International Surgery Journal
Halbhavi SN et al. Int Surg J. 2018 Jun;5(6):2119-2126
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20182056

Original Research Article

Clinical and microbiological profile of necrotizing fasciitis

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Received: 17 February 2018
Revised: 22 April 2018
Accepted: 10 May 2018

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ABSTRACT

Background: Necrotizing fasciitis, is a spectrum of diseases where necrosis of deeper soft tissue is by an infective microorganism. It is a life-threatening infectious disease with mortality rate ranging from 17% to 34%. Understanding patho-physiology plays an important role in providing better medical or surgical care. Aim of the present study was to find out the most common microorganisms causing Necrotizing Fasciitis, sensitivity pattern of the isolated organisms and effective antibiotic therapy.
Methods: This is a prospective observational study done in HSK Hospital, Bagalkot comprising 150 patients for a period of 8 months. The study group consisted of the patients admitted with clinical diagnosis of necrotizing fasciitis by different surgeons during this period.
Results: Out of 150 patients with necrotizing fasciitis, 121 (80.67%) were male and 29 (19.33%) were females. The maximum number of patients 45 (30%) were found in the age group of 61 to 70 years. 62 patients had Type II Diabetes Mellitus,13 patients were on steroids, 7 patients had liver disease. The culture and sensitivity reports from these 150 patients was positive for growth in 136(90.66 %). The most common Gram positive bacterial isolate was *Staphylococcus aureus* 48 (45.28 %) and Gram negative bacterial isolate was *Pseudomonas aeruginosa* 46 (38.33%). The antibiotic administration was a combination of Cefperazone-sulbactum (or), piprecallin-tazobactum (or), aminoglycosides for gram negative coverage and clindamycin (or) trimethoprim-sulphamethoxazole for gram positive coverage. Anaerobic coverage was with metronidazole/tinidazole. The mortality rate was 11.33% and the common isolate in these patients from wound swab was Acetinobacter with sensitivity only to colistin and tigicycline followed by *klebsiella*.
Conclusions: Males with age more than 60 years having diabetes mellitus were more prone to necrotizing fasciitis. Most common Gram positive bacterial isolate was *Staphylococcus aureus* and Gram negative bacterial isolate was *Pseudomonas aeruginosa*.

Keywords: Antibiotics, Culture and sensitivity, Necrotizing fasciitis

INTRODUCTION

Necrotizing fasciitis is an infectious disease with mortality rate ranging from 17% to 34%. It is a spectrum of diseases where necrosis of deeper soft tissue is caused by an infective microorganism. Necrotizing fasciitis involves the superficial fascia with extensive deterioration of the surrounding tissue. It has been classified based on different criteria viz. anatomical level of involvement or the requirement of surgical management. However, it is most convenient to categorize necrotizing fasciitis based on the microbiological characteristics of the pathogen involved.[1] It is suggested that the rapid, soft tissue necrosis seen in

necrotizing fasciitis is caused by the release of bacterial toxins and enzymes, leading to extensive inflammation, sepsis and multiple organ failure.[2]

Type 1 necrotizing fasciitis is a polymicrobial infection arising from aerobic and anaerobic bacteria, while Type 2 necrotizing fasciitis is caused by group A *Streptococcus* with or without a coexisting Staphylococcal infection. Although necrotizing fasciitis caused by fungi was previously classified under Type 2, fungal necrotizing fasciitis has recently been classified under its own category. Some classify it further in to type 3 which is caused due to mono-microbial gram-negative organisms like vibrio species, sporadic cases of *Haemophilus influenza* and *Klebsiella pneumonia*. Some authors have described the type 3 necrotizing fasciitis as clostridial myonecrosis or gas gangrene. Type 4 is of fungal origin and it affects the immunocompromised and involves *Candida* species. However, type 3 and 4 are not as frequently encountered as type 1 and 2.

Necrotizing fasciitis typically presents with vague, non-specific symptoms. Treatment consists of a combination of surgical debridement, antibiotic treatment based on the pathogen and oxygenation of the injured tissue. Immuno-compromised conditions, diabetes mellitus, alcoholism, end-stage renal disease, malignancy and chemotherapy are all predisposing factors in the development of necrotizing fasciitis.

