



## A 5-year retrospective analysis of necrotizing fasciitis – A single center experiences

Petogodišnja retrospektivna studija nekrotizujućeg fasciitisa – iskustvo jednog centra

Aleksandar I Kiralj\*, Zlata Janjić†, Jelena Nikolić†, Borislav Markov\*,  
Marija Marinković†

\*Clinic for Maxillofacial Surgery, †Clinic for Plastic and Reconstructive Surgery,  
Clinical Center of Vojvodina, Novi Sad, Serbia

### Abstract

**Background/Aim.** Necrotizing fasciitis (NF) is usually an acute infection of superficial fascia with rapid progression in around soft tissue. If not promptly recognized and aggressively treated NF usually leads to sepsis and multiorgan failure with fatal outcome, thus early diagnosis and prompt surgical treatment are crucial for healing of these patients. The aim of this article was to evaluate the clinical presentation of all patients with acute NF diagnosed and treated in surgical clinics of Clinical Center of Vojvodina, Novi Sad, Serbia. **Methods.** The medical records of patients treated for acute NF localized on a different parts of the body in Clinical Center of Vojvodina, Novi Sad, Serbia, during a 5-year period (from January 2008 to December 2012) were retrospectively evaluated. This study enrolled patients admitted via Emergency Center of Vojvodina with the diagnosis of acute NF either as the primary diagnosis or with the diagnosis at discharge after surgical treatment. **Results.** During a 5-year period there were 216 patients with final diagnosis of acute NF. Most of our patients (140 – 64.81%) were admitted with the initial diagnosis of cellulitis, abscesses, phlegmons or sepsis. Unfortunately, the clinical symptoms of acute NF were atypical at time of initial examination. Pain and swelling of the affected localization were the most presented bias of symptoms (183 – 84.72%). The majority of our patients were male (164 – 75.92%). Among the 216 patients, the most common pre-existing single factor was drug abuse (39 – 18.05%), followed by obesity (38 – 17.59%) and diabetes mellitus (31 – 14.35%).

### Apstrakt

**Uvod/Cilj.** Nekrotizujući fasciitis (NF) obično je akutna infekcija površne fascije sa rapidnom progresijom u okolno tkivo, koja često dovodi do sepse i multiorganskog oštećenja sa fatalnim završetkom ukoliko se ne prepozna brzo i ne leči agresivno. Rana dijagnoza i što brže hirurško lečenje presudni su za izlечение ovih bolesnika. Cilj ovog rada bio je da proceni kliničku sliku svih bolesnika sa akutnim NF koji

Trauma was most common etiological factor (22 – 10.8%) in infected wounds, followed by abdominal (15 – 6.94%) and orthopedic (11 – 5.09%) surgical intervention. In the present study idiopathic acute NF was diagnosed in 22 (10.18%) patients and more than one etiological factor were diagnosed in 20 (9.25%) patients. The majority of our patients had type I acute NF (172 – 79.62%) with Streptococcal species as the most common microorganism (125 – 71.02%). The most common localization was an extremity (151 – 69.90%). The minority of our patients had head and neck localization of infection (7 – 3.24%). Surgical treatment was performed in all the patients and most of them (183 – 84.72%) received the first surgery within 24 h. Other patients (23 – 10.64%) received operation after stabilization of general status or after getting the diagnosis of acute NF (unclear diagnosis on admission). During hospitalization, the most common complication among our patients was sepsis (156 – 72.22%). The mortality rate was 14.35%. **Conclusion.** Acute NF is a rare but very difficult and sometimes life-threatening disease of superficial fascia and around soft tissue. If acute NF is suspected, early radical excision of all the affected tissue with exploration and excision of superficial fascia with pathological and microbiological assessment are most significant for treatment. Appropriate antibiotics and intensive care setting to manage other organ failure of NF are recommended at the same time with surgery.

