

# Postoperative Wound Infection in a Pediatric Surgical Service

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● Seventy-two out of 1,325 consecutive pediatric patients (5.43%) developed an operative wound infection in a general pediatric surgery unit. The wound infection rate was observed to be highest in neonates (13.75%) as compared with the children over 5 years of age (2.93%). The increased susceptibility of newborns to wound infection was found to be statistically significant. Patients operated for gastrointestinal problems and solid abdominal neoplasms had the highest wound infection rate.  
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**INDEX WORDS:** Postoperative wound infection.

**T**HE DEVELOPMENT of postoperative wound infection is an important event that can not always be prevented. The economic, physical, and psychological impact of postoperative wound sepsis mandates the recognition of the problem and enunciation of the use of preventive measures.<sup>1</sup> The present day literature is replete with recognition of this problem in almost all surgical specialties dealing with the adult patient population and identification of high risk patients among this age group.<sup>2</sup> The problem of wound infection in general pediatric surgery remains to be identified and analyzed as only two reports, one each in English<sup>3</sup> and Spanish,<sup>4</sup> have so far been published. The study presented here is an attempt to identify the extent of postoperative wound infection in a general pediatric surgical unit in northwest India. An endeavor has been made to identify the high risk patients for this complication with relation to age, sex, and organ systems involved in the surgical procedure.

## MATERIALS AND METHODS

All patients undergoing surgical procedures in the pediatric surgical service were classified according to age, sex, and the type of operative procedure performed: clean, clean contaminated, contaminated, and dirty.<sup>5</sup> The latter two categories were combined in the analysis due to relatively smaller numbers and statistical facilitation. A surgical wound was categorized infected in the presence of frank pus developing up to 4 weeks after the surgical procedure.<sup>5</sup> Erythema at the suture line, seroma in the subcutaneous tissue, and minor stitch abscess not leading to development of frank pus were not included in this study. Patients not followed for 4 weeks postsurgery, dying within this period, and leaving the hospital against medical advice have been excluded.

The study comprises 1,325 consecutive patients of whom 1,103 were males and 222 females (sex ratio 4.9:1). Seventy-two patients developed frank pus in their surgical wounds. The incidence of wound infection, stratified into various age groups and types of surgical wounds, is depicted in Table 1. On bacteriologic analysis of pus, no organisms were isolated in four instances. No anaerobes or facultative anaerobes were grown in any of the specimens. *Staphylo-*

*coccus pyogenus*, either as the single isolate or in mixed organisms, was isolated in highest number of cultures (36%). The microbiology of the isolated pus is outlined in Table 2.

## RESULTS

The overall surgical wound infection rate was 72/1,325 (5.43%). The development of wound infection was not influenced by the sex of the patient operated (M:F ratio 61:11 or 5.5:1) with wound sepsis ratio of 4.9:1.

Statistical analysis (P.K.S.) of the different age groups shown in Table 1 was done by chi square test.<sup>6</sup> The null hypothesis taken for the analysis was that operative wound infection is independent of age. On analysis this hypothesis is rejected (degree of freedom [DF] = 3,  $X^2 = 28.4670$ ,  $P < .001$ ). In order to compare the infection rate among various age groups (neonatal, infants, preschool, and school age), the wound infection rates were compared (Table 3). There was a statistically significant higher chance of operative wound infection if the patient was less than 28 days of age as compared with the one above 5 years. The chances of wound sepsis diminish with advancing age, being minimal in children aged 5 years and above.

The highest rate of wound infection was observed in patients undergoing surgery for solid malignant tumors concomitantly with chemotherapy and radiotherapy (18.75%). This was followed by patients undergoing colonic surgery (12.39%). The lowest rate was seen in patients with uncomplicated hernia repair (Fig 1).

## DISCUSSION

There are three basic factors for consideration in the epidemiology of postoperative wound infection: the degree of microbial contamination at time of surgery, host resistance, and the condition of the wound.<sup>2</sup> The first of these, the degree of microbial contamination, can be reduced if not entirely eliminated. The last, condition of the wound; clean, elective, or traumatic can not always be controlled. For the second factor the host needs to be individualized. A critical analysis of

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Table 1. Operative Wound Infection Relative to Age

Age Group	Clean (infected)	Clean Contaminated (infected)	Contaminated (infected)	Total	Infected	Percentage
I. Neonatal						
Mean age, 15.45 $\pm$ 9.21 d	94	52	14	160	22	13.75
Range, 1–28 d	(5)	(11)	(6)			
II. Infancy						
Mean age, 5.72 $\pm$ 3.21 mo	207	77	42	326	22	6.74
Range, 1.5–12 mo	(5)	(3)	(14)			
III. Preschool						
Mean age, 3.02 $\pm$ 1.32 yr	196	180	20	396	15	3.78
Range, 1–5 yr	(2)	(9)	(4)			
IV. School						
Mean age, 9.14 $\pm$ 3.58 yr	220	188	35	443	13	2.93
Range, 6–14 yr	(1)	(6)	(6)			
Total	717	497	111	1,325	72	5.43

Statistical analysis: Degree of freedom = 3;  $\chi^2 = 28.4670$ ;  $P < .001$ . Null Hypothesis: Operative wound infection is independent of age.

