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Correlation Of Drain Tip Culture And Surgical Site Infections In Patients Undergoing Emergency Exploratory Laparotomy

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Abstract

Introduction - Incidence of surgical site infections is quite high after emergency exploratory laparotomies and the peritoneal cavity is routinely drained by abdominal drains in these patients. Since no study on abdominal drain tips had been carried out in the past, we studied the correlation of drain tip culture and surgical site infections in these patients. The report of the positive drain tip cultures was used for guiding a specific antibiotic in a particular patient.

Material & Methods – This study was conducted on 75 patients in a tertiary care institute in North India. Patients more than 14 years of age undergoing emergency exploratory laparotomy for perforation peritonitis were included in the study. Abdominal drain tip was sent for culture and sensitivity. A clinico-bacteriological study was conducted and correlation of drain tip culture with surgical site infections was statistically analysed.

Results and discussion – In our study, overall incidence of SSI was 50.66%. Gram-negative infections predominated and the commonest organism isolated was *Escherichia coli.* Overall incidence of positive drain tip culture was 44%. Incidence of positive drain tip culture in patients with SSIs was 63.15% and in patients without SSIs was 24.32% (p=0.0007). There was significant correlation of drain tip culture with wound culture and surgical site infections.

Conclusion - We conclude that abdominal drain tips, after removal, should be routinely sent for microbiological examination in patients undergoing emergency laparotomy specially if the patient develops signs of infection and wound swab culture cannot be obtained or is sterile. Drain tip culture helps in guiding a specific antibiotic in these patients. Abdominal drains are routinely placed in the peritoneal cavity in emergency laparotomy. This study, first of its kind in surgical patients, opens up

the idea of an important use of the abdominal drain “after it has served its desired purpose”. These patients are at higher risk of SSI and drain tip culture helps in dealing with infections in a better way.

Keywords: Abdominal drain, Drain tip culture, Exploratory laparotomy, Perforation peritonitis, Surgical site infection.

Introduction

Infections that occur in a wound created by an invasive surgical procedure are generally referred to as Surgical Site Infections (SSIs). SSIs being third most common nosocomial infections account for a quarter of all nosocomial infections.[1] SSI is one of the most common preventable complication of any surgery. Patients with surgical site infection are more likely to stay in the hospital for a longer duration and have an increased incidence of morbidity and mortality.[2] A septic surgical wound is therefore considered a ‘remarkable expensive luxury’.[3]

The majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th and 10th postoperative days.[4] Determination of risk factors for SSI has been a major focus of surgical research. There are various risk factors associated with SSI such as old age, immuno-compromised state, smoking, alcohol, obesity, malnutrition, diabetes and use of chemotherapeutic drugs.[5]

Inappropriate use of broad spectrum antibiotics or prolonged courses of prophylactic antibiotics has lead to a greater risk of SSI because of development of antibiotic resistant pathogens. Use of appropriate and well-targeted antibiotics is the need of hour to prevent development of resistance. One of the ways to do this is to culture the pathogenic organism, check for sensitivity and use the targeted antibiotic. Microbiological cultures for surgical site infections are usually taken from the wound as a swab, from the sample of pus discharging from the wound and from fluids draining in the surgical drains. Other samples usually taken from a patient with clinical evidence of an ongoing infection are tips of various catheters or lines used in the hospital setup which may be acting as a potential source of infection.

Drains are important in the management of surgical patients. They are appliances that act as a deliberate channel through which established or potential collection of pus, blood or body fluid egress to allow a gradual collapse and apposition of tissues.[6] Abdominal drains, which are usually made up of inert silastic material, are frequently placed in the post-operative period. The aim of this drainage is to reduce the potential source of infection, detect early anastomotic leakage or haemorrhage and to leave a tract for potential collections to drain following removal of these drains. Abdominal drains also help in the prevention of abdominal compartment syndrome. However, these drains themselves are also a potential source of infections; may induce anastomotic leakage and may cause damage by mechanical pressure and suction.[7]

The incidence of superficial and deep surgical site infections is quite high after emergency explorative laparotomies and the peritoneal cavity is routinely drained by abdominal drains in these patients. The aim of this was to know the incidence of positive drain tip cultures in patients undergoing emergency exploratory laparotomy, to assess the clinical evidence of infection in patients with positive and negative tip cultures, and to assess the correlation of drain tip culture and wound culture in patients with surgical site infections.