Necrotizing fasciitis can occur in otherwise healthy adults and is usually precipitated by some form of trauma like road traffic accidents, snake bite, burns etc. Necrotizing fasciitis is considered as one of the most dreadful disease with high mortality for ages.[3] Prompt diagnosis and early surgical treatment is the only key to reduce the mortality in necrotizing fasciitis.[4]

Much of the bacteriologic data in the literature related to necrotizing fasciitis is not up to date and report organisms present as a result of frequent secondary infection caused by opportunistic organisms.[5] Our prospective study, aims to find the clinical and microbiological profile of necrotizing fasciitis.

METHODS

It is a prospective observational study done in Medical college hospital, Bagalkot. The study period was from January 2016 to June 2017. 150 patients with a diagnosis of necrotizing fasciitis were admitted by multiple surgeons. The detailed clinical history and clinical examination of these patients was done.

Sample collection method for microbiological test

Blood was drawn before the administration of antibiotics and the samples were sent to the department of microbiology for culture and sensitivity. Other materials for the study consisted of the tissue or wound swabs.

The soft tissue specimen obtained by scraping the ulcer base or the deep portion of the wound edge with a sterile curette. When both tissue and swabs were taken, only the tissue sample was included in the study. The specimens were sent to the laboratory within 30 minutes. After debridement specimens were sent for histo-pathological examination to department of pathology to confirm the diagnosis of necrotising fasciitis.

Antimicrobial susceptibility testing

AST of isolates was performed by the standard disc diffusion method as recommended by clinical and laboratory standard institute (CLSI) guidelines.

Staphylococcus aureus was tested for methicillin resistance by cefoxitin screening as recommended by CLSI. Gram-negative bacilli were tested for ESBL production by a double disc diffusion method. Microorganism resistant to two or more classes of antimicrobials were classified as MDR.

The mortality rate was calculated from hospital medical records and proportion of mortality with various organisms compared.

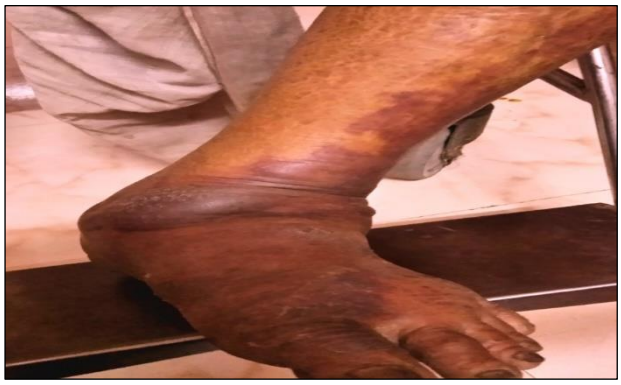

Figure 1: photograph of a left lower limb with blebs and necrosis classical of necrotising fasciitis.

Inclusion criteria

All patients admitted with diagnosis of 'Necrotising Fasciitis' in different surgical units during the study period.

Diagnosis was made by the following clinical features:

Local features

- Pain (disproportionately greater than expected)
- Edema and erythema of skin
- Woody hard texture to subcutaneous tissue
- Inability to distinguish fascial planes and muscle groups
- Presence of skin vesicles or bullae.

Systemic features

Fever, hypotension, tachycardia, septic shock, DIC, multiple organ failure.

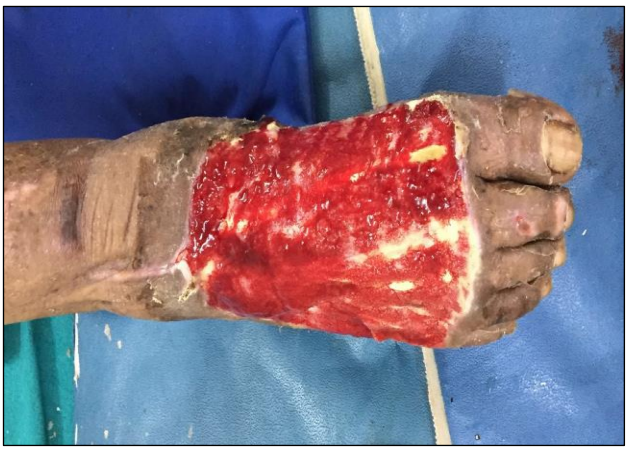

Figure 2: Photographs of lower limb with necrotising fasciitis; post-debridement status.

