A Comparative Study Of Efficacy Of Pre And Post Debridement Cultures In Open Fractures

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Abstract

Objective: To compare the efficacy of pre and post debridement cultures in open fractures Methods: In 100 patients with open fractures a pre and a post debridement culture were taken. Results of pre and post-debridement cultures with respect to respective organism and the percentage of wound ultimately infected with respect to the culture report were compiled. Results: Post debridement cultures showed a sensitivity of 70% and a Specificity of 55% as compared to pre debridement cultures which showed a sensitivity of 64% and a specificity of 24% ultimately led to infection. Conclusion: The use of postdebridement culture reports have better prognostic value than perioperative cultures in predicting the incidence of infection as well as the infecting organisms in open fractures .

INTRODUCTION

Open fractures are complex injuries that involve both bones and the surrounding tissues. By breaking the skin, an open fracture eliminates one of the major barriers to infection. Bacterial contamination has been shown to occur in upto 70% of open fracture wounds. Transition of these bacteria from mere contaminants to pathogens depends upon the host factors and the virulence of bacteria. The treatment of open fracture wound is actually an exercise in applied microbiology

It is required to define the role of pre-debridement and post-debridement bacterial cultures of open fractures for development of an objective criterion for: -

MATERIAL AND METHODS

A prospective study of one hundred cases of open fractures of long bones was conducted at in order to assess the efficacy of bacterial cultures in the management of open fractures. The subjects included cases admitted with open fractures ranging from Grade I to Grade IIIC of Gustilo and Anderson classification .

The protocol for initial management of open fracture included a swab culture of the wound at the time of admission to the casualty. Application of sterile dressing and immediate splintage of the extremity during the initial resuscitation of the patient was done. Intravenous antibiotics were begun immediately starting with a cephalosporin and an amino glycoside, which was augmented with metronidazole depending upon the history and classification of the wound.

The patients were taken to the operation theatre for debridement and lavage as soon as possible. Before application of post operative dressing, a piece of muscle from the wound was sent for post-debridement culture. The same laboratory performed organism identification and antimicrobial susceptibility testing on each isolate. Most of the wounds were closed by secondary intention or delayed primary intention after a clean wound was achieved by repeated irrigation and debridement. Rests of the wounds were closed by a coverage procedure such as split skin grafting or a rotational flap. Wound infection was suspected by the presence of one of the following clinical signs and symptoms: fever, erythema, pain and/or tenderness, swelling and discharge from the wound. The cases in which infection occurred, deep cultures of wound or soft tissues were obtained to determining the infecting organism.

Data was compiled and the infection rate concerning the type of fracture was recorded. Results of pre-debridement cultures with respect to respective organism and the percentage of wound ultimately infected with respect to the culture report were compiled. Post-debridement culture reports regarding the percentage of infected and the infective organism was also recorded. Fracture union was not taken as a criteria and only early infections suspected by the above

said signs and symptoms were considered. The mode of injury and the site of fracture and their effect on the development on infection were observed. Presence of chronic medical illnesses and history of smoking, alcoholism and other drug abuse was also recorded.

The relevance of perioperative cultures and emergence of infective microorganisms was analyzed and compared for statistical reporting of the results.

RESULTS

Out of one hundred patients with open fractures, majority of the patients (60%) belonged to the age group of 20-40 years. Probably, this is due to more frequent involvement in outdoor activities and road traffic accidents Thirty five percent of the patients were in the age group of 21-30 yrs. Patients in the age group less than 20yrs and more than 50 yrs constituted only about one-fourth of the total number. The incidence among males was about 13 times higher than females. There were 93 males and 7 female patients. This is because males are frequently engaged in outdoor activities and professions.

Most of the open fractures were sustained in road side accidents and nearly four-fifth of cases accounted for this mode of injury. Other causes included assault in eight patients, occupational injuries in six patients and fall from height in two patients. So high energy trauma is the most common mode of injury

Lower limbs were more frequently involved in accidents to sustain open fractures. The incidence of open fractures of lower limbs in our series were 73% as compared to the upper limb open fractures which comprised of 27%.

