Original Article

Necrotizing fasciitis in neonates– A novel approach: A ten year retrospective study treated with release incisions only

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Abstract

Necrotizing fasciitis is an acute surgical emergency resulting from spreading infection of the deep fascia by a variety of bacteria. Marked tissue edema, rapid progression of inflammation, and signs of systemic toxicity are the diagnostic clues. Mortality may be as high as 70%. A simple clinical examination by a Surgeon corroborated with intra-operative findings clinches the diagnosis. The causative organisms were found to be *Staphylococcus aureus* in majority of the cases with a poly-microbial infection (i.e. Staph + Strept pyogenes) being the usual findings. All of our cases were rapidly treated with release incisions only followed by regular dressings. All the patients healed well by secondary intention with no disability. There were no deaths in our study.

Keywords: Necrotizing fasciitis, neonate.

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INTRODUCTION

Neonatal Necrotizing Fasciitis (NF) is uncommon but often fatal. It is also termed as "flesh eating disease". NF is a bacterial infection of the skin, subcutaneous fat, superficial fascia, and deep fascia. Primary NF, implies lack of a known causative factor or any identifiable portal of entry for bacteria, and is rarely reported in the neonate[7, 13]. It presents acutely as an irregular, edematous, non demarcated erythematous patch, blanching on touch, with a progressive violet color of skin and a characteristic peau d'orange appearance. Secondary NF is attributable to overt localized sepsis such as omphalitis, balanitis, mammitis, postoperative complications, and following invasive fetal scalp monitoring. Clinically, it is characterized by marked tissue edema, rapid spread of inflammation, and signs of severe systemic toxicity. Secondary NF usually shows a poly-microbial culture and spreads locally or otherwise from the area of involvement. The prognosis is directly dependent on early diagnosis and management. A very high index of suspicion, prompt and aggressive surgical intervention, appropriate antibiotics, and supportive care form the main stay of management in the newborn infant with NF. This paper presents our experiences relating to the presentation, management and outcome of this highly morbid and potentially lethal condition over a period of three years.

MATERIAL AND METHODS

We managed 39 neonates with necrotizing fasciitis, over a span of three years, from January 2005 to December 2015. This paper presents a retrospective study of these thirteen cases of Neonatal Necrotizing Fasciitis handled by the authors in a non-institutional setup. Patients were grouped by etiology as primary and secondary NF. Data analysis were carried out for the etiological factors, age

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and sex predilection, anatomical site of occurrence, causative micro-organisms, antibiotic sensitivity, morbidity and the clinical outcome. The diagnosis of Necrotizing fasciitis was primarily clinical and considered with high index of suspicion and corroborated with the blood investigations and operative findings.

Table 1: Diagnostic criteria used by us

History	Pre-existing infection : mammitis / abscesses / Varicella
	H/o ? insect bite
	History of scalp shaving
	Idiopathic
	Excessive irritability and crying
	Rapid development or spread over a few hours.
On examination	Mildly elevated, erythematous patch not distinctly separated from surrounding skin.
	Tender to touch with definite blanching
	Peau d'orange appearance
	Violet discoloration of skin
	In late cases, e/o skin necrosis / blistering
Investigations	Leucocytosis / leucopenia
	Thromobocytopenia
	Hyponatremia
At surgery	Minimal bleeding on skin incision
	Thin yellowish dirty pus
	Easy separation of skin and subcutaneous tissue from underlying fascia
	Yellowish green necrotic fascia
Culture	Staph aureus alone
	Staph aureus with streptococcus
	No growth on culture
After 24 hours	Dry wound – dirty yellow fascia
After 72 hours	Copious purulent discharge from wound with sloughing off of the necrotic fascia in strands.

