Spinal Cord (2011) 49, 1143–1146

www.nature.com/sc

ORIGINAL ARTICLE

Pressure sores significantly increase the risk of developing a Fournier's gangrene in patients with spinal cord injury

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Study design: Retrospective chart review.
Objectives: The aim of our study was to evaluate the mortality rate and further specific risk factors for Fournier's gangrene in patients with spinal cord injury (SCI).
Setting: Division of Spinal Cord Injury, BG-University Hospital Bergmannsheil Bochum, Ruhr-University Bochum, Germany.
Methods: All patients with a SCI and a Fournier's gangrene treated in our hospital were enrolled in this study. Following parameters were taken form patients medical records: age, type of SCI, cause of Fournier's gangrene, number of surgical debridements, length of hospital and intensive care unit stay, co morbidity factors and mortality rate. In addition, laboratory parameter including the laboratory risk indicator for necrotizing fasciitis (LRINEC) score and microbiological findings were analyzed. Clinical diagnosis was made via histological examination.
Results: A total of 16 male patients (15 paraplegic and one tetraplegic) were included in the study. In 81% of all cases, the origin of Fournier's gangrene was a pressure sore. The median LRINEC score on admission was 6.5. In the vast majority of cases, a polybacterial infection was found. No patient died during the hospital stay. The mean number of surgical debridements before soft tissue closure was 1.9 and after a mean time interval of 39.1 days wound closure was performed in all patients.
Conclusions: Pressure sores significantly increase the risk of developing Fournier's gangrene in patients with SCI. We reported the results of our patients to increase awareness among physicians and training staff working with patients with a SCI in order to expedite the diagnosis.
Spinal Cord (2011) **49,** 1143–1146; doi:10.1038/sc.2011.75; published online 26 July 2011

Keywords: Fournier's gangrene; spinal cord injury; mortality rate; pressure sore; LRINEC score

Introduction

Fournier's gangrene is a severe and rapid progressing soft tissue infection of the scrotum and the surrounding tissue, and is usually associated with a high mortality rate. It was first described in 1883 by Fournier[1] as a foudroyante-extending infection of the scrotum and penis. Nowadays, it is regarded as a form of necrotizing fasciitis and involves the perineal, periurethral and genital region, which is mainly triggered by an infection of the skin or genitourinary tract such as perianal, perirectal or ischiorectal abscesses.[2] Furthermore, urethral strictures or abnormalities of the lower urogenital tract might also influence the development. Chronic urinary tract infections as a potential risk factor have also been reported in rare cases, which frequently occur in patients with spinal cord injury (SCI).[3] Further several risk factors, such as diabetes mellitus, obesity, malnutrition and corticosteroid therapy, in the medical history or alcohol abuse in the development of Fournier's gangrene have been described, while diabetes mellitus was the most common risk factor with 10–60% of cases.[2] However, there is a lack of data in the current literature analyzing the risk factors in patients with SCI and Fournier's gangrene. To our best knowledge, there are only three case reports available, which describe the Fournier's gangrene in patients with SCI.[4,5] A recent case report, reported the case of a 60-year-old woman with SCI who developed Fournier's gangrene after traumatic catheterizations for clean intermittent catheterisation.[6] Besides these case reports, there are no clinical studies available, which

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Received 10 March 2011; revised 9 May 2011; accepted 20 May 2011; published online 26 July 2011

analyze the risk factors and describe the incidence of Fournier's gangrene in patients with SCI. Therefore, this retrospective study was conducted to evaluate the risk factors as well as the complication and mortality rate in patients with SCI and Fournier's gangrene.

