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Management of necrotising fasciitis within a burns centre: do outcomes differ?

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Abstract

Introduction: Many similarities exist between the care of necrotising fasciitis (NF) and burn injury patients. Each group represents a small but complex cohort requiring multiple theatre trips, specialist reconstruction, meticulous wound care and multidisciplinary management. Over a six-year period, we sought to examine the clinical outcomes of NF patients managed within a burns centre against those managed by a plastic surgery service.

Methods: A retrospective case-note review was performed for all identifiable patients referred to our institution's designated burns centre or plastic surgery service between 2008–2014. Patient characteristics, length of stay, wound-related and clinical outcomes were extracted and descriptively presented with statistical analysis performed for survival and length of stay.

Results: Twenty-nine patients were included in the study (burns centre [B]: 17 patients; plastic surgery service [P]: 12 patients). Median total length of stay (B: 37 vs. P: 50 days, P=0.38), local length of stay (27 vs. 19 days, P=0.29) and survival till discharge (94.4% vs. 100%, P=0.73) demonstrated no statistically significant difference.

Conclusion: Caring for NF patients within a burns centre facilitated easier access to specialist reconstructive expertise and multidisciplinary care but did not lead to statistically significant differences in length of stay or survival. The management of NF within a burns centre facilitated provision of high-quality care to a highly challenging patient group.

Keywords

Necrotising fasciitis, burns centre management, clinical outcomes

Lay Summary

Research background:

Looking after patients with flesh-destroying infections (necrotising fasciitis [NF]) and burns frequently require very similar expertise and clinical resources. A small but increasing number of specialist burns centres will currently accept NF patients for surgical reconstruction and rehabilitation.

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Question being asked:

Does performing the surgical reconstruction and rehabilitation of NF patients in burns centres improve patient survival and reduce hospital stay?

How work was conducted:

The medical notes of NF patients referred to our hospital during 2008–2014 were reviewed following a change of practice (acceptance of NF to our burns centre in 2010). The survival, hospital-stay, wound healing and complications of patients managed by our plastic surgery and burns services were compared and statistically analysed.

What we did we learn:

Caring for NF patients in a burns centre improved access to specialist expertise and allowed provision of high-quality care but did not lead to measurable improvements in patient outcome.

Introduction

Necrotising fasciitis (NF) is a rare, severe infection of the skin and subcutaneous tissue that causes rapidly progressive soft-tissue necrosis.[1] It most commonly occurs in older, immunocompromised patients suffering from synergistic aerobic and anaerobic infections.[2] Population-based studies demonstrate an incidence of 0.15–0.55 cases per 100,000 annually with mortality rates in the range of 8.6%–20.8% within developed healthcare systems.[3–11] Prompt diagnosis, early aggressive surgical debridement and judicious critical care represent the fundamental tenets of management during initial illness.[12] Once on the road to recovery, patients conversely necessitate expert reconstruction undertaken within a specialist setting. Holistic support from a multidisciplinary team of nurses, physiotherapists, occupational therapists and psychologists is fundamental to minimising long-term physical and psychological disability.[13,14]

Many similarities can be drawn between the management of NF patients and patients with large burn injuries including requirements for lengthy periods of intensive care, multiple operating theatre trips and frequent dressing changes. Both groups require multidisciplinary care and pose difficult reconstructive challenges best addressed by surgeons with specialist expertise. Due to the analogous medical and nursing needs of patients with burn injuries and NF, NF patients appropriate for reconstruction have been accepted by our institution's regional burns centre since April 2010. Before this date, patients ready and suitable for reconstruction were accepted by the regional plastic surgery service. Following the service development, we set out to review the clinical outcomes of each group focusing on length of stay (LOS) and survival to determine whether burn centre management improved clinical outcomes and overall care.