Exclusion criteria

Patients with other skin manifestations like

- Cellulitis
- Diabetic gangrene
- Abscess
- Patients who had received antibiotic treatment or with ongoing antibiotic treatment.

Total cases included in the study were 150

Cases excluded from the study

- 11 cases surgically treated elsewhere and referred here for further management
- 05 cases of HPE not s/o necrotizing fasciitis.

Final consideration for the study

- Wound culture: 150 patients
- Blood culture: 48 Patients

Analysis

Data collected was analysed in SPSS (Statistical Package for Social Science) version 15.0. Different categories / subgroups were cross tabulated with proportions and percentage.

RESULTS

This is a prospective study of 150 patients admitted in HSK Hospital, Bagalkot with the diagnosis of necrotizing fasciitis which comprised of 121 males and 29 females as shown in Table 1.

Table 1: Total no. of cases and sex distribution.

Gender	Cases
Males	121 (80.67 %)
Females	29 (19.33 %)
Total (n)	150

Table 2: Co-morbid conditions associated with necrotizing fascitis:

Co-morbidity	No. of patients
Type 2 Diabetes Mellitus	62
Steroid abuse	13
Liver Disease	7

Age distribution

The youngest patient in the study group was 21-year-old and the oldest patient was 95 years old. The maximum number of patients were found between the age group of 61 to 70 years.

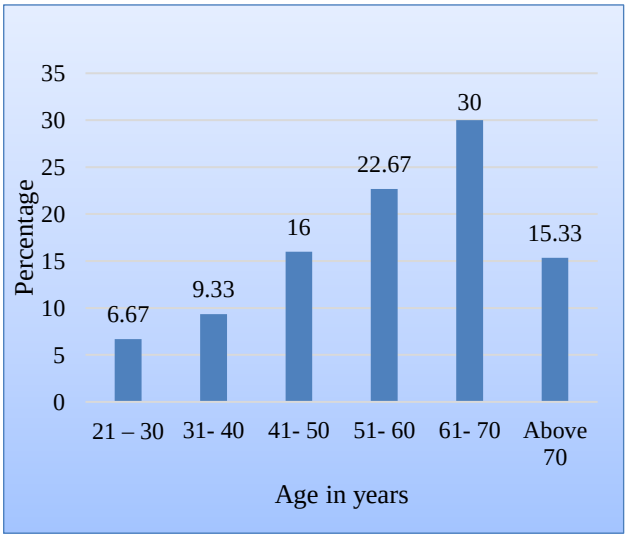

Figure 3: Frequency distribution with respect to age group

90.66 % of cases showed the presence of microbes out of all the tissue/swab cultures. 12.5% of blood cultures showed the presence of microbes.

Table 3: Distribution of cases with respect to the nature of growth in culture.

Nature of growth in culture	No. of cases
Mono microbial	51 (37.5 %)
Poly-microbial	85 (62.5 %)
Total no. of cases	136

Of all the cultures 62.5% of cases show polymicrobial growth while the remaining 37.5% showed mono microbial growth.

Table 4: Frequency of gram positive microbes grown in the culture with respect to their proportion with other microbes.

Bacteria	Total Number of organisms (N = 226)	Proportion of isolates to total no. of organisms
Gram-Positive	106 (46.9 %)	47
Staphylococcus aureus	48 (45.28 %)	21
Enterococcus species	21 (19.81%)	9
Streptococcus pyogenes	15 (14.15 %)	7
MRSA	11 (10.37 %)	5
Streptococcus species	11(10.37 %)	5

It is observed that *Staphylococcus aureus* and Pseudomonas aeruginosa were the commonest organisms among gram positive and gram-negative bacteria respectively. Gram positive bacterias showed high susceptibility to cotrimoxazole, tetracyclines among the routinely used antibiotics and to clindamycin among the reserved antibiotics.