**Key words:**  
fasciitis, necrotizing; risk factors; surgical procedures, operative; serbia.

su dijagnostikovani i lečeni na hirurškim klinikama Kliničkog centra Vojvodine u Novom Sadu. **Metode.** Retrospektivno je ocenjena medicinska dokumentacija bolesnika lečenih od akutnog NF, lokalizovanog na različitim delovima tela, u periodu od januara 2008. do decembra 2012. godine u Kliničkom centru Vojvodine u Novom Sadu. Ova studija je obuhvatila sve bolesnike koji su primljeni preko Urgentnog centra Vojvodine, kojima je postavljena početna dijagnoza akutnog NF i bolesnike kod kojih je dijagnoza postavljena

nakon hirurške intervencije. Dokumentovane su razlike u godinama i polu, komorbiditetu ili predispoziciji, lokalizaciji infekcije, biogramima rane i krvi, tipu i broju hirurških intervencija, te stopi mortaliteta. **Rezultati.** Tokom 5-godišnjeg perioda imali smo 216 bolesnika sa završnom dijagnozom akutnog NF. Većina naših bolesnika (140 – 64.81%) primljena je sa dijagnozom celulitisa, abscesa, flegmone ili sepsa. Nažlost, klinički simptomi akutnog NF bili su atipični u vreme inicijalnog ispitivanja. Bol i otok zahvaćene lokalizacije bili su najčešći bias simptoma (183 – 84.72%). Većina naših bolesnika bili su muškog pola (164 – 75.92%). Među našim bolesnicima najčešća predispozicija bila je uživanje droge (39 – 18.05%), zatim gojaznost (38 – 17.59%) i šećerna bolest (31 – 14.35%). Trauma je bila najčešći etiološki faktor (22 – 10.80%) inficiranih rana, slede ih abdominalne (15 – 6.94%) i ortopediske (11 – 5.09%) intervencije. U ovoj studiji idiopatski oblik akutnog NF bio je dijagnostikovan kod 20 (9.25%) bolesnika. Većina njih imala je akutni NF tipa I (172 – 79.62%) sa *Streptococcus* species kao najčešćim mikroorganizmom (125 – 71.02%). Najčešća lokalizacija oboljenja bili su ekstremiteti (151 – 69.90%). Najmanji broj bolesnika imao je infekciju lokalizovanu na glavi i vratu (7 – 3.24%). Hirurško lečenje

primenjeno je kod svih bolesnika i većina njih (183 – 84.72%) imali su prvu operaciju tokom 24 h. Ostali bolesnici (23 – 10.64%) imali su operaciju nakon stabilizacije opšteg stanja i nakon postavljanja dijagnoze akutnog NF (nejasna dijagnoza pri prijemu). Ekszisioni debridman svih zahvaćenih tkiva, uvek sa fasciectomijom urađen je kod svih bolesnika. Većina naših pacijenata je dva puta operisana (74 – 34.25%). Kod 15 bolesnika (6.94%) urađena je amputacija. U toku hospitalizacije najčešća komplikacija bila je sepsa (156 – 72.22%). Stopa mortaliteta iznosila je 14.34%. **Zaključak.** Akutni NF retko je, ali veoma teško i, ponekad po život opasno oboljenje superficijalne fascije i okolnog tkiva. Ukoliko postoji sumnja na akutni NF imperativ lečenja je rana radikalna ekszizija zahvaćenog tkiva sa eksploracijom i ekszizijom superficijalne fascije, te patohistološkim i mikrobiloškim ispitivanjem. Istovremeno sa hirurškim lečenjem preporučuju se odgovarajući antibiotici, te intenzivna terapija koja će regulisati rad organa oštećenih ovom bolešću.