Methods

A retrospective case-note review was performed of all identifiable NF patients referred and accepted to our institution between April 2008 and April 2014. Parameters within the following domains were extracted from each patient's notes: patient characteristics; LOS; survival; and wound-related and clinical outcomes. Two LOS outcomes were measured: local LOS with our service; and total LOS. Total LOS was defined as the sum of local and referring centre LOS. A more detailed break-down of parameters extracted is shown in Figure 1.

Due to the small sample size of each cohort, a descriptive statistical approach was taken with only the primary and secondary null hypotheses tested. Our primary null hypothesis was that there was no difference in survival between patients managed at the burns centre and those managed by the regional plastic surgery service. The secondary null hypothesis was that there was no difference in total or local LOS between the groups. To test the null hypotheses, we employed the Chi-squared and unpaired T-test with an α-value < 0.05 taken as statistically significant.

Patient characteristics
1. Age (years) 2. Sex 3. TBSA % tissue loss 4. NF Anatomical location 5. NF aetiology 6. Referring hospital 7. Managing service: burns centre or plastic surgery
Length of Stay
1. Total length of stay (LOS) (days) 2. Local LOS (days)
Survival
1. Survival of NF episode
Wound-related outcomes
1, Duration: debridement to healing (days) 2. Duration: topical negative pressure therapy (days) 3. Number of total theatre trips (n=) 4. Number of local theatre trips (n=)
Clinical Outcomes
1. Complications (any) 2. Discharge destination (home or elsewhere)

Figure 1. Data extracted from the case-note review.

Results

Twenty-nine NF patients were included in the study, comprising 12 patients managed by the plastic surgery service (P) before April 2010 and 17 patients managed by the regional burns service (B) after April 2010. The groups were demographically equivalent for age, gender and median percentage total body surface area (% TBSA) tissue loss (B: 4% vs. P: 3%; Figure 2a). Patients were mostly referred from external hospitals (B: 82.3% vs. P: 75%) with no difference in microbiological profile between study groups. The causation and anatomical location of NF between study groups were similar and are presented in Figure 2b and 2c.

We did not demonstrate any statistically significant difference in survival (B: 94.1% vs. P: 100%; $P = 0.73$), median local (B: 27 days vs. P: 19 days; $P = 0.29$) or total LOS (B: 37 days vs. P: 50 days; $P = 0.38$) between the study groups (Figure 3a and 3b). Median duration referral to transfer, debridement to healing and topical negative pressure therapy as well as number of theatre trips (locally and total), rates of any complication and number of patients discharged directly home are summarised and presented in Figure 3c.

Discussion

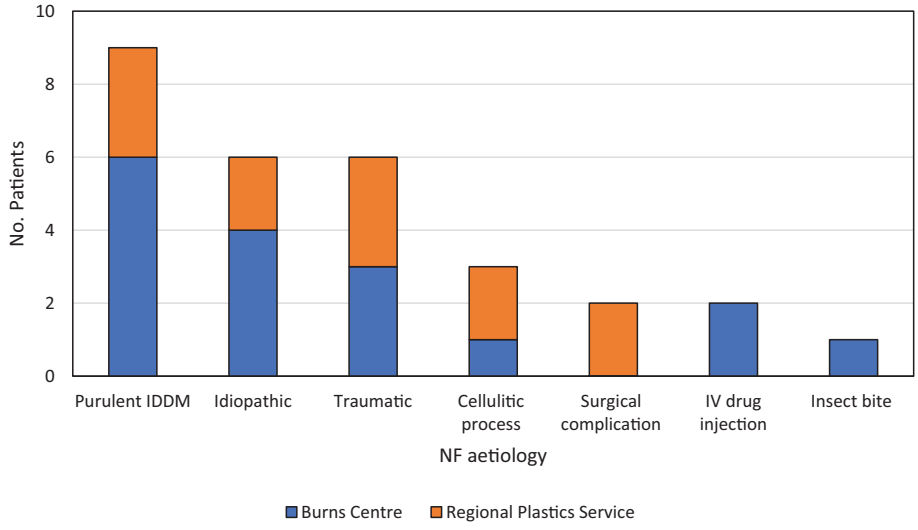
NF patients represent a small and complex patient group that, unlike burn patients, do not benefit from systematic and ongoing analysis of outcomes with data collection challenged by the low number of incident cases.[15] Despite a reportedly increasing international incidence, we did not observe an increase in the number of cases seen at our hospital with a static mean of 4.6 cases per year across both cohorts.[3,16–18] The patient demographic in our study matched the profile of NF patients reported in other studies with a preponderance of men and a mean age close to 50 years.[9,11,16,19–27] The established risks factors of diabetes mellitus, obesity and bacterial virulence were prevalent across our cohort with no significant differences between the groups.[2,28,29] Our sample was derived from a mixed rural–urban population and did not demonstrate a bimodal age distribution, in contrast, to the most recent UK metropolitan analysis.[9]