Table 5: Distribution of various organisms from the culture isolates.

Bacteria	Total Number of organisms (N=226)	Proportion of isolates to total no. of organisms
Gram Negative	120 (53.09 %)	53
Pseudomonas aeruginosa	46 (38.33 %)	20
Escherichia coli	32 (26.66 %)	14
Proteus vulgaris	3 (2.5 %)	1
Klebsiella pneumonia	18 (15 %)	8
Klebsiella oxytoca (ESBL)	5 (4.16 %)	2
Acitenobacter baumannii	10 (8.33 %)	5
Proteus mirabilis (ESBL)	6 (5%)	3

Table 6: Gram positive bacterias and their susceptibility to routine antibiotics.

Drugs	*MSSA*	*Enterococcus species*	*Streptococcus pyogenes*	*MRSA*	*Streptococcus* species
Amikacin		89.6%			
Amoxicillin-clavulanic acid	84%	54.6%			
Ampicillin/Amoxicillin	76%		72.3%		70.5%
Cefotaxime/Ceftriaxone		61.7%	63.7%		61.2%
Cefuroxime	52%	44.3%			
Ciprofloxacin/Ofloxacin	32.7%	68.8%		72.8%	
Trimethoprim/Sulphamethoxazole	98.6%		92%	94.7%	
Erythromycin/Azithromycin	72.4%	73%	84.3%	66.7%	72.7%
Gentamicin	93.1%	76.2%		94.2%	
Tetracycline/Doxycycline	97%	34%	96%	96.6%	94.7%
Cloxacillin	88%				

Table 7: Gram negative bacterias and their susceptibility to routine antibiotics.

Drugs	*Pseudomonas aeruginosa*	*Escherichia coli*	*Pseudomonas species*	*Klebsiella species*	*Acitenobacter baumini*
Amikacin	98.6%	100%	96%	78.6%	54%
Amoxicillin-clavulanic acid		25%		72.7%	43.8%
Ampicillin/Amoxicillin		21%		3%	36.2%
Cefotaxime/Ceftriaxone		19.6%	64%	64.8%	39.3%
Cefuroxime		28%	52.3%	66.9%	41%
Ciprofloxacin/Ofloxacin	97%	18.7%	66%	94.1%	37.8%
Trimethoprim/Sulphamethoxazole	27%	33%	68.1%	100%	62.7%
Gentamicin	99%	84.7%	88.9%	98.3%	64.8%
Ceftazadime	96.2%				53%

Gram negative bacteria showed high susceptibility to gentamicin, amikacin among the routinely used antibiotics and to Cefoperazone-Sulbactum, Piperacillin-Tazobactam among the reserved antibiotics

All the gram-negative organisms which were susceptible to combination of Cefoperazone+Sulbactum, Piperacillin+Tazobactum were also susceptible to imipenem/meropenem; their susceptibility almost nearing 100%. These have not been depicted in this table because as it was a hospital policy not to reveal the sensitivity of higher antibiotics as a routine to prevent indiscriminate use of drugs.

Assessing the antibiotic trend for necrotizing fasciitis at HSK Hospital, Bagalkot

Antibiotics administered to 150 patients were analyzed.

- 3.3% (n = 5) patients were started with Inj. Co-amoxiclav on admission
- 44% (n = 66) of the patients were started with Inj. Cefperazone-Sulbactum along with Tinidazole
- 33.5% (n=50) were started with combination of Inj.Piperacillin-Tazobactum and Tinidazole
- 19% (n=29) were started with other combinations of Inj. meropenem, amikacin/gentamycin, tinidazole.