**Ključne reči:**  
fasciitis, nekrotizujući; faktori rizika; hirurgija, operativne procedure; srbija.

## Introduction

Acute necrotizing fasciitis (NF) is an uncommon surgical emergency disease. Most articles suggest that the incidence and mortality of NF are increasing in the whole world<sup>1–4</sup>. This acute and devastating infection of superficial fascia easily spreads across the subcutaneous tissue and skin or toward deep fascia and muscles<sup>5–7</sup>. The reason for acute course of infection and fast extension of necrosis is thrombosis of microvessels in and around the affected fascia. Acute NF was uncovered and described by Hippocrates about 500 BC. After that description a few crucial articles were published and reported on the detail description of NF but under different names of the disease. British surgeon Joseph Jones described this disease as “hospital gangrene” in 1871. French physician Jean Alfred Fournier described the same disease “to spread over perineum in male patients”. In the recent time this localization of NF has begun to bear his name. The other name for NF such as suppurative fasciitis, streptococcal gangrene, necrotizing erysipelas, gas gangrene, hemolytic or clostridial gangrene, Meleney’s gangrene, Fournier’s gangrene, (“flesh-eating bacteria” or “killer bugs” in newspaper articles) have begun also to be used in the literature. In 1951 Wilson proposed the term “necrotizing fasciitis” for all difficult forms of soft tissue infection with superficial fascia necrosis<sup>7,8</sup>. Nowadays, as was usually in the past time, the diagnosis of NF is often delayed because the symptoms mimic some of similar conditions in the early stage of the disease<sup>9–11</sup>. If physicians miss the diagnosis in the early course of the disease, morbidity and mortality rate is high. Immediate and aggressive excision of the affected tissue is recommended after the diagnosis<sup>10–12</sup>. The cornerstone of surgical treatment is excision of all the affected tissues and repeating the same procedure every day until the newly infected tissue removal. The lack of purulent collection during surgical treatment usu-

ally leads to insufficient excision and to the infection progression<sup>10, 12, 13</sup>. That leads to long hospital stay, repeated surgical excisions, residual deformity and a high rate of mortality. The final outcome of the treatment of those with acute NF depends mainly on the prompt and aggressive surgical treatment<sup>9–11, 14</sup>. For all patients presented with acute infection, differentiation between other soft tissue infection and acute NF is a matter of great importance. Unfortunately, presentation of acute NF has no specific signs and symptoms. Usually, patients may be presented with general signs of infection (systemic toxicity and organ dysfunction). Local signs are erythema, edema, cellulitis, bullae or crepitus. Patients with acute NF usually complain of severe pain usually out of proportion to clinical findings. In the advanced stages of acute NF, pain as a sign of infection may decrease<sup>13–15</sup>. In surgical practice distinguishing acute NF from the other common but not severe skin infection is often challenging. Sometimes, imaging studies are useful before immediate surgical treatment. On the plane radiographs findings may include only the for real signs: thickening and hyperdensity of subcutaneous soft tissue due to fluid accumulation and the presence of gas was visible. Ultrasonography as an imaging study was not recommended specially in adults because swelling and thickening of soft tissue blocks ultrasound transmission. Magnetic resonance imaging is a useful method for confirming diagnosis of acute NF and evaluating their localization, thickness and distribution but magnetic resonance images must not delay a life-saving surgical treatment<sup>15–18</sup>. The final diagnosis of NF should be based on the following operative findings: lack of bleeding from the fascia during resection, lack of resistance of muscular fascia during dissection, the presence of fetid-smelling “dish water” pus, the presence of grey necrotic fascia. A full thickness skin and affected tissue biopsy and taking swabs for bacteriological examination are required<sup>5, 7, 11, 13</sup>. Frozen section biopsy of the affected tis-

sue, as a histological technique is useful in differential diagnosis NF and could be life-saving procedure in patients with lack of specific skin signs of this difficult disease. Histological evaluation reveals obliterative endarteritis with thrombosis of the subcutaneous vessels, leukocytic infiltration and microabscess formation. Histological examination of specimen showed that the whole microscopic view is filled with granulocytes (granulocytes counts as stages 3.)<sup>19-21</sup>. Since some laboratory findings were typical in acute NF, in 2004. Wong et al.<sup>22</sup> introduced the laboratory risk indicator (LRINEC) score for early recognition and prognostic outcome of acute NF. Laboratory data including in LRINEC score are hemoglobin, creatinine, glucose, sodium, C-reactive protein (CRP) level and white blood cell count. According to the investigation of some authors the LRINEC score was impressive diagnostic method and they advised them to distinguish NF from the other soft tissue infection<sup>23,24</sup>. Several microorganisms cause acute NF but no single microorganism or combination of them could not be appointed as a specific cause of NF. There were too many aerobic, anaerobic and mixed bacterial floras as a cause of infection of acute NF. The most important individual cause of infection was the group A *Streptococcus* classified as monomicrobial infection (or type II NF with 10% of all acute NF). Frequently, acute NF is polymicrobial infection caused by different anaerobic and aerobic organisms (or type I NF with 90% of all acute NF)<sup>2,9,16</sup>. Some etiological or predisposing factors are very important as a cause of acute NF (trauma, diabetes mellitus, obesity or poor nutritional state, alcohol or drug abuse, chronic or oncologic disease, immunosuppression) but sometimes acute NF is idiopathic<sup>1,3,8</sup>.