The most common microbiological pathogens were Group A beta-haemolytic streptococcus followed by mixed aerobic and anaerobic growths (*Escherichia coli, Bacteroides fragilis, Enterococcus faecalis*) and other non-Group A beta-haemolytic streptococcus species (Lancefield Groups B and C). Bladder and bowel species were well represented, and no difference was seen between the microbiological profile of the burns and plastic surgery groups. Our experience was broadly in line with an alternative UK experience that identified Group A streptococcus, *E. coli* and Enterococcus species as the most frequent pathogens.[9] It has been suggested that managing NF patients within a burns service presents an excellent way for virulent pathogenic organisms to colonise burns centres. Interestingly, at our centre we saw no evidence of this phenomenon demonstrating that attentive infection control encompassing adherence to hand hygiene, MRSA/CPO screening, thorough facility cleans pre- and post-procedure allay the risk of cross-infection. No incidences of pathogenic cross-infection were noted across either cohort.

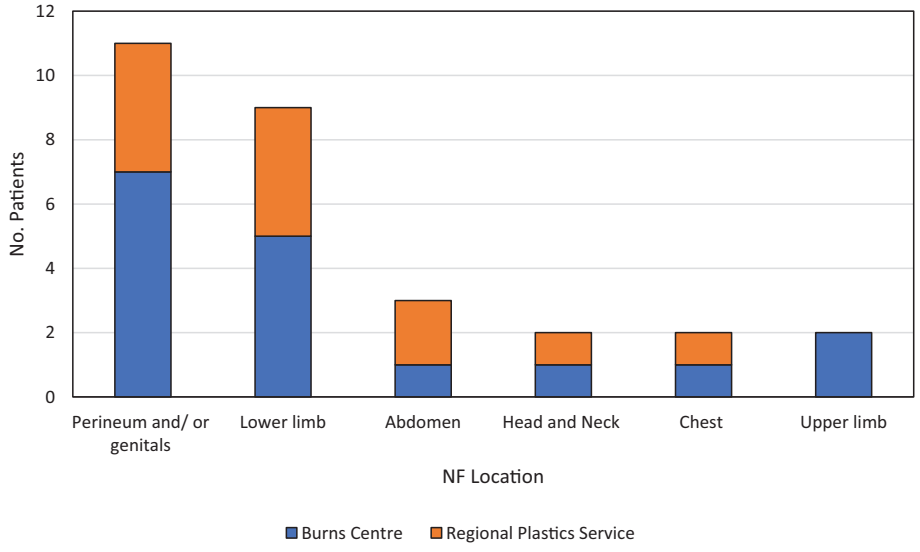
We found no statistically significant difference in mortality between the study groups with only a single death in the burns centre cohort and no deaths in the plastic surgery cohort. The burns centre mortality rate of 5.5% was lower than the published range of 7.6%–33% (Figure 4) and can

	Burns Service	Plastic Surgery
n=	17	12
Median age	46 years (22-64)	50 years (0-74)
Sex *Male*	12 (71%)	7 (58%)
Female	5 (29%)	5 (42%)
Mean TBSA	4% (1-11%)	3% (2-7%)
External Referrals	14 (82.3%)	9 (75%)

