58±105.20	0.260	44.11±77.44	85.77±111.81	0.017
ALT	30.13±26.42	25.65±36.36	0.485	26.69±25.30	18.26±12.32	0.078
AST	33.17±23.38	36.97±41.76	0.499	30.38±26.48	28.23±22.29	0.767
BUN	45.86±37.22	46.65±42.91	0.841	31.16±27.65	34.38±38.06	0.594
Cre	1.22±1.20	1.26±0.98	0.750	0.87±0.88	0.97±0.68	0.495
Glu	216.28±155.98	190.95±117.73	0.382	134.43±69.76	150.66±73.45	0.375
Na	136.51±5.38	134.97±5.22	0.121	136.89±69.76	137.52±4.24	0.556
K	4.33±0.61	4.14±0.73	0.146	4.24±0.60	4.10±0.63	0.300
HCO <sub>3</sub>	20.97±4.37	20.91±3.81	0.961	23.15±2.20	23.07±3.56	0.935
Lactate	2.55±1.96	2.67±1.93	0.722	1.24±0.88	1.90±1.98	0.123
Pulse	97.42±15.20	100.09±15.41	0.475	88.60±11.05	89.67±12.26	0.568
Respiratory rate	18.73±3.81	18.83±3.61	0.961	16.80±2.56	16.12±2.20	0.217
Saturation	96.19±2.70	96.67±2.32	0.287	97.69±2.05	98.09±2.03	0.340

ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; BUN: Blood urea nitrogen; CRP: C-reactive protein; Glu: Blood glucose; Hb: Hemoglobin; HCO<sub>3</sub>: Bicarbonate; K: Potassium; Cre: Creatinine; Na: Sodium; Plt: Platelet; WBC: White blood cell.

According to the level of deviation from normal values of each parameter and the FGSI score is determined with the total points obtained.<sup>[10]</sup> For each patient in this study, the FGSI score was calculated taking the clinical and laboratory parameters into consideration.

All the patients were evaluated regarding age, gender, comorbid diseases, the anatomic area affected (perianal, scrotal, perianal+scrotal), complications, the anaesthesia method used (spinal, general), the anaesthetic agent used and dose, amount of fluid given intraoperatively, duration of anaesthesia, presence of sepsis, preoperative and postoperative biochemical, hematological and inflammatory parameters, postoperative status in the ward or ICU, length of stay in the hospital and discharge status (discharged home with medication, exitus).

## Anaesthesia Procedures

### General Anaesthesia Procedure

General anaesthesia was applied to patients with contraindication for spinal anaesthesia, such as suspicion of infection having advanced to the gluteal area, bleeding diathesis, septic shock table, severe heart disease-causing hemodynamic instability, or if they did not accept spinal anaesthesia. The anaesthesia was applied as follows: in induction, propofol (2 mg/kg) and fentanyl (1–3 µg/kg) were used as intravenous agents and rocuronium (0.6 mg/kg) or atracurium (0.6 mg/kg)

as muscle relaxants. For anaesthesia maintenance throughout the operation, total intravenous anaesthesia (TIVA) was applied using 9–12 mg/kg propofol and 0.2–0.5 mg/kg/min ultiva bispectral index (BIS) monitorization, or 0.2–0.5 mg/kg/min ultiva and sevoflurane with BIS at 40–60. Mechanical ventilator parameters were set equivalent to the optimum PEEP value for driving pressure to be <12. Contramal+paracetamol was used as postoperative analgesia taking organ functions into consideration.

### Spinal Anaesthesia Procedure

Spinal anaesthesia was applied to patients with no suspected infection in the application area, no bleeding diathesis, no septic shock table, no severe heart disease-causing hemodynamic instability and acceptance of spinal anaesthesia. When patients were admitted to the operating table, first non-invasive blood pressure, ECG, pulse oximetry (SpO<sub>2</sub>) and body temperature monitorisation were applied; then sedation was administered as 2 mg midazolam IV. The patient was positioned lateral decubitus and the area where the anaesthesia was to be applied was evaluated regarding infection. The spinal anaesthesia was applied to the L3-4 space with 0.5% hyperbaric bupivacaine using a 27 G spinal needle, and the patient was then placed in the lithotomy position. Intraoperatively O<sub>2</sub> was administered at 2-4 lt/min from a nasal cannula and patients with SpO<sub>2</sub> <90 were applied with continuous positive airway pressure (CPAP). As standard monitoring, heart rate