Table 2. Bacteriology of Operative Wound Infection

Organism (s)	Clean	Clean Contaminated	Contaminated	Total Percentage
<i>Staphylococcus pyogenus</i>	7	4	2	13 18.0
<i>S pyogenus</i> + gram negative	3	6	4	13 18.0
<i>Pseudomonas pyocyanea</i>	1	6	0	7 9.7
Klebsiellae	0	2	4	6 8.3
<i>Escherichia coli</i>	0	1	5	6 8.3
Mixed intestinal aerobic flora	2	6	15	23 32
Pus but sterile culture	0	4	0	4 5.5
Anerobic or facultative anerobes	Nil	Nil	Nil	Nil
Total	13	29	30	72

the data presented by us indicates that the postoperative wound infection rate is age related within the pediatric age group. A neonate is highly susceptible to wound infection regardless of degree of contamination at time of surgery. The newborn child has an overall impairment in the host defence mechanism to combat infection.<sup>7</sup> It has been demonstrated that a neonate has a reduced plasma opsonin activity,<sup>8</sup> defects in number and function of granulocytes,<sup>9</sup> deficient cell-mediated immunity,<sup>10</sup> defective neutrophil chemotaxis,<sup>11</sup> and defective intracellular killing of bacteria by leukocytes, especially in a stressed newborn.<sup>12</sup> Transfusion of mature leukocytes, now being performed for neonatal septicemia,<sup>13</sup> appears to be a promising avenue for trials to improve the host defence mechanisms of a newborn undergoing a major surgical procedure with significant intraoperative bacterial spillage.

If the host factor is examined beyond the neonatal life, we observed that the infants and preschool children seem to be at a higher risk than children over 5 years of age. Protein energy malnutrition, not an insignificant phenomenon in a developing country like ours, perhaps alters the immune response of the children under this age group. Malnutrition has been demonstrated to lead to lymphopenia, decreased complement component C3, lower serum levels of immunoglobulin G and siderophilin, and impaired cell immunity.<sup>14</sup>

We did not observe any sex-related difference in the rate of wound infection in our series. There seems to be conflicting reports by others.<sup>15,16</sup>

The higher infection rates evident with clean contaminated and contaminated wounds are well documented and are directly related to bacterial spillage at

Table 3. Statistical Analysis of Table 2: Age Group and Wound Infections

Age Groups Compared	(I, IV)	(I, III)	(II, IV)	(II, III)	(III, III)	(III, IV)
Reduction factor	0.78	0.72	0.56	0.50	0.43	0.22
Level of significance	$P < .001$	$P < .001$	$.01 < P < .025$	$.01 < P < .025$	$.05 < P < .1^*$	$.25 < P < .5^*$
$\chi^2$	23.68	16.99	6.002	5.811	3.058	0.4562

Degree of freedom = 1 in each case.

\*Not significant.

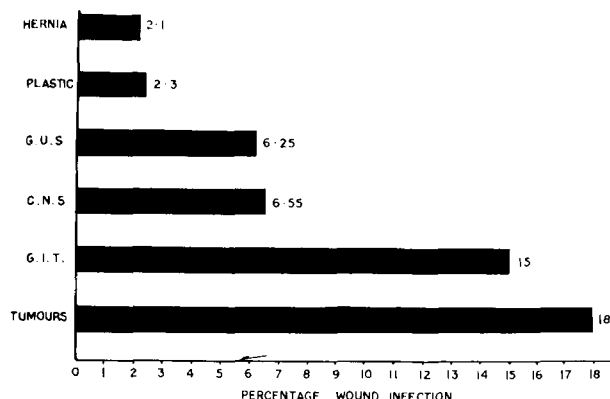


Fig 1. Wound infection: relation with organ systems operated.

time of surgery. *Staphylococcus pyogenus* was found to be the most frequent organism in clean cases like the earlier observations.<sup>3,15,16</sup> One of the possible causes of higher staphylococcus wounds in newborns could be the umbilical stump reservoir in the first 2 weeks of life.<sup>17</sup>

Operative wounds for surgery of solid malignant tumors show a high degree of susceptibility for infection. This could be related to well-known immunodeficiency in such patients together with anticancer chemotherapy and radiation therapy, which are well known to decrease the immune response.<sup>18</sup>

The overall wound infection rate of 5.43% in our series does not seem to be very different from larger series in adult patient populations.<sup>19</sup>

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