RESULTS

The age at presentation varied from 3 days to 60 days (mean 31 days). A female preponderance was observed with 27 females [69.2%] to 12 males [30.76%]. The commonest site of involvement was the scalp (30.76%) followed by the inter-scapular region (23.07%), nape of the neck (7.69%), back (7.69%), parotid region (7.69%), chest wall and abdomen (7.69%), chest wall and back (7.69%) and the inguinal region (7.69%). Etiologically, we found 21 patients (53.84%) with primary NF, and 18 patients with a known overt cause for sepsis (46.15%). Pre-disposing factors were abscesses in 3 patients (7.69%), 6 patients (15.38%) post-mammitis, 6 following unnoticed injury at ritual scalp shaving (15.38%) and 3 case (7.69%) post varicella infection. In other cases the predisposing factor could not be elicited. 3 / 4th patients were from a higher socio-economic stratum and had primary NF with one child having mammitis following breast manipulation during massage. 3/5 patients were from a middle class background, having primary NF, and 6 following ritual scalp shaving. Only one child out of the 4 babies from the lower socio-economic strata had primary infection. Thus, babies from middle and higher middle class backgrounds tend to show Primary NF while babies coming from lower socio-economic environments usually have a secondary NF.

Socio-economic stratum	Primary NF	Secondary NF	Total
Lower	3	9	12
Middle class	9	6	15
Higher class	9	3	12

Once the clinical diagnosis was made (Parameters for clinical diagnosis), immediate resuscitative measures were instituted with IV fluids, and parenteral antibiotics. Blood investigations for serum electrolytes, septic screening and coagulation profile were arranged and the lesions were surgically treated with urgent decompression by skin and fascial release incisions with blunt finger separation of the skin and subcutaneous tissue from the deeper layers revealing a yellowish-green necrotic fascia and tissue spaces opened up until resistance to separation of the skin and subcutaneous tissue from the fascial layer was encountered. The cavity was copiously irrigated with hydrogen peroxide and betadine and the space so created was packed with betadine ointment soaked gauze. This was followed by regular wound dressings with use of chemical debriding agents after the first 48-72 hours. It was noted that after the initial surgical release incisions, the wounds appear unusually dry for 48 hours followed by gradually increasing discharge and soakage from the sloughing off fascia. This is characteristically different from pyogenic abscesses where the wounds appear wet, bleeding and discharging until healed. The time to diagnosis (surgical referral) since onset of symptoms was in the range of 6 hours to 26 hours and mean time from diagnosis to surgical intervention was less than 2 hours in all our cases. Wound healing was by secondary intention in all our patients (100%). There were no deaths in our series. The causative organisms were Methicillin Sensitive *Staphylococcus aureus* in majority of the cases (27/39) which were susceptible to common anti-staphylococcus agents. This was followed by Streptococcus pyogenes (9/39) and poly-microbial infection was seen in others (4 / 39). The condition did not recur in any of the cases up to the last follow-up (6 months, since the last case.) There were no long term deficits / disability or disfigurement in any of the cases handled by our team.

DISCUSSION

Necrotizing fasciitis in the neonate may resemble cellulitis at presentation. The diagnosis of necrotizing