(HR), systolic (SAP), diastolic (DAP) and mean (MAP) arterial blood pressures, peripheral arterial oxygen saturation ( $SpO_2$ ), end-tidal carbon dioxide concentration ( $etCO_2$ ), body temperature with an esophageal heat probe, percent (%) concentrations of inspired-exported anesthetic gas (inspiration and expiration) and applied anesthetic gas were recorded. Bispectral index monitoring (with BIS-VISTA Covidien monitor) was performed in addition to patients receiving general anesthesia before induction. The BIS electrodes are placed 1.5–2 cm above the first electrode 1.5–2 cm between the two eyes, the 2<sup>nd</sup> electrode is placed to the right or the left in the middle of the distance between the hair and the eye, and the third electrode is placed between them, device calibration and contact test of the electrodes is completed. Then the measured BIS value was recorded. It is reported that the amount of anesthetic agent to be applied to the patient can be reduced by titration, faster recovery can be achieved, and the duration of postoperative intensive care can be shortened by monitoring the bispectral index (BIS).

A urine catheter was inserted in all patients in the preoperative period. Central venous catheter was placed in patients who were hemodynamically unstable and clinically considered sepsis in the preoperative period, and central venous pressure measurements were made, and patients were monitored. Also, arterial blood gas measurements were made where necessary.

The primary fluid preference in the patients was in the form of ringer lactate according to saline or liver enzyme status. However, it has been used in colloid solutions in hypotensive patients requiring fluid restriction or in patients with a fluid deficit that cannot be met with crystalloid. Blood replacement was performed in patients whose Hb level decreased below 10 g/dL in the complete blood count measured during debridement or in patients with Hb levels 10 g/dL despite the absence of any chronic disease (e.g., CKD).

### Statistical Analysis

Data obtained in this study were analysed statistically using SPSS 17.0 software (SPSS Inc., Chicago, IL, USA). Conformity of the data to normal distribution was tested with the Shapiro-Wilk test and variance homogeneity with the Levene test. In the comparison of two independent groups, the Independent Samples t-test was used with Bootstrap results and the Mann Whitney U-test with the Monte Carlo simulation technique. One-way ANOVA analysis with the post-hoc Tukey HSD test was used in the comparison of multiple groups. In the comparison of categorical data, the Pearson Chi-square and Fisher Exact tests were applied with the Monte Carlo simulation technique. Quantitative data were stated in the tables as mean±standard deviation (SD) and median (minimum-maximum) values, and categorical data as number (n) and percentage (%). A value of  $p < 0.05$  was accepted as statistically significant.

## RESULTS

Of the 113 patients included in this study, Group S comprised 70 (61.9%) males and 28 females with a mean age of  $57.49 \pm 15.69$  years, and Group G comprised 26 (12.5%) males and nine females with a mean age of  $50.97 \pm 17.69$  years. When the patients were evaluated regarding the length of stay in ICU, the patients in Group S spent a significantly shorter period in ICU ( $p = 0.032$ ). The Group S patients had statistically significantly lower FGSI scores than Group G patients ( $p = 0.001$ ). The demographic and surgical data of the patients are shown in Table 2.

In the evaluation of the hematological, biochemical and inflammatory parameters, the CRP values of Group S were observed to have fallen significantly more in the postoperative period compared to those of Group G ( $p = 0.017$ ). No statistically significant difference was determined between the groups regarding any other parameters ( $p > 0.05$ ).

In the evaluation of the subgroups of the general anaesthesia group, the TIVA group (Group T) comprised 24 (68.6%) patients and the Ultiva+sevoflurane group (Group US) 11 (31.4%) patients. No difference was determined between these two groups regarding preoperative hematological, biochemical and inflammatory parameters ( $p > 0.05$ ) (Table 3). In the evaluation of the postoperative biochemical and hematological data according to anaesthesia, the WBC, CRP, BUN and creatinine values of Group US were determined to be statistically significantly higher than those of the other groups (Group S and Group T) ( $p = 0.023$ ,  $p = 0.020$ ,  $p = 0.047$ ,  $p = 0.042$ , respectively) (Table 4).