Material and Methods

The study was conducted in the Department of Surgery, Pt. B.D. Sharma Postgraduate Institute of Medical Sciences, Rohtak in association with the Department of Microbiology, Pt. B.D. Sharma Postgraduate Institute of Medical Sciences, Rohtak. Patients undergoing exploratory laparotomy in emergency setting were included in the study. A total of 75 patients were included in the study.

Inclusion Criteria

1. Patients undergoing exploratory laparotomy after perforation peritonitis.
2. Patients more than 14 years of age.

Exclusion Criteria

1. Patients undergoing exploratory laparotomy for –
   a. Hemoperitoneum.
   b. For reasons other than perforation peritonitis.
2. Patients less than 14 years of age.
3. Patients taking steroids.
4. Patients seropositive for HIV, Hepatitis B, and Hepatitis C.
5. Patients receiving Chemotherapy/radiotherapy.

After detailed history and examination, patients were investigated for nutritional status and routine investigations like Hb, TLC, DLC, blood sugar and blood urea were done. Patients were adequately prepared in the pre-operative period with intravenous fluids and antibiotic prophylaxis with Ceftriaxone, Amikacin and Metronidazole.

In the post-operative period, the patients were observed closely for signs and symptoms suggestive of infection. Daily inspection of the midline wound and drain site was done for any evidence of infection. Two samples from the patients were sent to the Microbiology laboratory within two hours of collection -

1. Wound swab/aspirate.
2. Drain tip - The intra-abdominal drains were removed maintaining all aseptic precautions when the drain output was less than 25cc in 24 hours. The drain tip was cut off approximately 5cm from its intra-cavitory end and immediately sealed in a sterile, disposable container.

Wound swab culture was sent only in patients who developed evidence of SSI on the wound while drain tip culture was sent in all the patients regardless of SSI.

All the aerobic bacterial isolates obtained were subjected to antimicrobial susceptibility testing to a wide range of antimicrobial agents by Kirby-Bauer's disc diffusion method using controls.[8] Initially the patients were managed with antibiotics covering gram positive, gram negative and anaerobic organisms, as per standard protocol (Ceftriaxone + Amikacin + Metronidazole), and after the drain tip culture and sensitivity report was available, the antibiotic was changed, if required.

At the end of the study, the data was collected and analysed statistically by using Chi-square test. A p value of <0.05 was considered as significant.

Results

The following results were observed at the completion of the study:

1. Age

The youngest patient in our study was 15 years and the eldest patient was 75 years old. The mean age for males and females were 36.73 years and 43.4 years respectively with an overall mean age of 40.06 years.

2. Incidence And Type of SSI

Out of the 75 patients, 38 patients developed surgical site infection varying in depth and severity which implies that the incidence of SSI in our study was 50.66%. Seventeen patients (22.66%) were superficial, 11 (14.66%) were deep and 10 (13.33%) were organ space SSI in our study of 75 patients.

3. Duration of Surgery

The risk of SSI was evaluated based on the duration of surgery. In our study, majority of the surgeries took less than three hours with only eight patients undergoing surgery for longer than three hours as shown in table I.

Group	Duration of surgery	No. of cases (n=75)	SSI (n=38)	%
A	<1 hour	6	2	33.33
B	1-2 hours	34	16	47.05
C	2-3 hours	27	15	55.55
D	>3 hours	8	5	62.5

Table I: Duration of surgery and incidence of SSI.

4. Site Of Perforation And The Risk of SSI

Ileal (enteric) perforation was the most common pathology seen followed by peptic perforation of the duodenum. It was observed that incidence of SSI was higher in patients with ileal and colonic perforations compared to other sites as shown in table II.

Site of perforation	Total cases (n=75)	SSI (n=38)	%
Stomach	11	5	45.45
Duodenum	14	4	28.57
Gall Bladder	5	2	40
Jejunum	10	5	50
Ileum	23	17	73.91
Appendix	7	2	28.57
Colon	5	3	60

Table II: Site of perforation and incidence of SSI.

5. Type of Organism Cultured

Out of the 38 patients who developed SSI, cultures from wound swab showed a total of 29 positive reports, four of which were gram positive and 25 were gram negative. Cultures from drain tip in all the 75 patients showed a total of 33 positive reports, out of which six were gram positive and 27 were gram negative organisms as shown in table III and IV.

In both wound swab and drain tip culture, *Escherichia coli* was the most common organism isolated (37.9% and 39.3% respectively) with *Klebsiella* (24.1% and 15.5%), *Pseudomonas* (17.24% and 6.06%), *Staphylococcus aureus* (10.34% and 12.12%) being other common organisms isolated as shown in table III & IV.