Only six percent of the patients had associated diseases like diabetes and ischaemic heart disease, which could have an effect on the wound as well as fracture healing. This can be correlated to the fact that most of the patients in this series were from younger age group and these diseases are more common in elderly. Six patients had associated diseases out which four had diabetes and one had history of ischaemic heart disease and one suffered from diabetes as well as hypertension. Of the six patients with associated systemic diseases, three patients i.e. half of them developed infection. This 50 % rate of infection was well above the overall incidence of infection in open fractures which was 28%. Although the number of patients with associated diseases are small and the findings not ofmuch significance, these patients are more likely to develop complications like infection and need special care.

Almost one-third of patients in our study were part of polytrauma i.e. they had associated injuries along with open fractures. Associated injuries included orthopedic as well as other injuries like head or chest trauma which had their impact on healing of open fractures and development of infection. In our study, out of one hundred patients, thirty-seven had associated injuries while sixty- three had isolated open fractures. This pattern resembles the one presented by Gustilo et al.

Regarding the distribution of open fractures in our study, the incidence of Grade III fractures was 63% with further distribution:- Grade IIIA =15%:

Grade IIIB =35%; Grade IIIC =13%.The incidence of Grade II fractures was 25% while that of Grade I fractures was a meager 12%.

Out of 100 predebridement cultures done in the emergency department on the arrival of patient, one-fourth of the cultures came out to be positive and out of these 25 positive cultures, five grew more than one organism. As regards post debridement cultures which were taken in the operation theatre immediately after the debridement of open wounds, thirty four out 100 patients had positive cultures and 7 grew multiple organisms.

The overall infection rate of open fractures was 28% in this study. Of these 28 patients, only 4 grew multiple organisms which comes out to be one in every seven patients.

All the organisms found in pre debridement culture reports were Gram-negative. Pseudomonas was the commonest bacteria to grow in pre debridement cultures with 9 cultures, closely followed by E.coli (7times). Acinetobactor, Enterobactor, Klabsella were present 4 times each and Citrobactor and staphylococcus were present once each. Five pre debridement cultures had multiple organisms.

The pathological bacterial floral pattern was similar in both pre and post debridement cultures. It was dominated by gram-negative bacteria. E.coli was the commonest bacteria to grow in post debridement cultures with 12 cultures, closely followed by pseudomonas (10times). Acinetobactor was present 7 times while Enterobactor, Klebsiella and Citrobactor grew 2 times each. Streptococcus was also common with 4 cultures and Proteus with Staphylococcus once each.

Only one compound grade I patient out of 12 had positive culture in all the parameters i.e pre debridement, post debridement and infection cultures. So, compound grade I fractures have a low infectivity (8.3%) as compared to the overall rate (28%).

Compound grade II fractures had infection rate of 12% (3 out of 25 fractures) which is also on the lower side as compared to the overall rate of 28%.

While there was no positive pre debridement culture in grade II fractures, there were four post debridement cultures and three patients out of 25 got infected.

Acinetobactor was the most common infecting organism in this grade.

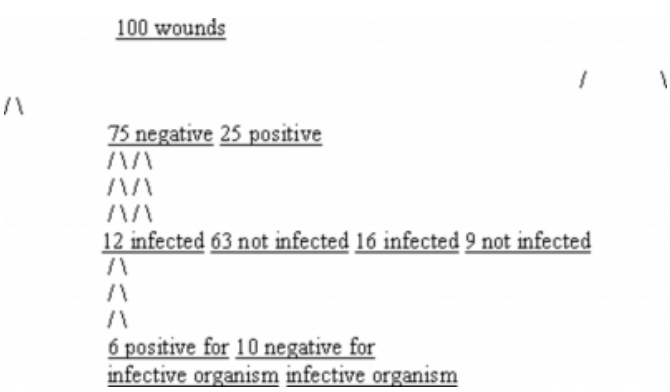
Compound grade IIIA group had 15 patients out of which 6 (40%) got infected. The most common infecting organisms were E. coli and Acinetobactor. Six patients had positive pre debridement and seven had positive post debridement cultures and in both the groups the most common pathogen was E. coli. In grade IIIB fractures, 12 (34.3%) patients got infected out of with Pseudomonas closely followed by E. coli. Again E. coli was encountered the most in both the pre debridement and post debridement cultures.