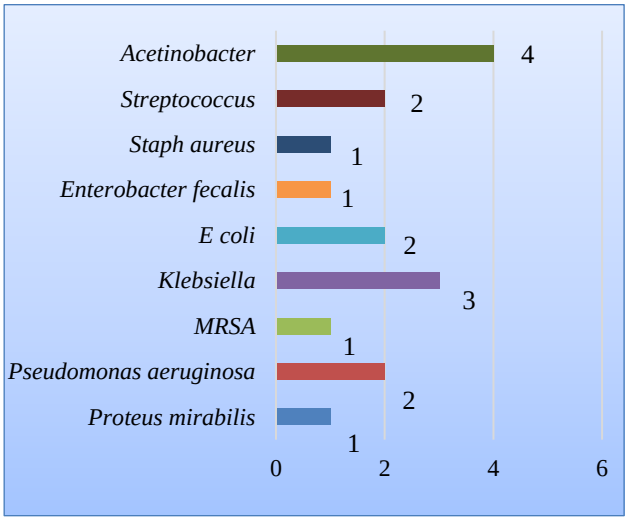

Figure 4: The cultures of organisms in patients who succumbed to necrotizing fasciitis

Assessment of mortality in HSK Hospital, Bagalkot attributed to necrotizing fasciitis

- Mortality recorded in the medical records department due to necrotizing fasciitis in the study period was 17 patients
- 9 patients were initiated with injection Piperacillin-Tazobactum on admission
- 3 patients were started on injection Cefperazone-Sulbactum on admission
- 5 patients were initiated with injection Meropenem on admission
- All of them received anaerobic coverage in the form of Metronidazole or Tinidazole
- The antibiotics were later changed according to the culture and sensitivity that was reported
- The most common isolate in these patients from wound swab was *Acetinobacter* (n=4) with sensitivity only to colistin and tigicycline
- Only 2 patients showed a positive blood culture correlating with the wound growing *Klebsiella* spp and *Streptococcus pyogenes.*

Analyzing the initial empirical therapy administered for 150 patients with necrotizing fasciitis in our hospital was as follows:

- Cefperazone + Sulbactum was given to 54.31 % of patients (81/150)
- Piperacillin + Tazobactum was given to 38.49 % of patients (58/150)
- Co-amoxiclav was given to 10.79 % of patients (16/150).

6.83% of the patients (10/150) were started with drug combinations of aminoglycosides, quinolones, Doxycycline, Trimethoprim-Sulphamethoxazole, Meropenem/Imipenem.

DISCUSSION

Age and gender

The maximum number of cases was observed between the age group of 61 to 70 years i.e. 45 cases, which contributes to 30% of the total cases included in the study.

The various studies that was referred indicate that there is a male preponderance in necrotizing fasciitis which is in accordance with our study as depicted in Table no.9. Out of 150 patients, 62 patients had T2DM, 13 patients were on steroids,7 patients had liver disease

Type of growth

Of the total tissue/swab and blood cultures sent 90.66% (136/150) and 12.5% (6/48) showed the presence of microbes. In a study by Chen C et al 93.8 % of cases showed mono microbial growth.[1] Among the culture growths observed in the present study, the polymicrobial growth was more common than the mono microbial growth, which accounts for 62.5% (85/150) and 37.5 % (51/136) of cases respectively.

This observation was in concordance with the study by Nischal et al, where 60 % of cases showed polymicrobial growth.

Table 8: Gender distribution in various studies vs the present study.

Gender	Chen C et al (2011)	Sah et al (2013)	Zarrin et al (2015)	Nischal et al (2015)	Shaik N et al (2006)	Present study (2017)
Male	69.3 %	54 %	74.08%	93.3 %	75.5 %	80.67 %
Female	30.7 %	46 %	25.92%	6.7 %	24.5 %	19.33 %

Table 9: Microbiological pattern in various studies vs present study.

Type of growth	Chen C et al (2011)	Mathew et al (2010)	Nischal et al (2015)	Present study (2017)
Polymicrobial	54.8%	44.4%	60 %	62.5%
Mono-microbial	45.2 %	55.6%	40%	37.5%

Culture reports

Analyzing the organisms growth revealed a total of 226 organisms; out of which 106 were gram positive and 120 were gram negative in nature. Among the gram positive bacterial growth, the commonest organism was found to be *Staphylococcus aureus* followed by *Enterococcus spp*, which contributes to 45.28% and 19.81% of growths respectively. Of all the gram-negative bacteria the commonest was *Pseudomonas aeruginosa* followed by *E. coli.*

Table 10: The most common organism from the culture in different studies.