	Wound swab culture	Drain Tip culture
Total no. of cultures sent	38	75
Total no. of positive cultures	29 (76.31%)	33 (44%)
Gram Positive	4 (10.52%)	6 (8%)
Gram Negative	25 (65.78%)	27 (36%)
Sterile	9 (23.68%)	42 (56%)

Table III: Class of organism cultured after wound swab culture and drain tip culture.

Organims	Wound swab culture (n=29)	Drain tip culture (n=33)
Escherichia coli	11 (37.9%)	13 (39.39%)
Klebsiella species	7 (24.13%)	5 (15.15%)
Pseudomonas aeruginosa	5 (17.24%)	2 (6.06%)
Acinetobacter	2 (6.89%)	4 (12.12%)
Citrobacter	-	2 (6.06%)
Enterobacter species	1 (3.44%)	1 (3.03%)
Staphylococcus aureus	3 (10.34%)	4 (12.12%)
Enterococcus	-	2 (6.06%)

Table IV: Type of bacterial isolates after wound swab culture and drain tip culture.

6. Drain Tip Culture And Its Correlations

Incidence of Positive Drain tip cultures:

Out of the total 75 patients included in the study, 33 patients had a positive drain tip culture which implies the incidence of positive drain tip culture in our study was 44%.

Drain tip culture and SSI:

When drain tip culture was correlated to SSI, it was found to be positive in 63.15% of patients who developed SSI, and in 24.32% of patients who did not have any evidence of SSI. On statistical analysis, $\chi2 = 11.47$ and $p=0.0007$ which was highly significant. Sensitivity of drain tip culture for SSI was 63.15% while specificity was 75.67% as per table V.

	Drain Tip Culture (n=75)	
	Positive (n=33)	Negative (n=42)
Patients with SSI	24 (63.15%)	14

(n=38)		
Patients without SSI (n=37)	9 (24.32%)	28

Table V: Drain tip culture and SSI.

Type of SSI	Drain Tip Culture	
	Positive (n=24)	Negative (n=14)
Superficial (n=17)	9 (52.9%)	8
Deep (n=11)	7 (63.63%)	4
Organ space (n=10)	8 (80%)	2

Table VI: Types of SSI and incidence of positive drain tip culture.

As shown in Table VI, the incidence of positive drain tip culture increased with severity of SSI and if this relationship is drawn on a line diagram shows a linear relationship between severity of SSI and incidence of positive drain tip culture. On statistical analysis, $\chi 2 = 1.98$ and p=0.371 which was not significant.

Correlation of drain tip culture and wound swab culture:

No. of patients with both wound swab and drain tip cultures positive: 23 patients.

No. of patients with same organism on drain tip and wound swab culture: 17 patients.

No. of patients with different organism of drain tip and wound swab culture: 6 patients.

Seventeen (22.66%) patients in our study had the same organism growth on both wound swab and drain tip culture while only six (8%) patients had different organisms on both the cultures. This result was statistically significant as well (χ^2=6.21 and p=0.01).

No. of patients with only wound swab culture positive: 6 patients.

No. of patients with only drain tip culture positive: 10 patients.

Six patients out of 75 (8%) had only wound swab culture positive while 10 patients (13.33%) had only the drain tip culture positive. Although this result was statistically not significant (χ^2=1.11 and p=0.290).

Discussion

Our study focused on assessment of surgical site infections in patients undergoing emergency exploratory laparotomy, where we used abdominal drains, which are routinely used in these patients, as a potential material to identify any ongoing infection and to culture and isolate the organism responsible for surgical site infection. This type of study had been done previously in various orthopaedic procedures like total hip replacement and spine surgeries, but there were very few references where abdominal drain cultures had been correlated with surgical site infections.

While the global estimates of SSIs are low, studies in India have always shown higher rates of infection. A study by Olson et al, conducted in US over a period of 10 year, documented a rate of infection to be 2.5% while a study in Goa revealed the incidence of post-operative wound infections to be 30.7%.[9&10] A study at AIIMS, India estimated an infection rate of 24.8% and a similar study at Aligarh reported an infection rate of 38.8%.[11&12] It is due to the variation in underlying diseases, differences in clinical procedures and infection control measures.