The head and neck region has an excellent blood supply and acute NF in that localization is rare.

Many authors founded that infrequent localization in the head and neck region was the reason for the delayed diagnosis and insufficient surgical excision<sup>4,8,12,25</sup>. In numerous group of soft tissue infections, acute NF is perhaps the most serious disease with the possibility of mortality rate from 6% to 76% and differentiating this uncommon infection is often challenging for all surgical specialties<sup>2,3,7</sup>.

## Methods

The medical records of patients treated for acute NF, localized on different parts of the body, in the Clinical Center of Vojvodina, Novi Sad, Serbia, during a 5-year period (from January 2008 to December 2012) were retrospectively evaluated. The following diagnostic criteria for acute NF (International Classification of Diseases, Ninth Revision, code 72886) were used: clinical evidence of rapid superficial fascial necrosis either by direct clinical inspection or by surgical exploration; the diagnosis was made indirectly by laboratory findings (microbiological or histological examination). According to our criteria, nobody of our patients had complete laboratory findings on admission, so we analyzed only leucocytes formula and serum sodium level. Frozen section biopsy was not required because most of our patients were admitted after working hours of the pathologist but the patients had the results of excisional biopsy (definitive pathological

examination). Swab, tissue or pus culture was performed at initial wound exploration in our patients. Native radiographic examination of the affected area and chest were performed in all the patients, but magnetic resonance imaging was not performed because of the critical general condition of most of the patients. We also examined and analyzed comorbidities at admission. All the patients had aggressive surgical excisional debridement and most of them repeated surgical procedures. This study enrolled patients admitted via the Emergency Center of Vojvodina with the diagnosis of acute NF either as the primary diagnosis or with discharged diagnosis after surgical treatment. The differences in age, sex, comorbidities or predisposing factors, symptoms and localization of infection, wound and blood culture, laboratory findings, the type and the number of surgical treatment and mortality rate were documented and retrospectively analyzed.

## Results

Within a 5-year period there were 216 patients with the final diagnosis of acute NF, the majority of whom (140 – 64.81%) were admitted with the initial diagnosis of cellulitis, abscesses, phlegmons or sepsis (Table 1).

**Table 1**

Clinical diagnosis at admission		
Diagnosis	Patients	
	n	%
Cellulitis	91	42.1
Acute necrotizing fasciitis	76	35.2
Phlegmone	19	8.8
Sepsis	19	8.8
Abscess	11	5.1
Total	216	100.0

The majority of our patients were male (164 – 75.92%) and 52 (24.07%) female, with the mean age 52 years (range 18 to 85 years).

Unfortunately, according to our experience, the clinical symptoms of acute NF were atypical at time of initial examination. Pain and swelling of the affected localization (183 – 84.72%) were the most presented bias of symptoms in our patients (Table 2).

**Table 2**

Local clinical symptoms on admission		
Symptoms	Patients	
	n	%
Pain	183	84.7
Swelling	183	84.7
Erytema	121	56.0
Skin necrosis	31	14.4
Bullae	164	75.9
Crepitation	5	2.3

Among the 216 patients, the most common pre-existing single factor was drug abuse (39 – 18.05%), followed by obesity (38 – 17.59%) and diabetes mellitus (31 – 14.35%). Trauma was the most common etiologic factor (22 – 10.18%) between infected wounds, followed by abdominal (15 – 6.94%) and orthopedic surgical intervention (11 – 5.09%). Deep soft tissue penetration and retention of a foreign body lead to serious infection of the affected region. In the present study idiopathic acute NF was diagnosed in 22 (10.18%) patients and more than one etiological factor was diagnosed in 20 (9.25%) patients (Table 3).