Materials and methods

All spinal-cord-injured patients over the age of 18 with Fournier's gangrene treated between January 2000 and February 2010 in the hospital of the author were enrolled in the retrospective study. Patients with necrotizing fasciitis or Fournier's gangrene without a SCI were excluded from the study. Information about the patient's medical history, age, sex, localization of pressure sores, American Spinal Injury Association classification, extent of SCI (paraplegia or tetraplegia), length of hospital and intensive care unit stay, number of surgical interventions and time interval until wound closure were taken from the patient's medical file. Furthermore, laboratory, microbiological and histological values were noted at the time of admission. Also, the laboratory risk indicator for necrotizing fasciitis (LRINEC) score were calculated on admission in all patients.[7,8] The LRINEC score, which is composed of the following six laboratory tests: glucose level, C-reactive protein level, white blood cell count, sodium level, creatinine level and hemoglobin is a useful adjunct in the initial diagnosis of necrotizing soft tissue infections.[7–9] As Fournier's gangrene is considered a necrotizing infection of the urogenital tract, we used the LRINEC score in our study.

The initial therapeutic management in all patients involved physiological support to correct fluid deficits, including electrolyte imbalances, followed by extensive operative debridement and antiseptic wound dressing changes and wide-spectrum antibiotic therapy. After radical surgical, debridement wound closure was performed.

Statistical analyses

The risk of developing Fournier's gangrene was compared between patients with pressure sores and patients without pressure sores using the relative risk. All statistical analyses were performed using commercial statistical software (GraphPad Prism 4.1, GraphPad Software Inc., San Diego, CA, USA).

Results

There were 16 male (15 paraplegic and 1 tetraplegic) patients with a median age of 43 years (range 23–67 years) treated with Fournier's gangrene between January 2000 and February 2010 in our hospital. According to the American Spinal Injury Association classification, 14 patients had a complete and 2 patients an incomplete lesion. The median length of hospital stay was 78 days (range 21–236 days), while the mean length of intensive care unit was 5 days (0–47 days). No patient died due to the Fournier's gangrene during the hospital stay. Only in two patients (13%), diabetes mellitus was noted. Obesity or cachexia was found in one case, respectively. In 13 patients (81%), an association with perineal or ischium pressure sore was found (Figure 1). One of them had grade two, five had grade three and seven had grade four pressure sore according to the European Pressure Ulcer Advisory Panel classifications.[10]

During the time interval, a total of 3991 patients were treated with a paraplegia or tetraplegia in our hospital. In all, 1219 out of 3991 patients had pressure sores, whereas 13 out of 1219 patients (1.1%) developed Fournier's gangrene due to pressure sores. Spinal-cord-injured patients with an associated pressure sore had a significantly higher risk of developing Fournier's gangrene compared with those without a pressure sore (relative risk = 2.7; 95% confidence interval = 2.1–3.4)

In all patients radical surgical, debridement was required. In 15 patients (94%) surgical intervention was performed within 24 h after admission. The mean number of surgical debridements before soft tissue closure was 1.9 (median 1.0; range 0–14). Mean time interval until wound closure was 39.1 days (median 26.5 days; 8–131 days). Due to the extent of the soft tissue necrosis, two patients required orchiectomy and three patients protective colostomy.

Laboratorial examinations revealed a median C-reactive protein of 24.4 mg dl^{-1} (2.5–43.3 mg dl^{-1}) and median white blood cell count of 12.850 leucocytes per ml (range 3.800–39.100 ml^{-1}). The median calculated LRINEC score on admission was 6.5 (range 2–9), whereas 11 patients (69%) had LRINEC $\geqslant 6$ and 1 patient $\geqslant 8$ (Figure 2). Our microbiological results showed a polybacterial infection in 11 patients. Two species of bacteria were noted in six patients