fasciitis is often delayed, and may be life threatening if not treated promptly and appropriately[1]. Most of the cases of NF have been reported in adults. The largest pediatric series was of 66 patients over a five year period at a Tertiary Institution in Mumbai. Described as early as 1848, a detailed description was presented by Meleney in 1924. The term "necrotizing fasciitis" was coined by Wilson in 1952 when he observed a rapidly progressive inflammation and necrosis of deep fascia subsequently involving the skin and subcutaneous tissue and development of cutaneous gangrene. The rapidity of spread is directly related to the thickness of the subcutaneous tissues at the site of involvement. The fascial involvement is typically more advanced than the skin necrosis would suggest. Among neonates, NF frequently was attributable to secondary infection, such as omphalitis, mammitis, balanitis, postoperative complications, fetal scalp monitoring, and bullous impetigo. Other associations of NF included necrotizing enterocolitis, immunodeficiency, and septicemia. Primary NF, which implies lack of a known causative factor or any identifiable portal of entry for bacteria, is rarely reported in the neonate. The site of involvement is usually related to the primary focus; i.e. in omphalitis and balanitis, the site of involvement is usually the abdominal wall. In cases of mammitis and fetal monitoring, the thorax and the scalp are sites involved, respectively. Invasive surgical procedures or even a minor insect bite may set the stage for development of necrotizing fasciitis. Necrotizing fasciitis and simple cellulitis usually may be differentiated on the basis of clinical signs and symptoms. Both simple cellulitis and necrotizing fasciitis may present with erythema and induration; however, any surgical wound occurring with these symptoms should be evaluated carefully for evidence of necrotizing soft tissue infection. The skin develops a violet color and may show blistering or frank necrosis[10]. The proper diagnosis should be suspected and often recognized before these late findings. The excessively crying neonate with a developing erythematous patch should never be taken lightly. Pain in Necrotizing fasciitis is seen only in the early stages, before there is death of the nerve endings, caused by thrombosis of the subcutaneous blood vessels and is said to be very severe, out of proportion to the apparent physical findings. Although not specific, tachycardia is a sensitive indicator and should prompt an urgent evaluation for necrotizing soft tissue infection. Secondary involvement of the muscles may occur in delayed management and may result in myositis or myonecrosis. An elevated leukocyte count may be noted in both necrotizing fasciitis and simple cellulitis. Hyponatremia with thrombocytopenia are early indicators of overwhelming sepsis. Hsieh *et al*[9] reported thrombocytopenia in established NF in about 50% of the cases, which is in congruence with our findings (30/39 cases – 76.92%). Overwhelming sepsis may lead to an initial pan-cytopenic response which should not be taken lightly. Majority of the neonates in our study, showed raised leukocyte count, with falling platelets and hyponatremia. Age of presentation was 10–28 days in a study conducted by Gangopadhyay *et al*[2] with Male to female ratio was 2:1. This is in contrast with our study where we noticed a female pre-ponderence. The mean age of presentation of the disease was 13.3 days in our study. Neck and scalp were the commonest site (53·3%) in the study by Gangopadhyay *et al*[2] which is in congruence with our study. We found that the commonest site involved was scalp (4/13) followed by inter-scapular (3/13), nape of neck (1/13), back (1/13), parotid region (1/13) and inguinal region (1/13). Two patients presented with the disease at multiple sites one with chest wall and abdomen (1 /13) and in other patient chest wall and back (1/13) were involved. Although there were no known causative factors in most of our patients, there may be an unrecognized injury to the epidermis with subsequent bacterial invasion in these relatively immune-compromised neonates. Thus, we cannot be 100% certain that our cases are primary necrotizing fasciitis. It is important that early diagnosis is made for NF because immediate surgical debridement offers the best chance for survival. Because of the variable changes of skin presentation and nonspecific laboratory findings in the early stage of the disease, prompt diagnosis is often difficult and relies on a high index of suspicion and previous experiences. Marked tissue edema, rapid progression of inflammation, and signs of systemic toxicity are the diagnostic clues. Ultrasonography, computed tomography, and magnetic resonance imaging have been very useful in the diagnosis of NF. In our study the diagnosis was clinical and none of the radiological techniques were used for the diagnosis. Stamenkovic and Lew [3] had suggested that immediate surgical exploration with frozen section biopsy may provide definite and life-saving diagnosis in questionable cases. McHenry *et al*[4] demonstrated that a prolonged lapse time between hospital admission and operative debridement was the only potential determinant associated with an unfavorable outcome in NF, and this has been supported in our series. It is important that prompt adequate surgery be performed. McHenry *et al* also said that the procedure should include early debridement of all necrotic tissue and drainage of affected fascial plane by extensive fasciotomy until viable bleeding tissue is encountered. Supportive care consists of aggressive fluid resuscitation and pain control. Though Hyperbaric oxygen therapy has been suggested; Brown *et al*[5] in a retrospective review