**Table 3**  
**Etiological factors and the pre-existing disease**

Etiological Factor	Patients	
	n	%
Idiopathic	22	10.2
Obesity	38	17.6
Drug abuse	39	18.1
Trauma	22	10.2
Diabetes mell	31	14.4
Chronic disease	5	2.3
Malignancy	6	2.8
Orthopaedic patients	11	5.1
Abdominal patients	15	6.9
Head and neck infections	7	3.2
More than one factors	21	9.3

The majority of our patients had type I acute NF (172 – 79.62%) with streptococcal species as the most common microorganism (125 – 71.02%) (Table 4).

**Table 4**  
**Type of acute necrotizing fasciitis (NS) and the results of wound culture**

Parameters	Patients	
	n	%
Type I NS	172	79.6
Type II NS	44	20.4
Microorganisms		
<i>Staphylococcus aureus</i>	111	51.4
Group A <i>Streptococcus</i>	125	71.0
<i>Escherichia coli</i>	93	43.01
<i>Pseudomonas aeruginosum</i>	48	22.2
<i>Acinetobacter spp</i>	62	28.7
<i>Proteus spp</i>	98	44.4

At admission all the patients had increased band cell count in peripheral blood and hyponatremia in laboratory findings. Localizations of acute NF were as listed in Table 5.

**Table 5**  
**Body sites of infection**

Body sites of infection	Patients	
	n	%
Head and neck	7	3.2
Trunk	58	26.9
abdominal wall	23	10.6
perineum	35	16.2
Extremity	151	69.9
upper extremity	53	24.5
lower extremity	98	45.4

The most common localizations were extremities (151 – 69.90%) (Figure 1). The minority of our patients had head and neck (7 – 3.2%) localization of infection and abdominal wall (23 – 10.6) (Figure 2). Surgical treatment was performed in all the patients and most of them (183 – 84.72%) received the first surgery within 24 hours. The other patients (23 – 10.64%) received surgical treatment after stabilization of general condition or after making the diagnosis of acute NF (unclear diagnosis on admission). Table 6 shows the number and the type of surgical treatment.

**Table 6**  
**Number and type of operation**

Variables	Patients	
	n	%
Number of operation		
1	0	0
2	101	46.75
3	64	29.62
4	51	23.61
Type of operation		
excision fasciectomy	216	100
suture adaptations	14	6.48
plastica sec. Thiersch	187	86.57
amputation	15	6.94

Excision of all the affected tissues often with fasciectomy was performed in all our patients. During operation, the infected tissues were excised and sent for histological examination. All histological reports confirmed the diagnosis of acute NF. After excision the wounds were left open. The patients were taken to the operative theatre every 24 to 48 hour to continue with surgical reexamination of infected and necrotic tissue. When the wound infection was under control wound reconstruction was finished (suture adaptations, skin grafts or amputations). Split thickness skin grafting was required for most of the patients (187 – 86.57%). Most of our patients required two operations (74 – 34.25%). Unfortunately, despite our efforts 15 (6.94%) patients received amputation. Complications were listed in Table 7.

**Table 7**  
**Complications of acute necrotizing fasciitis**

Complication	Patients	
	n	%
Skin lost	64	29.6
Sepsis	156	72.2
Septic shock	29	13.4
Multiorgan failure	45	20.8
Extremity lost	15	6.9
Death	31	14.4

During hospitalization, the most common complication among our patients was sepsis (156 – 72.22%), followed by skin loss (64 – 29.62%) and multiple organ failure (55 – 20.83%). Mortality rate among our patients was 14.35%. All patients were treated with broad spectrum antibiotics (started empirically and followed with target antibiotic therapy in according with the results of wound or blood cultures). Intensive care (intravenous fluids, parenteral nutritions, and other substitutional therapy) and monitoring of all vital parameters



**Fig. 1 – Necrotizing fasciitis localization in the upper and lower extremities.**



**Fig. 2 – Necrotizing fasciitis in the neck (left) and abdominal wall region (right).**

immediately after admission were required in all our patients. Hyperbaric oxygen therapy was not used in the treatment of acute NF because this modality may delay appropriate early excisional debridement.