(a)



(b)

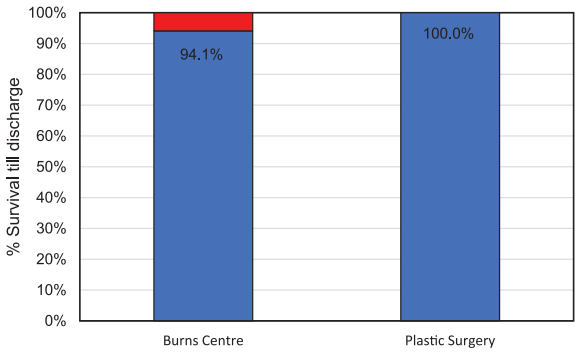


(c)

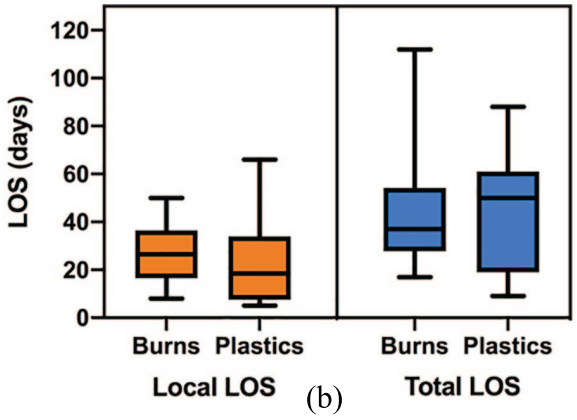
Figure 2. (a) Cohort characteristics. (b) Aetiology of NF. (c) Location of NF. NF, necrotising fasciitis.

be explained by the small sample size and long-standing policy of both services to not accept referrals until critical illness has resolved (although no referrals were ultimately declined during the study period). Such practice is not ubiquitous across burns centres, with some authors suggesting referral and transfer earlier in the clinical course may improve outcomes.[20] Nonetheless the stance is justifiable as a specialist service where resources are finite and early recognition with immediate aggressive debridement is the fundamental determinant of outcome.

We found no statistical difference between study groups for total and local LOS, suggesting that burns centre management did not alter LOS. Interestingly, the total LOS for those



(a)



(b)

	Burns Service (n=17)	Plastic Surgery (n=12)
Median duration: referral to transfer (days)	0.5 (0-27)	7 (0-36)
Median duration: debridement to healing (days)	53.5 (29-318)	53 (5-286)
Median number of theatre trips (local)	4 (1-6)	3 (1-7)
Median number of theatre trips (total)	6 (3-10)	7 (3-16)
Median duration: topical negative pressure therapy (days)	17.5 (5-23)	20 (8-27)
Any complication	10 (55.5%)	4 (33%)
Number of patients discharged directly home	14 (77.7%)	10 (83%)

(c)

Figure 3. (a) Percentage of patients surviving till discharge. (b) Median length of stay (local and total). (c) Other clinical and wound-related outcomes.*

patients receiving burns centre management was less than the plastic surgery cohort, reflecting the prompter transfer times to our burns centre. The LOS at our local burns centre was comparative to the average LOS for the five other published studies reporting burns centre outcomes (Figure 4) with ranges of 24.4–34.9 days.[16,20–23] Direct head-to-head comparison against the published literature is challenged by the lack of explicit and standardised outcome reporting for total LOS with comparative studies rarely stating LOS at referring centres. In a single small study of 10 patients over five years, Barillo *et al.* documented a mean time to burns centre referral of 8.9 days with a mean local LOS of 34.9 days and total LOS of 43.8 days.[21]

