Original Article

Detection of Toxic Shock Syndrome Toxin-1 among Children Undergoing Surgical Operations

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Abstract:

Background: Toxic-shock syndrome (TSS) is an acute onset; multiorgan disease caused mainly by Toxic-shock syndrome toxin-1 (TSST-1) producing *Staphylococcus aureus* strains.Testing for TSST-1 or anti-TSST-1 antibodies in the clinical setting may help to predict and prevent the appearance of TSS caused by *nosocomial S. aureus* infection.

Objectives: Detection of TSST-1 in the sera of children patients arranged to undergo surgical operations, and its relevance with certain demographic factors.

Patients and methods: This cross-sectional study was conducted in the Baquba General Teaching Hospital-Diyala province for the period from August 2015 to April 2016. Eighty eight patients from those undergoing surgical operations were enrolled. The age range was 1-14 years. Thirty one (35.2%) were males and fifty seven (64.8%) were females. Human privacy was respected by taking patient's consensus. Venous blood samples were collected aseptically; the sera were separated and kept frozen till use. Serum samples were investigated for the presence of TSST-1 using ELISA technique. Statistical analyses were done using SPSS version 18. P value less than 0.05 was considered significant.

Results: The results showed that the overall detection rate of TSST-1 among children undergoing surgeries was 44.3%. It was insignificantly higher among younger age group, females, and ruralizes. According to the type of surgery, the detection rate was higher among those patients with fractures (10.2%), followed by patients with burns (9.1%), but it failed to reach the levels of statistical significant.

Conclusion: About one half of children patients undergoing surgical operations are infected with TSST-1 producing S. aureus.

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Keywords: Toxic-shock syndrome, Toxic-shock syndrome toxin-1, S. aureus.

Introduction:

Infectious diseases caused by *Staphylococcus aureus* constitute a significant clinical and public health problem. It causes some of the most severe hospital-associated and community-acquired illnesses [1]. Toxic-shock syndrome (TSS) is an acute onset; multiorgan illness caused by TSS toxin-1 (TSST-1) producing *S. aureus strains*. The gene coding for TSST-1 is found in more than 20% of *S. aureus* isolates [2,3]. TSST-1 is the prototypical superantigen that binds to major histocompatibility complex molecule-II (MHC-II), yielding T cell

Stimulation, which promotes the protean manifestations of TSS [4,5]. One-third of all TSS cases have been found in men possibly due to surgical wounds or any skin wound. TSST-1 is the cause of 50% of non-menstrual and 100% of all menstrual TSS cases [6,7]. Additionally, the rate of neonatal TSS caused by Methicillin resistant *S.aureus* (MRSA) is increasing [8,9]. Clinically, TSS is associated with fever, shock and multisystem involvement, including a desquamative skin rash, making its diagnosis difficult because, in the early stages, its signs and symptoms resemble those of other common illnesses such as scarlet fever [10,11]. As S. aureus is ubiquitous pathogen, the risk for preoperative or postoperative nosocomial infections has been markedly increased particularly among immunocompromised hosts mainly due to MRSA that consequently may develop TSS [12,13]. In this context, it has been reported that 40 million patients undergo surgery each year in the United States, 20% of them developed postoperative nosocomial infection most commonly by *S. aureus*, and carriage of *S. aureus* in the anterior nares has been identified as a riskfactor for these infections [14]. Furthermore, it has been found that MRSA is the major cause of surgical site infections, with a higher mortality and longer duration of care recommended that preoperative MRSA surveillance allows the selection of appropriate and effective bundle of interventions of decolonization and prophylaxisprotocols and provides needed data for epidemiological studies [15,16]. Several studies had asserted that high prevalence of TSS was reported among patients with absence or low levels of anti-TSS-1 antibodies, suggesting that testing for TSST-1 antibody

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in the clinical setting may help to predict and prevent the appearance of TSS caused by nosocomial *S. aureus* infection [17,18,19,20]. Similarly, detection of TSST-1 is among a bundled intervention of decolonization and prophylaxis to decrease S. aureussurgical site infections [21,16,22].