Tomographic examination was made of 87 (77%) patients in the preoperative period. Of these patients applied with CT, 53 (46.9%) received spinal anaesthesia and 34 (30.1%) general anaesthesia. When the CT images were examined of the patients in Group G, there was no paravertebral area involvement in any patient. However, in 40% patients, there were reported to be lesion areas of heterogeneous soft tissue density observed as air values starting from the perianal region and continuing along the gluteal sulcus and within one or both of the right or left gluteal areas extending to the subcutaneous tissue. It was seen that spinal or local anaesthetic was not applied to any patient showing gluteal region extension.

The factors affecting the selection of anaesthesia method in the patients evaluated in the study are shown in Table 5. When the factors affecting the selection of general anaesthesia were examined, a positive correlation was determined between an increase in the FGSI score ( $r = 0.482$ ,  $p = 0.001$ ), the presence of sepsis ( $r = 0.485$ ,  $p = 0.001$ ) and gluteal region involvement ( $r = 0.628$ ,  $p < 0.001$ ). A positive correlation was determined between a decrease in platelet values and the application of spinal anaesthesia ( $r = 0.238$ ,  $p = 0.011$ ).

**Table 2.** Demographic characteristics and medical conditions of the study population (n=113)

Variables	Group S (n=78)	Group G (n=35)	p
Age (years)	57.49±15.69	50.97±17.69	0.131
Gender (male), n (%)	70 (61.9)	26 (23)	0.046
Comorbid disease, n (%)			
No comorbidity	36 (32.2)	14 (12.5)	0.384
Diabetes mellitus	8 (7.1)	7 (6.2)	
Cardiovascular	7 (6.2)	1 (0.9)	
Active cancer/chemotherapy	0 (0.0)	2 (1.8)	
HIV infection	1 (0.9)	0 (0.0)	
Chronic steroid use	2 (1.8)	0 (0.0)	
Diabetes mellitus+Chronic renal failure	24 (21.4)	10 (9.0)	
Time from onset of symptoms to presentation (days)	7.77±6.41	6.20±5.91	0.371
Length of stay in hospital (days)	17.61±15.23	21.02±14.21	0.438
Length of stay in ICU (days)	3.68±10.40	8.97±15.21	0.032
Length of stay in ward (days)	13.65±11.32	11.71±9.47	0.326
Duration of antibiotic use (days)	15.84±11.83	19.38±11.47	0.325
Fournier's gangrene severity index	3.19±2.70	6.82±3.81	0.001
Duration of surgery (mins)	71.39±34.98	94.35±43.21	0.006
Number of operations	1.27±0.71	1.20±0.47	0.514
Mortality, n (%)	2 (2.7)	3 (8.5)	0.342

**Table 3.** Preoperative and postoperative values of the hematological, biochemical and inflammatory parameters of the patients applied with different general anaesthesia techniques

Variables	Group-T (n=24)	Group US (n=11)	p	Group T (n=24)	Group US (n=11)	p
	Preoperative value	Preoperative value		Postoperative value	Postoperative value	
WBC	16.46±6.63	16.36±10.31	0.935	13.44±7.47	17.61±9.51	0.023
Hb	11.69±2.64	11.92±2.58	0.964	11.13±2.53	10.74±1.53	0.852
Plt	241.16±142.63	228.28±148.68	0.808	264.13±145.89	228.10±149.67	0.519
CRP	95.45±123.47	127.61±143.93	0.237	71.39±93.45	120.29±147.12	0.251
ALT	19.66±17.60	38.72±59.24	0.292	19.00±12.32	16.50±12.79	0.598
AST	28.58±31.42	55.27±55.87	0.090	24.00±12.38	38.40±35.60	0.086
BUN	45.50±48.33	55.27±55.87	0.112	27.50±14.96	50.90±65.66	0.103
Cre	1.22±1.20	1.26±0.98	0.895	0.82±0.47	1.34±0.97	0.046
Glu	190.75±132.87	191.36±80.76	0.978	190.95±117.73	134.43±69.76	0.314
Na	134.54±3.92	135.90±7.47	0.768	136.97±55.22	138.90±60.81	0.230
K	4.10±0.76	4.24±0.70	0.596	4.03±0.65	4.27±0.60	0.332
HCO <sub>3</sub>	23.20±3.53	22.96±3.80	0.264	23.20±3.53	22.96±2.20	0.899
Lactate	1.38±0.57	2.46±2.56	0.162	1.38±0.57	2.13±2.70	0.665
Pulse	103.42±15.47	93.10±13.59	0.081	88.19±9.97	92.80±16.26	0.336
Respiratory rate	19.33±3.02	17.80±4.63	0.277	16.57±2.15	15.20±2.09	0.106
Saturation	97.04±2.49	95.90±1.79	0.205	98.33±2.24	97.60±1.50	0.358

ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; BUN: Blood urea nitrogen; CRP: C-reactive protein; Glu: Blood glucose; Hb: Hemoglobin; HCO<sub>3</sub>: Bicarbonate; K: Potassium; Cre: Creatinine; Na: Sodium; Plt: Platelet; WBC: White blood cell.

**Table 4.** Comparison of the postoperative biochemical and hematological parameters according to groups

Variables	Postoperative value			p
	Group S (n=78)	Group T (n=24)	Group US (n=11)	
White blood cell	12.58±4.70	13.44±7.47	17.61±9.51	0.023
Hemoglobin	11.62±2.29	11.13±2.53	10.74±1.53	0.464
Platelet	345.29±147.45	264.13±145.89	228.10±149.67	0.003
C-reactive protein	44.11±77.44	71.39±93.45	120.29±147.12	0.020
Alanine aminotransferase	26.69±25.30	19.00±12.32	16.50±12.79	0.204
Aspartate aminotransferase	30.38±26.48	24.00±12.38	38.40±35.60	0.287
Blood urea nitrogen	31.16±27.65	27.50±14.96	50.90±65.66	0.047
Creatinine	0.87±0.88	0.82±0.47	1.34±0.97	0.042
Blood glucose	134.43±69.76	190.95±117.73	134.43±69.76	0.142
Sodium	136.89±69.76	136.97±55.22	138.90±60.81	0.556
Potassium	4.24±0.60	4.03±0.65	4.27±0.60	0.348
Bicarbonate	23.15±2.20	23.20±3.53	22.96±2.20	0.982
Lactate	1.24±0.88	2.67±1.93	1.24±0.88	0.254
Pulse	88.60±11.05	100.09±15.41	88.60±11.05	0.489
Respiratory rate	16.80±2.56	18.83±3.61	16.80±2.56	0.157
Saturation	97.69±2.05	96.67±2.32	97.69±2.05	0.340

**Table 5.** Evaluation of the factors related to the anaesthesia technique

	Anesthesia technique	
	r	p
Fournier's gangrene severity index	0.482**	0.001
Platelet	-0.238*	0.011
Requirement for inotropic agent	0.212*	0.026
Extent of surgery	0.212*	0.024
Sepsis	0.485**	0.001
Gluteal involvement	0.628**	<0.001

could occur intraoperatively and postoperatively are essential for the application of anaesthesia.<sup>[12]</sup> In some studies, some diseases that cause an immune system failure (such as DM) have been reported to increase susceptibility to FG.<sup>[13-15]</sup> In the current study, 55.7% of the patients had one or more comorbid diseases. When evaluated concerning comorbidities, the most significant was seen to be DM in 43.4% of the current study patients, followed by other pathologies, namely chronic renal failure (CRF) and cardiac diseases. The results of the current study were consistent with previous findings in the literature regarding the evaluation of comorbid diseases. However, when evaluated regarding factors related to mortality, there was not seen to be any relationship between DM and other comorbid diseases and mortality.

## DISCUSSION

Despite improvements in intensive care conditions and the development of new antibiotic agents, surgical debridement still constitutes the basis of FG treatment.<sup>[1-3,11]</sup> It has been reported that there was an accompanying sepsis table in approximately 40% of patients.<sup>[11]</sup> The selection of anaesthesia method for septic patients is important because of complications that may develop postoperatively, such as immune suppression, acute renal failure and cardiac depression. However, no consensus has been reached on which anaesthesia method should be selected for which patients.