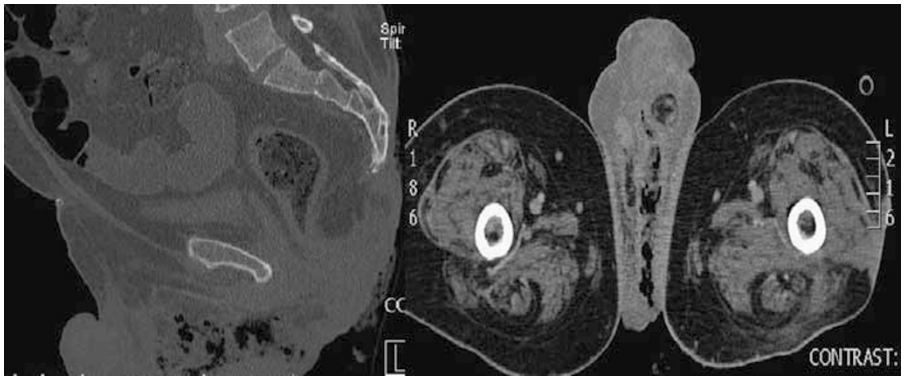

Figure 1 Computerized tomography of the pelvic region showing the Fournier's gangrene. Please note the positive aerogram as a sign of deep infection.

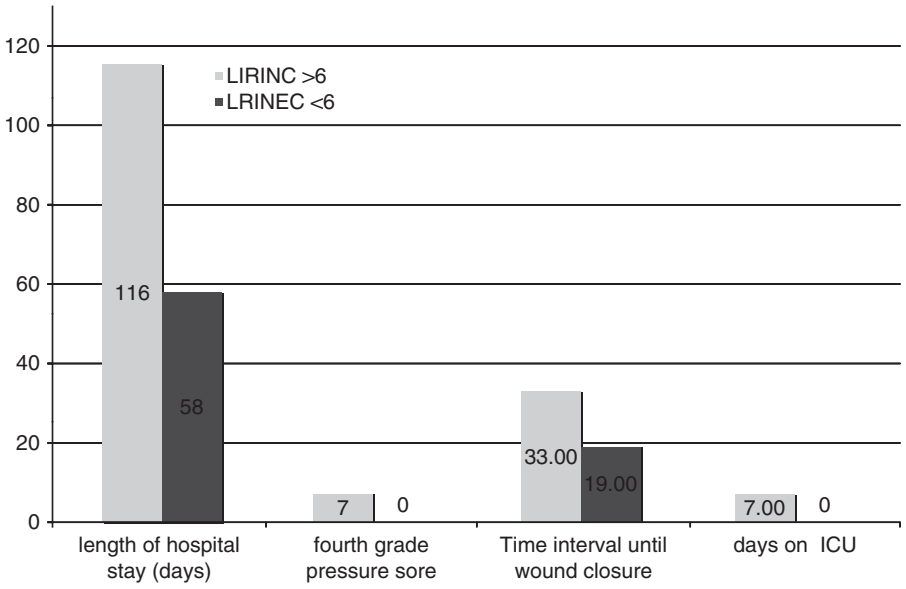

Figure 2 Detailed information about length of hospital and intensive care unit stay and time interval until wound closure depending on the LRINEC score are given in Figure 2.