Patients and methods:

This cross-sectional study was conducted in the Baquba General Teaching Hospital- Diyala province for the period from August 2015 to April 2016. 88 patients were enrolled, all ofthem were arranged to undergo surgical operations. The age range was 1-14 years. Thirty one (35.2%) were males and fifty seven (64.8%) were females.. All subjects were interviewed by means of a structured questionnaire for genera demographic factors gender, age, residence, educational levels. Human privacy was respected by taken patient's consensus. Five milliliters of venous blood sample was drawn aseptically; the sera were separated and kept frozen till use. Serum samples were investigated for the presence of TSST-1 using ELISA technique, (MYBio Source, USA) kit. Statistical analyses were done using SPSS version 18.Chi-square was used for paired comparison, and P value less than 0.05 was considered significant.

Results:

Eighty Eight child patients from those arranged to undergo surgical operation were included in this study. The age range was 1-14 years. The mean age was 8.26 ± 3.33 years. Thirty one (35.2%) were males and fifty seven (64.8%) were females. Twenty one (23.9%) were urban and sixty seven (76.1%) were rural. The type of surgeries include 12(13.6%) ENT surgeries, 8(9.1%) were extraction of foreign bodies, 10 (22.4%) hernias, 6(6.8%) UT surgeries, 13 (14.8%) fractures, 19(21.6%) burns, 8 (9.1%) cardiovascular surgeries, 4(4.5%) neurosurgeries, 4(4.5%) cosmetic surgeries, and 4(4.5%) appendectomy, table (1) showed distribution of patients according to age, sex, and residence. The distribution of TSST-1 according to age, sex, residence of patients was showed in table (2). The TSST-1 detection rate was slightly higher in the 1-7 years compared to 8-14 years age group (31.8% vs 28.4%). The detection rate was also slightly higher among female compared to males (23.9 % vs 20.5%). It was also higher in rural than in urban (30.7% vs 13.6 %). In all these three relationships, the difference was failed to reach the levels of statistical significant. According to the type of surgery, the detection rate of TSST-1 was highest among those patients with fractures (10.2%) followed by patients with burns (9.1%); however, the difference in both cases was insignificant.

Table (1): Distribution of patients according to their age, sex, and residence.

Variables	No.	%	95% Confidence interval	
Age (Ys)				
1-7	35	39.8	29.8	51.1
8-14	53	60.2	48.9	70.2
Total	88	100		
Sex				
Male	31	35.2	24.4	43.2
Female	57	64.8	56.8	75.6
Total	88	100		
Residence				
Urban	21	23.9	14.8	33.0
Rural	67	76.1	67.0	85.2
Total	88	100		

Table (2): Distribution of TSST-1 according to the age, sex, residence.

Variable	TSST-1		Total (%)	P value
	Positive (%)	Negative (%)		
Age				
1-7	28(31.8)	21(23.9)	49(55.7)	Chi-Square= 0.439
8-14	25(28.4)	14(15.9)	39(44.3)	P=0.329[NS]
Total (%)	53(60.2)	35(39.8)	88(100)	
Sex				
Male	18(20.5)	13(14.8)	31(35.2)	Chi-Square=3.66
Female	21(23.9)	36(40.9)	57(64.8)	P=0.073[NS]
Total	39(44.3)	49(55.7)	88(100)	
Residence				
Urban	12(13.6)	9(10.2)	21(23.9)	Chi-Square= 1.83
Rural	27(30.7)	40(45.5)	67(70.1)	P= 0.212[NS]
Total	39(44.3)	49(55.7)	88(100)	

Table (3): Distribution of TSST-1 according to the type of surgery.

Type of surgical operation	TSST-1		Total (%)	P value
	Positive (%)	Negative (%)		
ENT surgeries	4(4.5)	8(9.1)	12(13.6)	Chi-Square= 11.4 P= 0. 249 [NS]
Foreign bodies	4(4.5)	4(4.5)	8(9.1)	
Hernias	5(5.7)	5(5.7)	10(11.4)	
Urosurgeries	1(1.1)	5(5.7)	6(6.8)	
Fractures	9(10.2)	4(4.5)	13(14.8)	
Burns	8(9.1)	11(12.5)	19(21.6)	
Cardiovascular surgeries	4(4.5)	4(4.5)	8(9.1)	
Neurosurgeries	1(1.1)	3(3.4)	4(4.5)	
Cosmetic surgeries	0(00)	4(4.5)	4(4.5)	
Appendicitis	3(3.4)	1(1.1)	4(4.5)	
Total	39(44.3)	49(55.7)	88(100)	