In grade IIIC fractures, 6 of the 13 patients got infected and the infection ratewas 46.2% which was as expected far higher than the overall rate of 28%. E. coli was again the main culprit. In general, gram-negative bacteria commonly E. coli and Pseudomonas were found to be the commonest organisms not only in causing infection in open fractures but also in the pre debridement and the post debridement culture reports.

Twelve patients of the total 28 who ultimately got infected had an initial negative pre debridement culture. So, as far as the pre debridement cultures are concerned, 64% of the positive pre debridement cultures ultimately led to infection but only 24% of them grew the same organism in the infected wounds which was present in the pre debridement cultures. About 43% of the patients who ultimately got infected had negative pre debridement cultures at admission.

PREDEBRIDEMENT CULTURE RESULTS

Figure 1



In contrast, the results of post debridement cultures proved that they are not only sensitive but are also more specific than the pre debridement cultures are concerned. Thirty four of the 100 post debridement cultures done were positive and 7 of them grew multiple organisms. So, the rate of multiple organisms in post debridement cultures i.e. about one out of every fifth culture is almost same as that of pre debridement cultures. But, out of 34 positive post debridement cultures, 24 of them ultimately led to infection as compared to only 16 patients out of 25 with positive pre debridement cultures. Nineteen patients of the 34 with positive post debridement cultures grew the same organism in the infected wound as compared to a mere 6 patients in the pre debridement culture group out of total of 25. Only four patients of the total 28 infected had a negative post debridement culture in contrast with 12 patients out of 28 infected with negative predebridement culture.