In our study we encountered surgical site infection in 50.66% of patients. This percentage is significantly higher compared to other studies and it can be attributed to the fact that we have studied SSI incidence in patients of perforation peritonitis while most other studies have been conducted on elective surgical patients. Moreover, ours is a tertiary care referral centre where patients usually present after the disease process has progressed significantly. Due to delayed presentation and gross contamination of the peritoneal cavity, patients in our centre were at a higher risk of SSI.

In our study, the youngest patient was 15 years of age and the eldest patient was 75 years old. Maximum number of patients were in the age group of 31-40 years (22 out of 75) with the mean age of 40.06 years. This result is in concurrence to the clinical spectrum of perforation peritonitis.[13] A study conducted by Chakma et al in Imphal, India on 490 patients of perforation peritonitis, the mean age was 48.28 years which was almost equivalent to the mean age of 49 years found in another study by Singh G et al.[13&14] Majority of the patients in our study were male i.e. 70.66% and the rest were female. The heavy preponderance of males could be attributed to the adverse sex ratio in our state. On comparing the incidence of SSI, we found that incidence of SSI was similar in both the sexes in our study (50.94% in males and 50% in females).

In 1985, Haley et al found that surgeries longer than two hours were predictive of wound infection.[15] In our study we found that the occurrence of SSI proportionately increased with increased duration of surgery. While surgeries which lasted less than one hour had SSI in 33.3%, the incidence of SSI in longer surgeries (>3 hours) was at 62.5%. The difference in SSI with duration of surgery was not significant statistically but the increasing percentage of SSI with duration of surgery was clearly evident in our study.

The perforations of proximal gastrointestinal tract are six times as common as perforations of distal gastrointestinal tract as has been noted in various studies in India.[16] This is in sharp contrast to studies from developed countries like US, Greece and Japan which revealed that distal gastrointestinal tract perforations were more common.[17] Not only the site but the etiological factors also show a wide variation. In a study by Khanna et al from Varanasi, on 204 cases of gastrointestinal perforations, more than half (108 cases) were due to typhoid. They also encountered perforations due to duodenal ulcer (58), appendicitis (9), amoebiasis (8) and tuberculosis (4).[18]

Peptic perforation is the most common cause of perforation peritonitis followed by typhoid ulcer perforations as suggested by Singh et al, Dandapatt et al and Sanjay G et al in their respective studies.[19] The cause of non-traumatic terminal ileal perforations were enteric fever (62%), non-specific inflammation (26%), obstruction (6%), tuberculosis (4%) and radiation enteritis (1%) as reported by Wani et al.[20] In a recent study conducted in our institute, on patients with ileal perforations, typhoid accounted for 42% perforations, tuberculosis was seen in 20%, trauma in 14% and rest 24% were non-specific causes.[21]

In our study, results were similar with peptic ulcer perforation being the most common perforation encountered (33.33%). The second most common site of perforation was ileum (30.66%). In patients with ileal perforations, in our study, the most common cause was identified to be enteric fever (56.52%), followed by tuberculosis (21.7%) and trauma (13.04%) while the rest were nonspecific causes. This result was in concurrence with various studies mentioned above.

Although there is no comparable relation between different sites of gastrointestinal perforation and incidence of SSI as all the surgical wounds in cases of perforation peritonitis are classified as dirty wounds but in our study we found that there was a higher incidence of SSI in patients with ileal or colonic perforations (89.4% and 100% respectively).

Though earlier studies incriminate *Staphylococcus aureus* as the most common organism, the increasing role of gram negative bacilli in the etiology of nosocomial infections has been emphasised in research throughout the world. Few recent studies by Compte et al in Mexico, Kamat el al in India revealed gram negative bacteria (*Escherichia coli* most commonly) as the frequent isolates.[10&22] In a Swedish study, among the bacteria isolated, gram negative bacilli (31%) and *Staphylococcus aureus* predominated.[23] In Indian study by SA Khan et al, Escherichia coli was the most common pathogen found (25%), followed by *Pseudomonas aeruginosa* (20.83%)

and coagulase-positive *Staphylococcus* (19.04%) in general surgical setup.[24]

In our study, out of the 29 positive wound swab cultures, 25 (65.78%) were gram negative and out of the 33 positive drain tip cultures, 27 (36%) were gram negative organisms. These results are in concurrence with the literature of SSI and also relate to the increase in gram negative bacteria causing SSI in recent years.

After incubation organism growth was identified. On wound swab culture, *Escherichia coli* and *Klebsiella* were the most common organism isolated (37.9% and 24.13% respectively), followed by *Pseudomonas* (17.24%) and *Staphylococcus aureus* (10.34%). The other organisms isolated were *Acinetobacter* and *Enterobacter* species.

