DOI: 10.38103/jcmhch.95.4

Original research

CLINICAL CHARACTERISTICS AND TREATMENT OUTCOMES OF SKIN AND SOFT TISSUE INFECTIONS IN CHILDREN: A PROSPECTIVE STUDY

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ABSTRACT

***Background**: This study addresses the elevated prevalence of skin and soft tissue infections (SSTIs) within the pediatric demographic, necessitating a comprehensive inquiry into their varied clinical manifestations. The primary objectives involve the assessment of clinical and laboratory characteristics of SSTIs in children and an exploration of their correlation with treatment efficacy.*

***Methods**: From April 2022 to June 2023, a prospective observational study was conducted on 87 pediatric bacterial SSTI cases at a Tertiary Paediatric Centre in Central Vietnam.*

***Results**: SSTIs were most common in children ages 1-4, 48.3%. Seasonal trends showed a peak incidence in summer (43.7%). In 93.1% of patients, febrile presentation and edema predominated. About 40.2% of people had lower extremity involvement. Analysis showed significant rates of severe (73.6%) and purulent (67.8%) SSTIs. Leukocytosis was found in 39.1% of patients, mostly due to 72.4% increased CRP. Even though only 2.4% of blood cultures were positive, Staphylococcus aureus caused 76.9% of infections. About 42.5% of patients had shorter treatments. Significantly, purulent SSTIs required longer antibiotic therapy than nonpurulent infections ($p < 0.05$). 27.6% of children needed surgery, and most received intravenous antibiotics. Most importantly, all patients recovered.*

***Conclusions**: Predominantly observed among pediatric cases were purulent SSTIs, exhibiting a proclivity for the lower limbs, with Staphylococcus aureus as the predominant etiological agent. Treatment duration for purulent SSTIs exceeded that for nonpurulent infections. Intravenous antibiotic administration emerged as the predominant therapeutic modality, yielding favorable outcomes.*

***Key words:** Skin Diseases, Infectious; Child; Vietnam; Anti-Bacterial Agents.*

I. BACKGROUND

Skin and soft tissue infections (SSTIs) represent commonly encountered infectious conditions, manifesting with diverse clinical presentations across varying degrees of severity [1]. This constitutes a significant factor leading to the escalating hospitalization rates of pediatric patients [2].

SSTIs encompass surface infections such as impetigo, cellulitis, folliculitis, necrotizing fasciitis, infections related to animal or human bites, surgical site infections, and infections in immunocompromised hosts [1]. In children with systemic lupus erythematosus, increased susceptibility to SSTIs has been observed. Research suggests that SSTIs are the second most common type of infection among this population, highlighting their significant clinical importance [3].

The clinical manifestations of the disease result from the interplay between bacterial invasion and the host's defense mechanisms. The clinical diversity of SSTIs necessitates physicians to distinguish cases requiring active therapeutic intervention from those of lesser severity [4]. Failure to effectively treat severe infections may lead to the deeper infiltration of bacteria from the dermal and subcutaneous lesions, culminating in bloodstream infections.

Received: 20/02/2024. **Revised:** 28/4/2024. **Accepted:** 10/5/2024.
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The primary etiological agents of the disease are *Staphylococcus aureus* and *β-hemolytic Streptococcus group A* [5]. Given the escalating antibiotic resistance of bacteria globally, particularly the increasing prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA), there is a pressing concern necessitating more effective antimicrobial strategies [6]. Timely and accurate antibiotic prescription is imperative for achieving high treatment efficacy. Presently, a growing number of pediatric patients seek medical intervention for treatment, underscoring the need for a more in-depth understanding of the disease [7]. In pursuit of heightened diagnostic precision, timely intervention, and the preemptive mitigation of complications we conduct this study. This study aims to assess of clinical and laboratory characteristics of SSTIs in children and an explore of their correlation with treatment efficacy.

II. METHODS

2.1. Setting and data collection

All children under 16 years old were diagnosed with skin and soft tissue infections and received treatment at a Paediatric Centre - Hue Central Hospital from April 2022 to June 2023.

Inclusion criteria were: Patients diagnosed with skin and soft tissue infections based on clinical manifestations and bacterial culture and identification of the causative bacteria from the infected site specimen [1]. Children and their families consented to participate in the study.