## Discussion

Acute NF is a very serious disease in all the parts of the world with the increasing incidence<sup>2,9</sup>. On the basis of our previous study, acute NF was highly increasing in annual incidence from 16 to 43 patients<sup>26</sup>. Acute NF is a rapidly progressing and life treating infection of superficial fascia which may be difficult to differentiate from the other soft tissue infection<sup>14–16,27</sup>. In the present study, most of the patients (140 – 64.81%) were admitted with the initial diagnosis of cellulitis, abscesses, phlegmons or sepsis, because as a matter of fact, only in a small group of patients there were “hard” clinical signs of acute NF, like in other clinical studies<sup>1,3,9,27</sup>. In our previous studies we reported the similar results<sup>26,28</sup>. Unfortunately, presentation of acute NF in our patients showed no pathognomonic or specific signs; pain and swelling of affected localization (183 – 84.72%) were the most presented bias of symptoms. Based on the current literature, the results of signs examination were similar<sup>2,5,6</sup>. Usually, patients may present with general signs of infection

(systemic toxicity and organ dysfunction) and with severe pain, out of proportion to the clinical findings. But, confusion arose in the advanced stages of acute NF, because pain as a sign of infection may decrease<sup>14–16</sup>. This fact was the main reasons for delay in making the diagnosis and surgical treatment, leading to complications<sup>8,9,11,26</sup>. Given the heterogeneity in acute NF characteristics, comparison between studies from the whole world is sometimes difficult<sup>2,3,5,9</sup>. Other differences in studies outcome may be explained by the preexisting factors<sup>1,8,12,16</sup>. In our previous study drug and alcohol abuse and diabetes mellitus were similar pre-existing factors and no patient had obesity<sup>26</sup>. In our new study the most common pre-existing single factor was drug abuse (39 – 18.05%), followed by obesity (38 – 17.59%) and diabetes mellitus (31 – 14.35%). Recent world studies have reported an increasing incidence of NF among injection drug users<sup>1,2,29</sup>. Most of these patients had HIV infection because of the lack of local immune response. Contrary to expectations, we found that obesity was the most increased single risk factor among our patients in the last ten years. One possible reason may be a generally higher body mass index among the citizens of Vojvodina in the last three decades. Some studies examined obesity as a risk factor associated with repeated acute NF<sup>6</sup>. According to Wong et al.<sup>30</sup> patients with diabetes mellitus were over 70% of all cases in theirs study. Lin et al.<sup>17</sup>

showed that the most prevalent comorbidity in NF was also diabetes<sup>17</sup>. In our previous and the new study the most common localization was an extremity (151 – 69.90%) no matter what the microbiology results were. In order to define the etiology of acute NF localized in extremities, the number of infected chronic wounds associated with trauma was the most common factor in our study, like in the other study with the same localization<sup>5,6</sup>.

Fortunately, only a few of our patients had infection of surgical wounds (3 after abdominal and 2 after orthopedic operation). We know that NF occurs after minor trauma, penetrating wounds or insect bites, but surgical procedures were most dramatic. One of the limitations of this study was uncompleted information of impact of trauma and his detail analyzes in our patients with acute NF. In our series the majority of patients had type I acute NF (172 – 79.62%) with Streptococcal species as the most common microorganism (125 – 71.02%). There may be multiple reasons for the variability between different studies. According to the report of Giuliano et al.<sup>31</sup>, type I acute NF was commonly associated with trauma and abdominal wound and type II was more typically localized in extremities. Liu et al.<sup>29</sup> showed that type II NF was more serious presentation than type I. The others authors show no significant difference among clinical presentations of type I and type II NF<sup>1,12</sup>. According to Tsai et al.<sup>32</sup>, *Staphylococcus aureus* and *Streptococcus spp* were the most common microorganisms in the USA and Europe and monomicrobial Gram-negative microorganisms were most common in Asia. Some authors conclude that clinical characteristics of Gram-negative infections are more fulminant than of Gram-positive infections. The minority of our patients had head and neck localization of infection (7 – 34.24%), like in the other studies<sup>12,15,16</sup>. This localization was associated with diabetes mellitus as the risk factor and with the other similar infection such as Ludwig's angina<sup>13</sup>. According to several authors, cervicofacial acute NF was well-described but potentially fatal infection<sup>8,13,33</sup>. Postoperative infection following dental extractions was common and sometimes followed by acute NF as the most serious infection of this localization<sup>4</sup>. Infection spreads in the superficial fascia very fast at the beginning. After that, blood vessels are thrombosed, and the lymphatics disrupted and the skin of face or neck becomes ischemic and necrotic. Same of the most important characteristics of acute NF on the head and neck localization are extreme systemic toxicity and rapid spread of disease, associated with high morbidity, mortality rate<sup>4,8,13</sup>. The second limitation of this study are uncompleted laboratory and radiographic findings. All our patients were critically ill and we evaluated them in the Emergency Center as soon as possible. Fluid resuscitation, antibiotic and the other substitutional therapy was started after admission, like in other articles<sup>1,4,6,7</sup>. After that most of our patients (83 – 84.72%) were transported to the operative theatre because of aggressive surgical excision of infected tissue and wound care. Laboratory evaluation always includes complete blood counts, blood glycemia and electrolyte and arterial blood gases. All our patients had hyponatremia and leucocytosis. In the literature one of the proposed models for predicting outcomes from acute NF was laboratory risk indicator score<sup>23</sup>. Using the cur-