A thorough preoperative preoperative evaluation of the patient and the prediction and prevention of complications that

The spread of the disease has been reported to be an independent and the most important risk factor for mortality in FG patients.<sup>[16]</sup> The FGSI is an objective scoring system that has been developed to predict disease severity and prognosis in patients with Fournier's gangrene.<sup>[10]</sup> Previous studies have shown conflicting results concerning the relationship between FGSI score and mortality. Although some studies have reported a higher mortality rate in patients with a high FGSI score,<sup>[17,18]</sup> other studies have emphasised that there is no relationship between FGSI score and mortality.<sup>[19,20]</sup> In the current study, there was a strong positive correlation between FGSI score and mortality (r=0.289, p=0.002). In addition, the findings obtained in this study demonstrated that the FGSI scores of the spinal anaesthesia group (3.19±2.70)

were statistically significantly lower than those of the general anaesthesia group ( $6.82 \pm 3.81$ ) ( $p < 0.001$ ) and there was a strong positive correlation between an increase in total FGSI score and the application of general anaesthesia ( $r = 0.482$ ,  $p = 0.001$ ). When the subgroups were analysed regarding the relationship between the anaesthesia method and the data forming the FGSI score, no single factor alone had a significant association with the selection of anaesthesia method. thereto our knowledge, there were no data in the literature about correlations between the FGSI score and anaesthesia application, no comparisons could be made with the current study results (Fig. 1).

The use of CT in FG diagnosis is controversial. While some authors have emphasised that time is lost with the taking of CT and there could be disease progression, others have stated that by evaluating superficial and deep fascia structures with CT, the degree of necrosis can be revealed, which cannot be fully determined in physical examination, and this can be of guidance in determining the extent of resection and could determine the etiological factor causing the development of FG.<sup>[21,22]</sup> That the use of CT could be of guidance in the selection of the anaesthesia method was first highlighted by Koitabashi et al.<sup>[6]</sup> until the publication of that study, there had been no data about lower back or paravertebral region involvement in FG patients. They emphasized that spinal anaesthesia should not be applied in the presence of lumbar subcutaneous gas.<sup>[6]</sup> The current study is the most extensive study to have evaluated the role of CT in the selection of the anaesthesia method. In the preoperative period, 87 (77%) of the current study patients underwent tomographic examination. Of the patients applied with CT, spinal anaesthesia was selected for 53 (46.9%) and general anaesthesia for 34 (30.1%). When the CT images were examined of the patients in the general anaesthesia group, there was no paravertebral area involvement in any patient, but in 40% there were reported to be lesion areas of heterogenous soft tissue density observed as air values starting from the perianal region and continuing along the gluteal sulcus and within one or both of

the right or left gluteal areas extending to the subcutaneous tissue. It was seen that spinal or local anaesthetic was not applied to any patient showing gluteal region extension. In the evaluation of the factors related to general anaesthesia, there was seen to be a strong correlation between the selection of general anaesthesia and the presence of gluteal involvement ( $r = 0.628$ ,  $p < 0.001$ ).

The presence of sepsis was seen to be an independent factor related to the selection of anaesthesia method ( $r = 0.482$ ,  $p = 0.001$ ). The primary aim of an anaesthetist in the intraoperative period is to provide safe and optimal care to be able to obtain the maximum benefit from the surgery to septic patients and the radiological source control procedure.<sup>[23]</sup> Sato et al.<sup>[7]</sup> emphasised that if there is sepsis in the table of FG patients or concomitant septic shock or hemodynamic instability, general anaesthesia should be selected for these patients. However, there is no ideal anaesthetic agent for patients in septic shock. The selected agents should be administered at small doses incrementally according to the patient response.<sup>[23]</sup> In the current study, propofol and fentanyl were used with titration as intravenous agents in anaesthesia induction and rocuronium or atracurium as muscle relaxants. TIVA anaesthesia was used in 68.6% of the patients in anaesthesia maintenance.

In some recent studies, it has been emphasised that in patients where TIVA anaesthesia was used rather than sevoflurane in breast and colorectal cancer, there was a positive effect on survival through less depression of immune system functions.<sup>[24,25]</sup> Furthermore, in two recent randomised, controlled studies, in the comparison of the application of propofol anaesthesia and paravertebral block for postoperative analgesia with sevoflurane and opioids in patients operated on for breast cancer, there was seen to be less loss of natural killer cell functions in patients following propofol anaesthesia.<sup>[26,27]</sup>

In the current study, spinal anaesthesia was preferred for patients with no bleeding diathesis or septic table, no infection in the area where spinal anaesthesia was to be applied and who were hemodynamically stable. In studies presenting anaesthesia experience in FG patients, Kim,<sup>[5]</sup> Koitabashi,<sup>[6]</sup> and Sato<sup>[7]</sup> reported that spinal anaesthesia was preferred in cases with no infection in the area where spinal anaesthesia was to be applied and no hemodynamic instability. The indications for the selection of the anaesthesia method in the current study were seen to be similar to previous findings in the literature.