2.2. Study design, data definition

The study was executed employing a prospective observational research design.

Study variables: General Characteristics: Age, gender, and season. Clinical Characteristics: Fever, swelling, warmth, redness, pain, site of infection, disease type, and severity level. Nonpurulent SSTIs consist of rapidly spreading superficial cellulitis and erysipelas. These infections are typically caused by groups A, B, C, and G *beta-hemolytic streptococci*, and occasionally by MSSA. Diagnosis of these infections is based on clinical evaluation, and it is not necessary to perform cultures since there is usually no reliable and easily accessible specimen to culture [8]. Purulent SSTIs encompass several types such as cutaneous abscesses, carbuncles, furuncles, and sebaceous cyst infections. These infections are usually caused by *S aureus*, including both MSSA and MRSA. Whenever feasible, it is advisable to do a culture test to identify the presence of the pathogen and its resistance pattern [8]. Paraclinical Measures: White blood cells, C-reactive protein (CRP), pus culture, blood culture, and ultrasound. Treatment: Treatment response and treatment outcomes.

2.3. Statistical analysis

The clinical and laboratory features were described using count, percentage, median, and interquartile range. Chi-square tests compare proportions of two or more independent groups to determine the link between non-parametric variables. When quantitative variables follow a normal distribution, a one-way analysis of variance (ANOVA) test compares independent group means. If at least one quantitative variable is not normally distributed, the Kruskal-Wallis test compares independent group means. All statistical analyses were done using IBM SPSS Statistics 20.0 (IBM, New York, USA).

III. RESULTS

The study comprised 87 patients, the majority of whom were between the ages of 1 and 4 (48.3%), with the lowest proportion being between 13 and 16 years old (5.7%). There were more males than females. In the summer, 43.7% of the cases of illness were recorded (Table 1).

Table 1: General characteristics of SSTIs in children

Characteristic		N = 87	Percentage (%)
Age	< 1 year old	24	27.6
	1 - 4 years old	42	48.3
	5 - 12 years old	16	18.4
	13 - 16 years old	5	5.7
Gender	Male	51	58.6
	Female	36	41.4
	Spring	8	9.2
	Summer	38	43.7
	Autumn	23	26.4
	Winter	18	20.7

Fever is the most common symptom among patients. The likelihood of experiencing heat symptoms in affected skin is lower than the likelihood of experiencing edema (93.1%), redness (69%), and discomfort (62.1%). In terms of severity, the lower limbs are afflicted the most (40.2%), followed by the buttocks and perineal region (8%). Infections of the skin and soft tissue with purulent discharge were the most prevalent, accounting for 67.8% of all cases. This was significantly higher than the proportion of cases without purulent discharge (32.2%). Notably, moderate-intensity infections exhibited the highest occurrence, representing 73.6% of all cases (Table 2).

Table 2: Clinical of SSTIs patients

Characteristic		N = 87	Percentage (%)
Symptoms	Fever	59	67.8
	Swelling	81	93.1
	Heat	45	51.7
	Redness	60	69.0
	Pain	54	62.1
Skin infection area	Craniofacial	30	34.5
	Body	12	13,8
	Upper limb	16	18,4
	Lower limbs	35	40,2
	Buttocks/ perineum	7	8.0
Classification	Purulent SSTIs	59	67.8
	Non-purulent SSTIs	28	32.2
Severity of the SSTIs	Mild	18	20.7
	Average	64	73.6
	Severe	5	5.7

Among patients, 56.3% exhibited a white blood cell count below 15 k/µl, while 74.7% had a C-reactive protein value below 40 mg/l. Notably, *Staphylococcus aureus* growth was observed in 76.9% of purulent cultures, whereas the rate of positive blood cultures was remarkably low at 2.4% (Table 3).

Table 3: Laboratory features of SSTIs patients

Characteristic		N = 87	Percentage (%)
White blood cell	< 15 k/µl	49	56.3
	≥15 k/µl	38	43.7
C-reactive protein	< 40 mg/l	65	74.7
	40 mg/l - 100 mg/l.	12	13.8
	≥100 mg/l	10	11.5
Purulent culture (N = 39)	*Staphylococcus aureus*	30	76.9
	Negative	9	23,1
Blood culture (N = 42)	MRSA	1	2,4
	Negative	42	100

For 27.6% of patients, a combination of antibiotics and drainage was necessary for treatment. Notably, 57.5% of patients exhibited a favorable response to treatment, and 100% of patients achieved full recovery from the illness (Table 4).