POSTDEBRIDEMENT CULTURE RESULTS

Figure 2

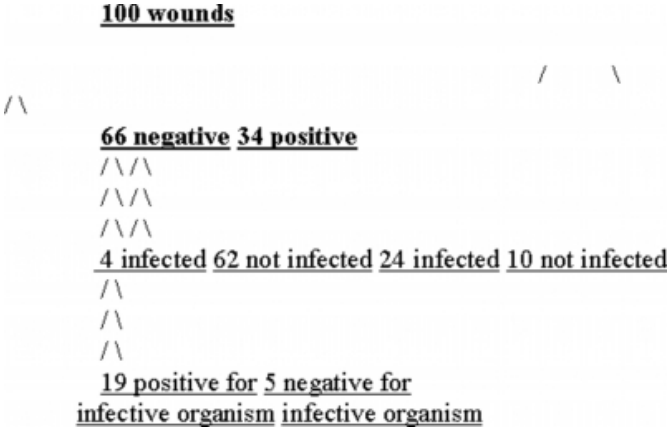


Figure 3

$ No.	LI	AI	AD	Grade	Pre debridement culture	Post debridement culture	Infection culture
1	LL	A	A	IIIB			
2	LL	P	A	IIIB			Pseudomonas
3	LL	A	A	IIIC		Strep. Faecalis	
4	LL	P	A	IIIB			
5	LL	A	A	IIIB		Pseudomonas	
6	LL	P	A	IIIB		Pseudomonas ; E. coli	E. coli
7	UL	A	HTN	IIIC	E. coli		E. coli
8	LL	A	A	IIIB	Acinetobactor	Acinetobactor	Acinetobactor
9	UL	A	A	II			
10	LL	A	A	I			
11	LL	P	A	IIIB		E. coli	
12	LL	A	A	IIIA			
13	UL	A	A	I			
14	LL	A	A	IIIB			
15	LL	P	A	I			
16	LL	P	A	IIIB			
17	LL	A	A	II			
18	LL	A	A	IIIA	E. coli		
19	LL	A	A	IIIA	Pseudomonas ; Citrobactor	E. coli	E. coli Acinetobactor
20	LL	P	DM	IIIB	Enterobactor	E. coli Acinetobactor	E. coli Acinetobactor
21	LL	P	A	IIIB	Enterobactor	Pseudomonas	Pseudomonas E. coli
22	UL	A	A	IIIA	E. coli		
23	UL	A	A	IIIA	Pseudomonas Staphylococcus		
24	LL	P	A	IIIB			
25	LL	A	A	II			
26	LL	P	A	II			
27	LL	P	A	IIIA		E. coli	
28	LL	P	A	IIIA		Pseudomonas	Pseudomonas
29	LL	A	A	IIIA			
30	UL	P	A	II		Acinetobactor	Acinetobactor
31	LL	A	A	I	Klabsella	Proteu Mirabilis	Enterobactor
32	LL	P	A	IIIB			
33	UL	P	A	IIIC			
34	UL	A	A	IIIA	Acinetobactor		
$ No..	**LI**			**Grade**	**Pre Debridement culture**	**Post Debridement Culture**	**Infection Culture**
35	LL	P	DM	IIIB	E. coli Pseudomonas	E. coli Acinetobactor	E. coli
36	LL	P	A	IIIB	Acinetobactor E. coli	Pseudomonas	Pseudomonas
37	LL	A	A	IIIB			
38	LL	P	A	II			
39	LL	P	A	II		Acinetobactor Pseudomonas	Acinetobactor
40	LL	A	A	I			
41	LL	A	A	IIIC	Pseudomonas		
42	UL	A	A	IIIC			
43	UL	A	A	II			
44	UL	A	A	IIIB	Klabsella		
45	LL	P	A	I			
46	UL	P	A	IIIB			
47	UL	A	A	IIIB		Citrobactor	Pseudomonas
48	UL	A	DM, HTN	II			
49	LL	A	A	II			
50	LL	A	A	II			
51	LL	A	A	IIIC	Klabsella	Klabsella Pseudomonas	Enterobactor
52	LL	P	A	II			
53	LL	A	A	I			
54	UL	A	A	II			
55	LL	A	A	IIIA	E. coli	E. coli	E. coli
56	UL	P	A	I			
57	LL	A	A	I			
58	LL	P	A	IIIB	Pseudomonas	Pseudomonas	
59	LL	A	A	I			
60	LL	A	A	II			Klabsella
61	UL	A	A	IIIB			
62	UL	A	A	IIIC	Pseudomonas	Streptococcus	Pseudomonas
63	LL	P	A	I			
64	UL	P	A	II			
65	LL	A	A	IIIB	Enterobactor	E. coli	E. coli
66	LL	P	DM	II			
67	LL	P	A	II			
68	LL	A	A	IIIC			
69	UL	A	A	IIIC			
70	LL	A	A	IIIB	Enterobactor		
71	LL	P	A	II			
$ No..	**LI**	**AI**	**AD**	**Grade**	**Pre Debridement culture**	**Post Debridement Culture**	**Infection Culture**
72	LL	A	A	IIIB			
73	UL	A	A	IIIB			
74	UL	A	A	IIIC	Pseudomonas	Citrobactor	Acinetobactor
75	LL	A	A	IIIA			
76	LL	P	A	IIIB		Pseudomonas Klabsella	Pseudomonas
77	UL	A	A	IIIB			
78	LL	A	A	IIIA		Enterobactor	Enterobactor E. coli
79	LL	A	DM	IIIB		E. coli	
80	UL	P	A	II			
81	LL	A	A	II		Enterobactor	
82	LL	A	A	II			
83	LL	P	A	IIIA			Enterobactor
84	LL	A	DM	IIIB	Klabsella		
85	LL	A	A	II		Streptococcus	
86	LL	A	A	IIIB			
87	LL	P	A	IIIA		E. coli	
88	UL	P	A	IIIC		E. coli	E. coli
89	UL	A	A	IIIB	Pseudomonas	Pseudomonas Acinetobactor	Pseudomonas
90	UL	A	A	IIIB	E. coli Pseudomonas	Acinetobactor	Acinetobactor
91	LL	A	A	IIIB			
92	LL	A	A	II			
93	LL	A	A	IIIB	Acinetobactor	E. coli	
94	LL	A	A	IIIC		Streptococcus	Streptococcus
95	LL	A	A	IIIC			
96	LL	P	A	II			
97	LL	A	A	I			
98	LL	P	A	IIIB			
99	LL	P	A	IIIA		Staphylococcus	Staphylococcus
100	LL	A	A	II			

LI- Limbs involved ; LL – Lower limb ; UL – Upper limb DOA-Date of admission ; MOI-Mode of injury

AI-Associated disease ; AD-Associated injury

DISCUSSION

An open fracture is one in which bone ends have penetrated throughthe skin and there is injury to the underlying soft tissues of varying severity. Prevention of wound sepsis, healing of the fracture and a return to optimum function are challenging goals for the treating surgeon. The initial treatment of the patient in general and the fracture in particular often determines the final outcome of the injury as to life, residual disability and functional results of the involved extremity.