Although in the main aim of the current study, there was no effect on the biochemical, hematological and inflammatory parameters of the anaesthesia methods used, there was seen to be a significant decrease in the CRP and WBC levels in the postoperative period in the patients applied with spinal anaesthesia. A significant elevation was observed in the inflam-

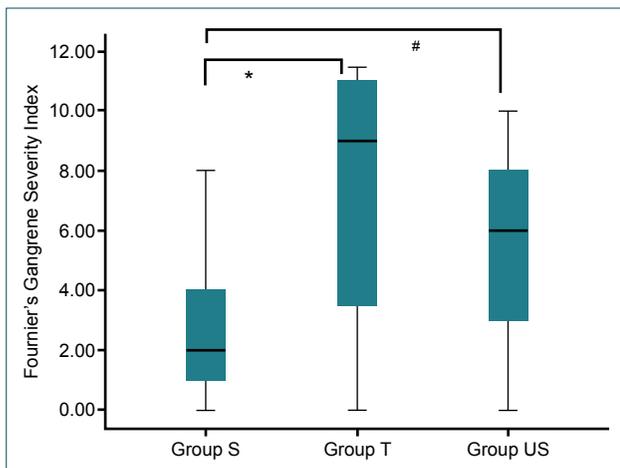


Figure 1. Fourniers Gangrene Severity Index.

matory parameters (CRP, WBC), BUN and creatinine values in the patients applied with general anaesthesia. In a study conducted by Malan, it was reported that sevoflurane could have a negative effect on renal functions.<sup>[28]</sup> However, this is also a condition that can be encountered associated with a septic shock table or spread of the disease.<sup>[23]</sup> For the evaluation of this in the current study, Group T and Group US were evaluated regarding patients with sepsis and total FGSi scores. No difference was determined between the groups regarding the preoperative presence of septic table ( $p=0.558$ ), and when evaluated regarding total FGSi scores, Group US were determined to have lower FGSi scores ( $5.54\pm 3.29$ ). Although there is no other study that has evaluated the effects of the use of TIVA and ultiva-sevoflurane on inflammatory parameters in FG patients, Nakanuno et al.<sup>[29]</sup> reported that CRP values were lower postoperatively in patients where propofol was used as the anaesthetic agent compared to patients where sevoflurane anaesthesia was used. The results of the current study were seen to be consistent with the literature regarding both kidney functions and inflammatory parameters.

The most important limitation of this study was that as it was retrospective, it was dependent on the quality of the documentation kept in the ICU. However, patient records have been kept in great detail in our clinic, especially for the last 10 years, both in the computerised system and as nurses' observation forms, so the data loss can be considered to be at a minimum level. However, this type of study conducted prospectively would enable the more objective testing of immune functions in patients applied with general anaesthesia or spinal anaesthesia.

## Conclusion

As a result, many factors should be considered in the selection of anesthesia methods in patients with FG. Our study showed that adequate debridement was successful with spinal anesthesia in patients with localized involvement in the scrotal region without gluteal region spread and who did not develop a septic table. Besides, it was shown that in cases of more extensive involvement and contraindication for spinal anesthesia (such as gluteal involvement or bleeding diathesis extending to the back) or septic patients, propofol as an induction agent, and isoflurane and sevoflurane as maintenance are titrated according to the patient's response in small doses to be used safely. However, prospective studies involving more patients on the subject should be conducted.

**Ethics Committee Approval:** This study was approved by the Kahramanmaraş Sutcu Imam University Faculty of Medicine Clinical Research Ethics Committee (Approval number: 2019-04-12, date: 06.03.2019).

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M.B.B., O.B., M.K.D., H.Ç.; Analysis: O.F.B., B.K.; Literature search: O.F.B.; Writing: O.F.B., B.K., V.F.P.; M.B.; Critical revision: O.F.B., B.K., V.F.P.; M.B., E.B., M.B.B., O.B., M.K.D., H.Ç.