Most common organism in culture		Chen C et al (2011)	Mathew et al (2010)	Nischal et al (2015)	Present study (2017)
Poly-microbial	Gram positive	*Enterococcus* (29.4 %)			*Staph. aureus* (45.28%)
	Gram negative	*E. coli* (22.9 %)	*P. aeruginosa (23 %)*	*P. aeruginosa* (33 %)	*P. aeruginosa* (38.33%)
Mono-microbial	Gram positive	*Staph. aureus* (21.4 %)			
	Gram negative	*Vibrio* species (17.5 %)	*E. coli* (45.6 %)	*E. coli* (40 %)	

Chen C et al observed that vibrio species is the commonest followed by Staph. aureus in mono microbial growth.[1]

In a study conducted by Varsha et al among the isolates the most common microbe was Staph. aureus followed by *E. coli* and *Pseudomonas spp*.[6] Zarrin et al concluded that the commonest organism grown is *Pseudomonas aeruginos*a followed by *E. coli* and *Klebsiella Spp*.+7

In Jagdish et al study showed *Bacteroides fragilis* and group A *Streptococcus* were the commonest combination of organism isolated in patients diagnosed with Necrotising fasciitis.[8] Shaikh N et al observed that *Streptococcus spp* is the commonest followed by *S. aureus* and *E. coli*.[9] Similar results to that by Varsha et al were observed in a study by Sah et al.[10] The most common gram positive organisms in necrotizing fascitiis was *S. aureus*, *Streptococcus pyogenes* whereas among gram negative it was *E. coli* and *Pseudomonas* species as observed by Siddhartha et al.[11] Mathew et al observed that *Pseudomonas* was the commonest followed by *Klebsiella pneumoniae* and *Staph aureus* in polymicrobial growth and *E. coli* in case of mono microbial growth respectively.[12] The study by Nischal et al, *Pseudomonas aeruginosa* was the most common organism followed by *S. aureus* in case of polymicrobial growth and E. coli was the most common pathogen in mono microbial growth.[14] After observing the results of various authors, it is proven that *S. aureus*, *Pseudomonas spp* and *E. coli* are the commonest organism grown in skin and soft tissue infections. As is apparent from the various studies poly-microbial growth is more predominant than mono-microbial growth in necrotizing fasciitis. Present study also shows similar results.

Antibiotic sensitivity

In this study the gram-positive organisms showed high sensitivity to Cotrimoxazole and Doxycycline (routinely

used drug) and Clindamycin (reserved drug). Of all the gram-negative spectrum of antibiotics, amikacin and gentamicin are shown to be effective in routinely used antibiotics. Cefeperazone + sulbactum and Piperacillin + Tazobactum among the reserved antibiotics in addition to Meropenem/Imipenem demonstrated high level of sensitivity.

Table 11: Antibiotic sensitivity in various studies vs the present study.

Antibiotic sensitivity		Sah et al (2013)	Zarrin et al (2015)	Varsha et al (2008)	Present study (2017)
Gram positive	Routinely used drugs	Amikacin, Gentamycin and Vancomycin			Co-trimoxazole
	Reserved drugs				Clindamycin
Gram negative	Routinely used drugs	Ciprofloxacin and Aminoglycosides			Amikacin and Gentamycin
	Reserved drugs		Imipenem, Amikacin and Piperacillin + Tazobactum	Imipenem, Amikacin and Piperacillin + Tazobactum	Cefoeperazone + Sulbactum and Piperacillin + Tazobactum

However, in the study by Varsha et al gram negative with ESBL property showed susceptibility to Imipenam, Piperacillin + Tazobactam and Amikacin and offered resistance for other routine drugs, this result was supported by the study conducted by Zarrin et al. Whereas in the study by Sah et al it is observed that Amikacin, Vancomycin and Gentamycin showed great susceptibility for gram positive bacteria.[10] Gram negative bacterias were susceptible to aminoglycosides and ciprofloxacin but *E. coli* were resistant to ciprofloxacin.

Table 12: Comparison of mortality rates in various studies.