rent literature, we found that a score was unsatisfactorily examined and remained invalidated in lager studies<sup>1,6,34,35</sup>. Some authors recommended fresh frozen section biopsy for the fast diagnosis of acute NF<sup>20-22</sup>. The third limitation of this study is impossibility to make an accurate pathological diagnosis of acute NF, because the pathologist does not work on alert. Early detection and excisional debridement of all the infected tissue, whatever its size, was the key to save the patient's life. Several study recognized a very high mortality rate for patients who did not receive surgery<sup>9,10,17,36</sup>. High mortality and morbidity are often associated with lately diagnosed acute NF and with delayed surgical treatment<sup>7,10,27</sup>. Surgical treatment was performed in all our patients and in most of them (183 – 84.72%) within 24 hours. Like in other infections, the aim of surgical debridement in acute NF is to completely remove infected tissue, if possible in a single operation<sup>7,10,16</sup>. Like in the management of other infected wounds, we always leave them open and use moist wound dressing. Not all patients with acute NF could be cured in one surgical procedure. In most patients secondary wound infection may occur due to increased tissue ischemia<sup>10,34,35</sup>. Most of our patients required two operations (74 – 34.25%). Repeated excisional debridement was a cornerstone of surgical procedure in treatment of acute NF<sup>1,6,7,10,14</sup>. After excisional debridement and when the wound infection was under control, wound reconstruction was finished (suture situations, skin grafts or amputations). The majority of our patients underwent reconstruction with split thickness skin grafts (187 – 86.57%). Unfortunately, in our study 15 (6.94%) patients received amputation. The other authors showed that amputation was the most common in diabetic patients or in drug users<sup>1,10,20</sup>. The rate of amputation varied from 0 to 22% according to other studies<sup>1,3,7,34,36</sup>. The mortality rate in our present study is 14.35% (31 of 216 patients). Even with up to date knowledge of acute NF, all studies showed a very high mortality rate in any anatomic site ranging from 10 to 76%<sup>1,3,7,33</sup>. According to most studies, predictive variables of mortality are age > 75 years, male gender, obesity and diabetes mellitus<sup>6,9,12,36</sup>.

## Conclusion

Acute necrotizing fasciitis is a rare but very difficult and sometimes life-threatening disease of the superficial fascia and around soft tissue. We highlight the possibility that acute NF is not an expected presentation of soft tissue infection yet, and usually not recognized in the early course of the disease. Acute necrotizing fasciitis usually used to be mistaken as cellulitis, phlegmons or abscess. We suggested a high index of suspicion for all patients with unexplained severe pain of any part of the body with general signs of infection and unexplained multiorgan failure. If acute necrotizing fasciitis is suspected, early radical excision of all affected tissue with exploration and excision of superficialis fascia with pathological and microbiological assessment must be the treatment of choice. Appropriate antibiotics and intensive care setting in order to manage other organ failure due to necrotizing fasciitis are recommended at the same time with surgery.

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