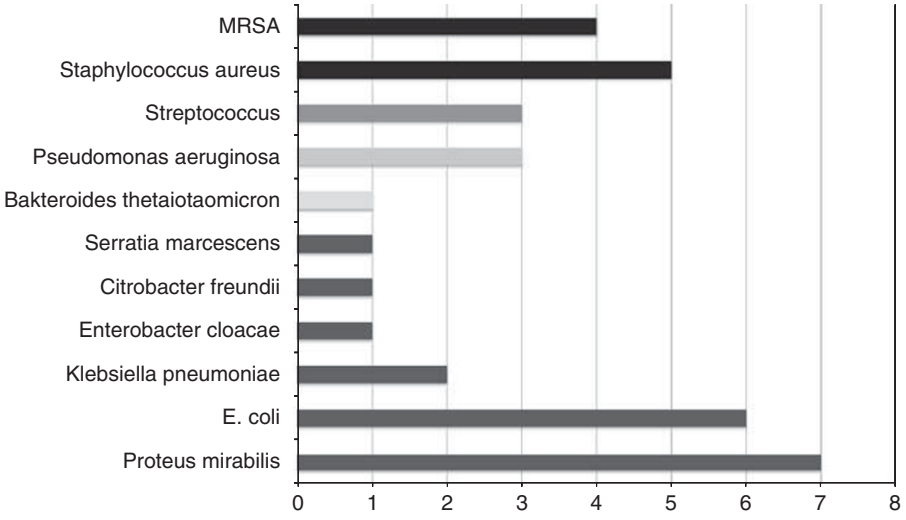

Figure 3 This figure reveals our microbiological results. *Proteus mirabilis* was with seven cases the most common bacteria followed by *Escherichia coli* (*E. coli*) with six cases. MRSA, methicillin-resistant *S. aureus.*

and three different bacteria in four patients. Four species of bacteria was found in one patient. The most common bacterias were Gram-negative Enterobacteriaceae in 12 cases and *Staphylococcus aureus* in five cases. Four out of the five patients with *S. aureus* had methicillin-resistant *S. aureus* (Figure 3). All patients were treated initially with wide-spectrum antibiotics.

Discussion

Several studies have been focused on the risk factors of developing Fournier's gangrene in patients without SCI, whereas diabetes mellitus and alcohol abuse were the most common described factors.[2,11,12] The aim of our study was to analyze and describe the risk factors in patients with SCI and Fournier's gangrene. In addition, the type of the pathogen was also determined, as there has been reported a different bacterial spectrum in patients with SCI.[5,13]

Usually, spinal-cord-injured patients have a higher risk of developing complications, such as chronic urinary tract infection or heterotopic ossification.[14,15] Approximately 85% of patients with para- or tetraplegia develop a pressure sore during their lifetime.[16] The occurrence of Fournier's gangrene in the context of a pressure sore has already been described in a 47-year-old man with C4 tetraplegia.[4] In our study, 81% of patients with Fournier's gangrene had an associated pressure sore. Patients with a pressure sore had

approximately three times higher risk of developing a Fournier's gangrene.

Su *et al*.[8] reported on the LRINEC score in patients with necrotizing fasciitis. A significant correlation was found between LRINEC $\geqslant 6$ and mortality as well as complication rate. We also calculated the LRINEC score in all patients, as Fournier's gangrene is a necrotizing infection. We also found an increased hospitalization and increased time interval until wound closure in patients with a LRINEC score $\geqslant 6$.

Interestingly, no patient died in our patient collective. In contrast, the mortality rate in patients without SCI and Fournier's gangrene was higher with 13–22%.[2] One reason might be the younger patient collective and lower rate of co morbidities compared to other studies.[17] McHenry *et al*.[18] found a lower mortality rate in patients with necrotizing fasciitis, who where treated within 25 h after admission.

Besides the described risk factors, we believe that more unknown processes influencing the inflammation cascade exist, that impacts on the mortality rate in patients with SCI, as Hume *et al*.[19] found that the adrenocorticotropic hormone concentration after surgical SCI is significantly reduced compared with the level before the injury.

Limitations of this study are those inherent to retrospective case series and the limited patient number. Another limitation of the study is the missing control group such as Fournier's gangrene without SCI.

In conclusion, spinal-cord-injured patients have a high risk of developing pressure sores during their lifetime. The overall incidence of developing Fournier's gangrene in the context of pressure sores is relatively rare with 1.1%. However, patients in our patient collective with an associated pressure had approximately three times higher risk of developing Fournier's gangrene compared with patients without pressure sores. Therefore, we recommend a close clinical and laboratory monitoring in all patients with pressure sores. All patients with grade three and four ulcers or those with pressure sores of any grade and signs of infection should be admitted, ideally to a specialized clinic. In addition to a thorough clinical evaluation by experienced clinicians, simple laboratory parameters can be helpful in the early detection of Fournier's gangrene. We reported the results of our patients to increase awareness among physicians and training staff working with patients with a SCI in order to expedite the diagnosis. Future prospective randomized clinical studies are required to verify our findings.

Conflict of interest

The authors declare no conflict of interest.

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