Study	Chen C et al (2011)	Zarrin et al (2015)	Present study (2017)
Mortality rate (in percentage)	17%	13%	11.33%

The present study showed mortality of 11.33 % which is comparable with other studies like Chen C et al which is 17% and Zarrin et al which is about 13%.

CONCLUSION

Males with age more than 60 years having diabetes mellitus were more prone to necrotizing fasciitis though other co-morbidities played a minor role in the pathogenesis. Most common Gram positive bacterial isolate was *Staphylococcus aureus* and Gram negative bacterial isolate was *Pseudomonas aeruginosa*. The appropriate guideline for antibiotic administration in cases of necrotizing fasciitis would be a combination of:

- Cefperazone-sulbactum (or) piprecallin-tazobactum (or) aminoglycosides for gram negative coverage.
- Clindamycin (or) trimethoprim-sulphamethoxazole for gram positive coverage.
- Anaerobic coverage with metronidazole/tinidazole.

The mortality rate in this study was 11.33% and the most common isolate in these patients from wound swab was *Acetinobacter* (n = 4) with sensitivity only to colistin and tigicycline followed by *klebsiella* (n = 3).

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Chen C, Li WC, Hong YC, Shie S, Fann W, Hsiao C. The microbiological profile and presence of bloodstream infection influence mortality rates in necrotizing fasciitis. Critical Care. 2011;15(3).
2. Singh G, Sinha SK, Adhikary S, Babu KS, Ray P, Khanna SK. Necrotising infections of soft tissues-a clinical profile. Eu J Surg. 2003;168(6):366-71.
3. Jones J. Investigation upon the nature, causes and treatment of hospital gangrene as it prevailed in the confederate armies, 1861-1865. Surgical memories of the war of rebellion. New York: United States Sanitary Commission; 1871.
4. McHenry CR, Piotrowski JJ, Pentrinic D, Malangoni MA. Determinants of mortality for necrotizing soft tissue infections. Ann Surg. 1995;221(5):558-63.
5. Majeski JA, John JF Jr. Necrotizing soft tissue infections: a guide to early diagnosis and initial therapy. South Med J. 2003;96(9).

6. Gupta V, Datta P, Singla N. Skin and soft tissue infection: frequency of aerobic bacterial isolates and their antimicrobial susceptibility pattern. JAPI. 2008;56:390-1.
7. Afroz Z, Metri BC, Jyothi P. Bacteriological profile and antimicrobial susceptibility pattern of skin and soft tissue infections among gram negative bacilli in a tertiary care hospital of South India. J Pharm Sci Res. 2015;7(7):397-400.
8. Sadasivan J, Maroju NK, Balasubraniam A. Necrotizing Fasciitis. Indian J Plast Surg. 2013;46(3): 472-8.
9. Shaikh N. Necrotizing fasciitis: a decade of surgical intensive care experience. Indian J critical Care Med. 2006;10(4):225-9.
10. Sah P, Khanal R, Upadhaya S. Skin and soft tissue infections: bacteriological profile and antibiotic resistance pattern of isolates. J Universal Coll Med Sci. 2013;1(3):18-21.
11. Das S, Basu D, Manigandan G. Necrotising Fasciitis: a rare fatal outcome of road traffic accidents. Egyptian J Forensic Sci. 2013;3:92-5.
12. Das S, Basu D, Manigandan G. Necrotizing fasciitis: a rare fatal outcome of road traffic accidents. Egyptian J Forensic Sci. 2013;3(3):92-5.
13. Kumar ABC, Subramanyam SG, Kilpadi AB. Clinico-microbiological aspects of necrotising fasciitis in type ii diabetes mellitus. Indian J Surg. 2011;73(3):178-83.
14. Nischal N, Rajashekara B, Manjunath BD, Santhosh CS. Clinico-microbiological profile of necrotising fasciitis in a tertiary care hospital. Int J Sci Study. 2015;3(5):95-8.

Cite this article as: Halbhavi SN, Reddy R, Kalburgi EB, Poulose A, Gowd YCV. Clinical and microbiological profile of necrotizing fasciitis. Int Surg J 2018;5:2119-26.