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## ORJİNAL ÇALIŞMA - ÖZ

### Peroneal nekrotizan fasiit hastalığında anestezi tekniğini seçerken kullanılması gereken faktörler var mı?: İki merkezden bir kohortun tanımlayıcı analizi

Dr. Ömer Faruk Boran,<sup>1</sup> Dr. Bülent Katı,<sup>2</sup> Dr. Veli Fahri Pehlivan,<sup>3</sup> Dr. Maruf Boran,<sup>4</sup> Dr. Evren Büyükfirat,<sup>3</sup> Dr. Mehmet Buğra Bozan,<sup>5</sup> Dr. Osman Barut,<sup>6</sup> Dr. Mehmet Kutlu Demirkol,<sup>6</sup> Dr. Halil Çiftçi<sup>2</sup>

<sup>1</sup>Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi, Anestezi ve Reanimasyon Anabilim Dalı, Kahramanmaraş

<sup>2</sup>Harran Üniversitesi Tıp Fakültesi, Üroloji Anabilim Dalı, Şanlıurfa

<sup>3</sup>Harran Üniversitesi Tıp Fakültesi, Anestezi ve Reanimasyon Bölümü Anabilim Dalı, Şanlıurfa

<sup>4</sup>Amasya Şerefeddin Sabuncuoğlu Eğitim ve Araştırma Hastanesi, Yoğum Bakım Ünitesi, Amasya

<sup>5</sup>Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, Kahramanmaraş

<sup>6</sup>Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi, Üroloji Anabilim Dalı, Kahramanmaraş

**AMAÇ:** Mevcut çalışmada özellikli bir hastalık grubu olan Fournier's gangrenli hastalarda kullanılacak anestezi yöntem seçiminde etki eden faktörlerin incelenmesi ve literatür eşliğinde tartışılması amaçlanmıştır.

**GEREK VE YÖNTEM:** Ocak 2014-Mayıs 2019 yılları arasında Fournier's gangreni nedeniyle ameliyat edilen 113 hasta geriye dönük olarak değerlendirildi. Yetmiş sekiz hastanın spinal anestezi (Grup S), 35 hastanın ise genel anestezi (Grup G) ile ameliyat edildiği görüldü. Hastalar yaş, cinsiyet, kullanılan anestezi yöntemi (spinal, genel), uygulanan anestezi ajanı sepsis varlığı, biyokimyasal, hematolojik ve enflamatuvar parametreler gibi bilgiler açısından değerlendirildi.

**BULGULAR:** Çalışmaya alınan hastaların FGSI skorları açısından değerlendirildiğinde de grup I'deki hastaların daha düşük değerlere sahip oldukları görüldü ( $p=0.001$ ). Ameliyat öncesi dönemde hastaların 87'sine (%77) tomografik inceleme yapıldığı görüldü. Hastaların tomografik görüntüleri incelendiğinde genel anestezi uygulanan hastalardan 13'ünde (%37.1) sağ/sol gluteal alandan birisi ya da her ikisinde de bulunan ve cilt altı dokuya dek uzanan içerisinde hava değerleri izlendiği görüldü. Genel anestezi seçimine etki eden faktörler incelendiğinde FGSI değerindeki artışın ( $r=0.482$ ,  $p=0.001$ ), sepsis varlığı ile ( $r=0.485$ ,  $p=0.001$ ) ve gluteal bölge tutulumu ile ( $r=0.628$ ,  $p<0.001$ ) pozitif yönde korelasyon izlenirken platelet değerlerindeki düşüşle de spinal anestezi uygulaması arasında ilişki olduğu görüldü ( $r=0.238$ ,  $p=0.011$ ).

**TARTIŞMA:** Fournier's gangrenli hastalarda anestezi yöntemi seçimi hastanın genel durumu, sepsis varlığı, kanama dizatezi bulunup bulunmaması, gibi faktörlerin yanı sıra FGSI indeksi ve tomografik olarak gluteal bölge tutulumu gibi pek çok faktörün etkilediği kompleks bir durum olup anestezi yöntemi tercihinde hastaların risk-fayda dengesinin bireysel olarak değerlendirilmesi gerekmektedir.

**Anahtar sözcükler:** Anestezi yönetimi; Fournier's gangreni; sevofluran; TIVA; ultiva.

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