The median duration from referral to transfer was 0.5 days for the burns centre group compared to seven days for the plastic surgery group, reflecting greater availability of beds within the burns service facilitating prompter transfers. Redman *et al.*, in their burn centre experience of 12 patients over five years, reported a mean diagnosis to transfer time of 14 days (range = 1–94 days) with a mean 1.8 (range = 0–6) procedures before transfer and 3.4 (range = 0–10) burns centre procedures.[20] For this study, patients underwent an equivalent number of local theatre trips in the burns and plastic surgery groups reflecting the similar surgical approaches taken by services towards patients received at equivalent stages in their wound-healing journeys. The median

Study	Sample size (n=)	Local LOS	Median theatre trips	Mortality
Glass *et al.*, 2015 *[9]*	24	61 (mean)	5 (1-17)	20.8%
Hodgins *et al.*, 2015 *[22]*	46	34 (median)	2	26.5%
Endorf *et al.*, 2005 *[15]*	65	32.4 (mean)	2.9 (mean)	17%
Redman *et al.*, 2003 *[18]*	12	21 (mean)	3.4 (mean)	33%
Barillo *et al.*, 2003 *[19]*	10	34.9 (mean)	5.1	20%
Bernal *et al.*, 2012 *[20]*	393	24.4	1.47 (mean)	7.6%
Faucher *et al.*, 2001 *[21]*	57	28.5 (mean; survivors only)	4.1 (1-15)	12%
Proud *et al.*, 2014 *[23]*	219	21 (median)	3	15.9%
Swain *et al.*, 2013 *[11]*	15	29 (median)	3.5 (1-7)	20%
Wang *et al.*, 2014 [24]	115	24.5 (mean)	2	20.9%
Tunovic *et al.*, 2012 [25]	130	33.3 (mean)	2.4 (mean)	13.1%
Pakula *et al.*, 2012 [26]	54	18 (mean)	6 (mean)	16%

Figure 4. Published studies reporting outcomes for patients with necrotising fasciitis.*
*Greyed-out boxes indicate study reporting burns centre experience.

number of TNPT days for the burns centre group was 17.5 days in 11 patients compared to 20 days in four patients for the plastic surgery group. These findings are similar to those of Endorf *et al.*, who reported an average duration of 16.9 TNPT days in 24 patients managed within a burns centre.[16] In all settings, TNPT dressing was employed as a highly versatile temporising measure to facilitate wound bed preparation during patient optimisation prior to definitive closure.

Eleven patients (37.9%; B: 7. P: 4) were identified as having NF of the perineal or genital region (Fournier's gangrene [FG]) with a precipitant cause identified in the majority of patients. FG patients were managed analogously to other NF patients with judicious debridement and dressing before definitive surgery. Dressing changes (particularly vacuum-assisted closure applications) were challenged by the anatomical morphology of the region with either split thickness skin grafting, local flaps or testes burial in the ipsilateral thigh performed for definitive surgery. Skin grafting procedures were challenged by poor take with all patients experiencing some degree of graft loss, one patient experiencing complete graft loss and three patients requiring revisional grafting. After successful skin grafting, we found FG patients quickly rehabilitated and were promptly discharged. Rates of complication and discharge directly home did not differ between the study groups. Recorded complications were predominantly medical including pulmonary embolism, endocarditis, *Clostridium difficile* infection and stomal problems. Discharge directly home was achieved for 77% of the burns cohort compared to 83.3% of the non-burns cohort and compares to 54% in the published literature.[16] We suggest that discharge directly home is an insufficiently reported surrogate marker for quality of care in NF cohorts (and for burn care more generally). Encompassing survival, it represents a significant milestone in recovery, restored independence and is reflective of the multidisciplinary care provided by nursing and allied health professionals.

No criterion was set for the minimum level of tissue loss accepted with the range of received tissue loss 1%–7% TBSA. All referred ward-based NF patients fit enough to undergo a spinal or general anaesthetic were accepted by burns and plastic surgery. A long-standing protocol to ring-fence at least one burns network bed was enforced throughout the study period. As a burns centre with excess bed capacity and flexible staffing arrangements, we have found that managing NF patients did not impede

admissions of emergency burns and increased service utilisation, especially when incident NF admissions were relatively low at a mean 5.2 per year. By only accepting NF patients suitable for ward-level care, we were able to prioritise beds for burns patient (where necessary) with the option to keep NF patients resident at referring centres supported by outreach services when a bed was unavailable. While we appreciate other burns centres may not be so fortunate as to have redundant capacity, we strongly feel admitting NF patients makes organisational and financial logic as well as improving quality of care provided to a unique cohort who would not otherwise benefit.