showed that this therapy did not reduce mortality or the number of surgical debridement in the treatment of major truncal NF. Stanley Loo *et al* suggests that the only predictor to prognosis is the time to surgical debridement. We observed that, because necrosis is present at the junction between the subcutaneous tissue and fascia, definite diagnosis is usually made at surgery by demonstration of a lack of resistance of normally adherent fascia to gentle finger pressure or blunt probe dissection. All of our cases were surgically treated only with release incisions followed by regular dressings. We have not required extensive debridement or hyperbaric oxygen therapy for survival, in any of our cases. Moss *et al* [6] had recommended that the antibiotic therapy should be a combination of penicillin or a cephalosporin for Gram-positive, an amino-glycoside for Gram-negative, and Clindamycin or Metronidazole for anaerobic organisms. It is therefore important to retrieve wound culture results as promptly as possible so that appropriate antibiotic therapy can be instituted. Most of our cases were mono-microbial, and in view of the analysis of our previous cases, our first line antibiotic is Ceftrioxone with Metronidazole. In 9 of our cases, a sub-optimal response to a third generation cephalosporin after 72 hours, necessitated use of Linezolid. Both the cases discussed by Stanley *et al*[7] were treated with multidisciplinary approach and recovered. There was no mortality in our series. In the study by Sawin *et al*[8], the neonatal age group had a mortality rate greater than 70%. Gangopadhyay *et al*, have reported mono-microbial involvement in 66% of their cases with predominance of *Staphylococcus* species. In our series too, Methicillin sensitive *Staphylococcus aureus* was isolated in the cultures in 27 /39 cases. Various authors [8,10,11,12] have observed the association of this bacterium with NF. A very high index of suspicion with immediate Surgical reference and Management prevents definite life threatening complications and rapid spread. The condition is known to extend in a matter of hours and not days, and vast areas of skin and deeper tissues may get de-vascularized and necrosed. Review of Literature on NF reveals that majority of the cases have established skin necrosis and gangrene, suggesting a late diagnosis. It is our observation, that accurate and timely clinical diagnosis can prevent massive skin necrosis and avoid the trauma of wide surgical excision and extensive debridement in an already compromised and sick child. A simple clinical examination by a Surgeon corroborated with intra-operative findings of thin yellowish purulent discharge below the subcutaneous tissue with a yellowish green necrotic fascia, clinches the diagnosis. In the Indian scenario, even in Urban Hospitals, use of Computerized Tomography / frozen section are neither financially nor clinically feasible. Vital time may be lost in scheduling the procedure and subsequently getting the reports. Also, use of sedation / anesthesia in the already sick child in the uncontrolled setting of the CT department, may be potentially damaging. Total leukocyte counts, falling platelets and low Serum Sodium further strengthen the diagnosis. In our series, active/extensive debridement was not required in any of the cases. With control of spread, a well defined demarcation appears between the affected and the normal tissue and the area sloughs off. We did not use reconstructive procedures in the form of Skin Grafting. Regular dressings ensured development of good natural skin cover and all had complete healing within 90 days of the infection.

CONCLUSION

Neonatal NF is an uncommon but often fatal bacterial infection of the deep fascia extending to the skin, subcutaneous fat and superficial fascia. Clinically, it is characterized by marked tissue edema, rapid spread of inflammation, and signs of systemic toxicity. Primary NF is rare but is commonly caused by Staph. Aureus. Secondary NF usually is poly-microbial in origin and the location of initial involvement depends on the underlying etiologic factor. High index of suspicion with prompt surgical release, appropriate antibiotics, and supportive care are the main stays of management in the newborn infant with NF. Earlier the diagnosis, lesser is the morbidity and mortality even with non-extensive surgical intervention. Though this is a very small series, and presents our experience in a non-Institutional based setting, we are confident that these results may be reproduced if the principles of management are strictly adhered to.

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