Drain tip culture isolates correlated with wound swab culture with *Escherichia coli* (39.39%) and *Klebsiella* (15.15%) being the two most common isolates followed by *Staphylococcus aureus* (12.12%) and *Acinetobacter* (12.12%). Other isolates on Drain tip culture were *Pseudomonas, Citrobacter* and *Enterococcus.*

Out of the 75 patients in our study, 33 patients had a positive drain tip culture when the drain was removed and sent for microbiological examination. So we can say that the incidence of positive drain tip culture in our study was 44%. This incidence was significantly high as compared to the previous studies in orthopaedic procedures. For instance, the study by Sorensen TS revealed the incidence of positive drain tip culture to be only 11.4%.[5]

When we compared the patients with surgical site infection and patients without surgical site infection we found, in our study, that incidence of a positive drain tip culture was 63.15% in patients with SSI and 24.31% in patients without SSI. This relation was statistically highly significant (p=0.0007) and implies that drain tip acts as a good indicator of SSI and incidence of a positive drain tip culture increases in the presence of surgical site infections. Sensitivity of drain tip culture as an indicator of SSI was 63.15% while specificity was calculated to be 75.67% in our study.

On comparing the 'type of SSI' and drain tip cultures, we found that the incidence of positive drain tip culture increased as the severity/depth of infection increased as patients with organ/space SSI showing positive cultures to be 80% compared to 63.63% in deep SSI and 52.9% in superficial SSI. This leads us to believe that rate of positive drain tip culture increases with degree of SSI. Though this relation was found to be statistically not significant (p=0.371)

The above analysis signifies that drain tip culture helps us in diagnosing the presence or absence surgical site infection in a particular patient, but it not too reliable when it comes to grading the severity of infection and a positive drain tip culture does not mean that the patient has, or will have, a higher degree of SSI.

Correlation of Drain tip culture and wound swab culture

When we compared the wound swab culture and drain tip culture, we found that the number of positive drain tip cultures was more (33) than positive wound swab cultures (29). This does not mean that drain tip cultures will be positive and more compared to wound swab cultures in all patients with SSI as both the incidences were not statistically comparable. But it gives us good evidence that drain tip culture is a potential investigation to find out the organism causing SSI and may be used for an ongoing organ/space SSI before, or if there is no, superficial evidence of infection.

When we compared the number of patients who had the same organism on both the culture reports (17) and patients who had different organism on both the cultures (6), the result was found to be statistically significant (p=0.01). So we can infer that there was a significant correlation between drain tip culture and wound swab culture in our study.

Six patients out of 75 (8%) had only wound swab culture positive while 10 patients (13.33%) had only the drain tip culture positive. Although this result was statistically not significant (χ^2=1.11 and p=0.290), but it signifies that if the wound swab culture is sterile and patient has signs of infection, there is a possibility of the drain tip culture being positive and may help us in identifying the causative organism.

From the above correlations, it becomes clear that both wound swab and drain tip cultures significantly correlate to each other and either of them can be used to identify the causative organism in patients with surgical site infections. Wound swab culture is an established routine investigation done in patients with surgical site infections. It can be taken as soon as the patients develops discharge on the wound. On the other hand, to obtain the drain tip culture we need to wait till the drain has served its desired purpose i.e. to drain the post-operative collection of blood, pus and other body fluids, which leads to delay in adequate treatment.

So we can say that wound swab culture is the ideal investigation to identify the causative organism in surgical site infections. If we can obtain the swab for culture and sensitivity from the wound, then the relevance of drain tip culture is not too much. But in patients who develop signs of infection and the wound swab culture cannot be obtained or is sterile, the drain tip culture is a useful investigation and may help us in identifying the organism before, or even without, any external manifestation of an ongoing infection.

Conclusion

From our study we conclude that drains are a useful asset in patients undergoing exploratory laparotomy which should not be overlooked. Drain tips should be sent for microbiological examination which helps us in identifying the causative organism and guide a specific antibiotic. Since the organism isolated on wound swab and drain tip correlate in majority of the cases, wound swab culture is ideal to isolate the causative organism but if the infection does not manifest externally or the wound swab culture is negative, drain tip culture should be used to guide the antibiotic.

All the results of our study may not be statistically conclusive but this study, first of its kind in surgical patients, opens up the idea of an important use of the drain "after it has served its desired purpose" and more research on this topic in the coming years may help us in dealing with surgical site infections in a better way.

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