While there is an increasing incidence of NF in the developed world, there is a contrasting decline in the incidence of severe burns due to improved health and safety measures. This represents a strategic concern for burn services that must demonstrate resource utilisation, retain clinical expertise but also ensure emergency availability of burns beds. The cost of managing NF within and outside of a burns unit has been examined by several authors.[23,30–32] Faucher *et al.*, in one US burns centre study, reported mean costs of $5202 per day despite cost containment measures.[23] Jiménez-Pacheco et al., in a Spanish study conducted by a urology service, reported mean costs of €25,108 ($27,989) per patient admitted to an intensive care unit and requiring at least one debridement.[32] Widjaja *et al.* also costed their Australian experience in 92 sequential patients at a mean of $34,887 per patient but did not include costs incurred by referring hospitals or during rehabilitation.[30] To inform and contextualise our analysis of clinical outcomes, we undertook a cost assessment that demonstrated median ward-based costs, theatre costs and total costs (B: $20,560 [£16,606] vs P: $9644 [£7789]; $P = 0.06$) were greater within the burns centre compared to the plastic surgery groups but the analysis did not reach statistical significance.

Surprisingly, despite the increasing prevalence and greater costs of NF care being undertaken within burns services, there is no UK clarity amongst commissioning bodies (local clinical commissioning groups or specialised services commissioners) over who is responsible for funding NF care. This causes regional differences between services for the acceptance of NF patients dependent on local funding arrangements. Due to the Welsh burns service being commissioned on a non-tariff basis, management of NF cases within our burns centre is economic. NHS commissioners would be well-placed to address variation in commissioning for NF care amongst burns and plastic surgery services so that such care is appropriately and equitably funded while not financially detracting from core burn activities.

This paper has three main weaknesses. First, it is a retrospective study with data collection dependent on the availability and quality of pre-existing clinical documentation, especially for wound-related outcomes. This increases risk of outcome reporting bias while also representing a methodological flaw, albeit one inherent to all other studies identified in our literature review. Second, the infrequent incidence of NF limits the sample size across the six-year study period and increases the difficulty of detecting statistically significant differences between burn centre and non-burn centre cohorts. Third, the burn centre and plastic surgery groups are not contemporaneous and are derived from different time periods; therefore, incremental technological or procedural developments across this period could account for some differences in clinical outcome. Methodologically, we specifically chose not to include the Laboratory Risk Indicator for Necrotising Fasciitis score in our comparative analysis because it is a physiological score for improving early diagnosis of NF and not an outcome prediction tool. Furthermore, the reported sensitivity (68%–80%) of the score has been questioned and the necessary information was not always available during our retrospective notes review.[33]

Conclusion

We have compared survival and LOS as well as other clinical and wound-related outcomes for NF patients managed within a burns centre and plastic surgery service at the same institution over a period of six years. Managing NF patients within a burns centre did not translate into measurable and statistically significant improvements in survival, LOS or other clinical outcomes. Nevertheless, the incremental gains of high-quality supportive care, judicious wound management, timely reconstruction and a well set up burns multidisciplinary team cumulatively provided the best opportunity for healing and recovery following NF. These subtler unmeasured gains were brought about through greater access to a specialist multidisciplinary team focused primarily on physical wound healing and psychosocial rehabilitation than would have possible under a pure plastic surgery service. In an era where the clinical outcomes for NF patients have not altered despite improvements in critical care

and early aggressive surgical debridement, we would encourage all clinicians managing NF patients to explore the management of NF within a burns centre.

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Declaration of conflicting interests

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