Discussion:

Since more than decade ago, *S. aureus*, particularly MRSA strains had been identified as one of the most prevalent nosocomial pathogen that were responsible for a wide range of postoperative infections leading to significant patient

morbidity and mortality [21,13,4,] Undoubtedly the source of these strains could be either endogenously from healthcare workers carries these germs in their anterior narse or on their skin, or exogenously from admitted infected or carrier patients [23,24]. It is worth to remember here the results of our previous study in which the rate of nasal carriage of *S. aureus* among general population in Diyala province was 26.3% and higher rate was found among HCWs 30.5%, and in the healthcare settings including surgical theaters, hospital wards, and kitchens (27.2%, 22.0% and 18.6%) respectively [25]. So unsurprisingly, both hospital-acquired and community-acquired MRSA (CA-MRSA) strains had increased in frequency in the last few years, reaching epidemic dimensions [13]. Therefore, medical authorities and researchers were in continuous searching for an accurate detection and effective intervention to reduce the rate of nosocomial infections due to *S. aureus* [21,15,22]. A part from hospital admitters, surgical and burn patients were under a particular risk for acquiring S. aureus nosocomial infections for well documented reasons [14,25,16]. . For these reasons, the present study was arranged to detect the TSST-1 which surely indicate the presence of TSST-1 *S. aureus* producing strains among surgical and burn patients in Diyala province. The present study found that the overall detection rate of TSST-1 among surgical patients was 44.3%. Similar higher results had been previously reported among burn and surgical patients [21,26]. Parsonnet and his workers reported that *S. aureus* was isolated from at least one site in 52% of women in Tokyo, and of these 9% were TSST-1 positive [2]. Furthermore, children with burns had greater risk of developing toxic shock syndrome than adults probably due to insufficient antibody titers. However, infants below 6 months and children more than 4 years were found to have protective levels of anti-TSST-1 antibodies [17,19]. Therefore, burned patients with negative titers of anti-TSST-1 antibody may be susceptible to TSS, suggesting that testing for TSST-1 antibody in the clinical setting may help to predict and prevent the appearance of TSS caused by nosocomial MRSA infection [27,20]. The higher rate of detection of TSST-1 among patients from rural areas compared to those from urban may indirectly indicate a higher carrier rate of *S. aureus* among rurals probably due to microbial, patient or environmental factors [2]. Given the importance of *S. aureus* nosocomial infections, as revealed by our findings, along with related results of previous studies, suggest the urgent need for the establishment of an effective bundled intervention with surgical site infections among patients undergoing surgeries including Preoperative decolonization and prophylaxis is one potential strategy to decrease or eliminate *S. aureus* nasal carriage among certain patient populations or in certain healthcare settings [21,15,28]. Routine screening of surgical or burn patients for the detection of antibodies to TSST-1 producing *S. aureus* stains using a rapid laboratory assay is the least recommended intervention [29]. Gustinet al. [30]. Indicates that surveillance data on surgical site infections may be an interesting epidemiological source for planning for the development of anti-staphylococcal vaccines is a priority to prevent surgical site infections. Additionally, surveillance data are very important to determine the local stains of *S. aureus* and to decide effective interventions [16, 22,24]. More precisely, it is essential that all pediatric and emergency departments accepting children with burns are aware of the symptoms, signs and early management of TSS [31].

Conclusion:

About one half of children patients undergoing surgical operations are infected with TSST-1 producing *S. aureus*. Preoperative screening of patients for TSST-1or anti-TSST-1 antibodies is recommended to reduce the postoperative nosocomial infections.

Author Contributions:

AsmaaHaseebHwaid initiated the project and searched the databases for potentially eligible articles based on their titles and abstracts (study conception and study design). Abdulrazak SH. Hasan reviewed the articles, performed the statistical analysis and interpreted the results and wrote the manuscript. Zaienb M. criticalrevision. All the authors reviewed the final version of the manuscript prior to submission for publication.

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