Lee J[1], in 1997, retrospectively reviewed two hundred forty-five open fractures to determine the prognostic value of wound bacterial cultures concerning deep infections requiring surgical management. The results of pre debridement cultures showed 119 positive cultures out of total of 225 patients which comes out to be about 53%. Whereas, in our study only 25% of the pre debridement cultures were positive and out of these positive cultures, 20% grew multiple organisms as compared to 50% rate of multiple organisms in the study by Lee et al. Regarding post debridement cultures, 118 out of 225 i.e. 52.5% were positive in Lee's study while in our study 34% of the cases had positive post debridement cultures. In a similar article by Faisham WI et al[2]

39.3% of predebridement cultures and 24.2% of post debridement cultureswere positive. Valenziano CP et al[3] came out with 24% incidence of positive pre debridement cultures which is similar to our study.

In our study out of 25 positive pre debridement cultures, majority of cultures were positive in the compound grade III fractures (24 out of 63 patients) i.e. 38% of grade III fractures had positive pre debridement cultures and there was no positive pre debridement culture in grade II open fracture. Only one patient had positive pre debridement culture in grade I open fractures. Among the grade III fractures, grade IIIA had 40% of positive pre debridement cultures (6 out of 15 cultures were positive) while those in grade IIIB (13 out of 35) and grade IIIC (5 out of 13) had similar percentage of 37% and 38% respectively. Hence, whether it was grade IIIA, IIIB or IIIC the rate of positivity of pre debridement cultures was far higher than grade II or grade I fractures.

The predominance of gram-negative bacteria in pre debridement, post debridement cultures and in cultures in infected open fractures suggests three points : --

The changing trend of bacterial pathogens infecting compound fractures from earlier being gram-positive to gram-negative.

Evolution of hospital acquired pathogens, which are predominantly gram- negative, being the ultimate cause of infections.

Failure of current antibiotics to tame the gram-negative bacteria.

In our study, 25 out of the 100 initial pre debridement cultures done, grew one or more organism. Out of these 25 positive pre debridement cultures, five patients (20%) grew multiple organisms. As Robinsonet al[4] termed the organisms grown in pre debridement cultures as contaminants, similarly in our study almost one- fifth of the patients at the time of presentation had multiple organisms in their wounds

If the pre debridement and post debridement cultures are to be compared with regards to sensitivity and specificity in compound fractures, post debridement cultures are far more reliable as per our study. Post debridement cultures are more sensitive. 70% of the positive post debridement cultures got infected while only 64% of the positive pre debridement cultures ultimately led to infection. Also, if about 43% of the patients who ultimately got infected had negative pre debridement cultures at admission, only 14% patients of the total 28 infected had a negative post debridement culture.

This clearly favours that post debridement culture reports are more sensitive than the pre debridement ones in predicting the probability whether an open fracture will ultimately be infected or not.

If the specificity of both pre debridement and post debridement culture reports is taken into account, again post debridement cultures are more reliable.

While only 24% of the organisms grown on pre debridement cultures ultimately caused infection, in contrast, more than the double percentage of patients, 55% had the same infecting organism which was present in the post debridement culture. In contrast to studies done by Kreder HJ etal[5] and D'Souza etal[6] which show pre debridement cultures to be more specific it is the post debridement cultures which are more specific in our study in predicting the type of organism ultimately leading to infection.

Our study of one hundred open fractures supports as in study done by ValenzianoCPetal[3]facts that bacterial cultures are of

limited use in predicting the incidence as well as the infecting organisms. If done it is the post debridement culture reports which have some prognostic value.

CONCLUSION

Clearly, the use of perioperative cultures must be questioned as these are of limited use in predicting the incidence of infection as well as the infecting organisms in open fractures, nevertheless, if done it is the post debridement culture reports which have some prognostic value.

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