Table 4: Treatment response and outcomes

Characteristic		N = 87	Percentage (%)
Treatment method	Antibiotics	63	72.4
	Antibiotics and rainage	24	27.6
Treatment response	Good response	50	57.5
	Partial response	37	42.5
Treatment outcome	Cured	87	100
	Not cured	0	0

The percentage of children with a treatment time of less than 7 days was the highest at 42.5%. The average treatment time for purulent infections was 7 days (median 6 days), which was significantly longer than the average treatment time for non-purulent infections of 5 days (median 4 days; $p < 0.05$). Intravenous antibiotics were used most often, followed by oral antibiotics (Table 5).

Table 5: Treatment duration and route of antibiotic administration

Characteristic		Purulent SSTIs (N = 59)		Non-purulent SSTIs (N = 28)		Total (N = 87)		p
		n	%	n	%	n	%	
Treatment duration	Under 7 days	15	25.4	22	78.6	37	42.5	< 0.05
	From 7 to 14 days	30	50.8	3	10.7	33	37.9	
	From 14 days or more	14	23.7	3	10.7	17	19.5	
	Median 25^{th} - 75^{th}	8 (6 - 12)		5 (4 - 6)		7 (5 - 11)		< 0.05
Route of antibiotic administration	Oral	6	10.2	2	7.1	8	9.2	> 0,05
	Intravenous	46	78.0	22	78.6	68	78.2	
	Both routes	7	11,9	4	14,3	11	12,6	

IV. DISCUSSION

Anatomically and etiologically, SSTIs are heterogeneous infections. Among the 87 children in our study, those aged 1 to 4 had the highest infection rate, comparable with earlier studies. This may be due to increased environmental exposure and sensitivity to pathogenic agents in this age group, as well as poor hygiene and a propensity for accidents and insect bites. After 6 months, passive maternal immunity declines, making children more susceptible to illnesses. Infections are more common in men and peak in summer. Due to poor hygiene and warm, humid weather, thin, sensitive skin in children makes bacterial infiltration easy. SSTIs are most common in summer due to outdoor activity and environmental factors [9].

Among clinical symptoms, 67.8% of the pediatric cohort had fever, which commonly prompts families to seek medical attention. Fever, a sign of systemic inflammation, correlates with disease severity. Lower extremities were more afflicted, followed by head, face, neck, and upper extremities. The lower extremities were frequently implicated in these presentations, as in earlier studies.

The purulent culture investigation showed 76.9% *Staphylococcus aureus*, consistent with the disease's geographical pattern. The main cause of SSTIs with abscesses, furuncles, and carbuncles is *Staphylococcus aureus*. Blood cultures had a 2.4% positive rate, consistent with previous investigations. Given the low frequency of bloodstream infections in simple SSTIs in children without underlying health issues, blood culture may not be necessary [10].

In this study, the percentage of children with a treatment time of less than 7 days was the highest at 42.5%. This is in contrast to the findings of a study by Hermione J. Hurley et al., in which the majority of patients (63.8%) were treated for 7 to 10 days, with only 4.4% treated for less than 7 days and 1.4% treated for more than 14 days [11]. Intravenous antibiotics were used most often (78.2%). In a study of 399 children with MRSA abscesses, Steven T. Papastefan et al. reported that 53.9% of patients received only intravenous antibiotics, 41.6% received both intravenous and oral antibiotics, and only 4.5% received only oral antibiotics [12].

V. CONCLUSION

SSTIs represent prevalent infections presenting with varied clinical manifestations. In this investigation, cellulitis and abscess formation emerged as the predominant infection types, predominantly affecting the lower extremities. *Staphylococcus aureus* constituted the most frequently identified pathogen. A comprehensive recovery was observed in all treated patients. The study revealed correlations between the infection type and severity, results of pulurent and blood cultures, ultrasound findings, and subsequent treatment responses.

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