

A Comparative Study of Bacteriological Culture Results Using Swab and Tissue in Open Fractures: A Pilot Study

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Learning Point of the Article:

Role and ideal technique of bacteriological culture in acute open fractures.

Abstract

Introduction: The role of perioperative cultures to identify infection in open fractures has been doubtful. The method of sampling for cultures in open fractures includes swab or tissue collection. However, the efficacy of either of these two techniques has not been compared in the setting of an acute open fracture. We conducted a study to compare the bacteriological culture results between the two techniques.

Methodology: A pilot study was done at our institution, where all type 2, 3A, and 3B open fractures admitted in the emergency and operated for debridement and stabilization were included in the study. Intraoperatively, after debridement of the wound, swab and tissue specimens were collected and sent to the same laboratory. The results of the cultures were then collected for comparison after the necessary incubation period. Follow-up of outpatient records was also done to see its clinical significance.

Results: A total of 30 samples of swab and tissue cultures collected post-debridement of acute open fractures in the operation theater were studied. Only 13 samples grew an organism either in swab/tissue culture or both. Nine tissue samples and eight swab samples showed growth. In four cases, both swab and tissue showed growth, but the same organism grew in only one instance. The other three cases showing growth in both tissue and swab had different organisms. Statistically, the kappa coefficient was found to be 0.26 and the agreement between swab and tissue culture was found fair. However, the kappa did not account for the species of the organisms. Tissue samples showed more number of specific organism growing in them, compared to swab culture samples.

Conclusion: The ideal technique of taking samples for culture in acute open fractures is uncertain. Tissue culture may be better in isolating specific organisms in an acute open fracture wound. However, it is uncertain if the same organism may cause infection.

Keywords: Open fractures, swab culture, tissue culture, infection.

Introduction

Infection poses a serious problem in the management and outcome of open fractures [1]. The role of perioperative cultures to identify infection in open fractures has been doubtful [2, 3]. The method of sampling for cultures includes swab or tissue collection. Studies have previously compared swab cultures at different stages - pre-debridement and post-debridement [3, 4, 5, 6, 7, 8]. Post-debridement cultures have been found to be more reliable compared to pre-debridement cultures in identifying the infecting organism and resulting

infection [4, 5, 8, 9]. The efficacy of either of these two techniques when done at the post-debridement stage of an acute open fracture has probably not been studied so far. We conducted a pilot study to compare the bacteriological culture results between the two techniques - swab and tissue culture in acute open fracture wounds.

Aim

This study aims to compare the bacteriological results using swab and tissue in acute open fractures.

Access this article online

Website:
www.jocr.co.in

DOI:
2250-0685.1296

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Swab result	Tissue result	Follow - up
MRSA	No growth	Nil growth
Skin commensals	No growth	Nil growth
Environmental contaminants	No growth	Nil growth
No growth	Skin commensals	Staph. aureus
Skin commensals	Enterococcus	Trichosporon
No growth	Non-fermenting GNB	Non-fermenting GNB
Aeromonas	Envt. contaminants	Nil growth
Enterococcus	Enterococcus	Nil growth
No growth	Coag.-negative Staph. aureus	Not available
No growth	Coag.-negative Staph. aureus	Skin commensals
No growth	Enterococcus	Nil growth
Environmental contaminants	<i>E. coli</i>	Not available
Skin commensals	No growth	Pseud. aeruginosa

Methodology

This is a prospective study done at our institution between April 2017 and April 2018. Before the beginning of the study, the institutional ethical clearance was obtained to conduct a pilot study to compare between swab and tissue cultures in acute open fracture wounds. Following the results of which a larger size sample was to be studied, after the initial sample size of 30.

	n=30	Frequency (%)	
Gender			
Female	8	(28.57)	
Male	20	(71.43)	
Mechanism			
RTA	19	(63.3)	
Workplace injury	8	(26.7)	
Fall	3	(10)	
Type of open fracture			
Type 2	19	(63.3)	
Type 3A	6	(20)	
Type 3B	5	(16.7)	
Swab culture			
Negative	22	(73.3)	
Positive	8	(26.7)	
Tissue culture			
Negative	21	(70)	
Positive	9	(30)	
Swab growth			
Skin commensals	3	(37.5)	
Environmental contaminants	2	(25)	
Specific organism	3	(37.5)	
Tissue growth			
Skin commensals	1	(11.1)	
Environmental contaminants	1	(11.1)	
Specific organism	7	(77.8)	
Time (all cases)	Mean±SD		
Time to hospital (H)	4.79±0.88		
Time to surgery (H)	18.85±2.82		
Time to sample collection (H)	19.86±2.83		
Time (growth and no growth cases)	Growth group (Median±Interquartile range)	No growth group (Median±Interquartile range)	Pvalue*
Time to reach hospital (H)	1.25 (1-7.25)	5 (2-6.5)	0.38
Time to reach operation theater (H)	13.5 (10-20.5)	14.5 (11.8-25.8)	0.46
Time to sampling (H)	14.5 (10.5-21.4)	15 (12.7-26.8)	0.39

*Mann-Whitney U-test: P>0.05

The inclusion criteria were all type 2, 3A, and 3B open fractures admitted in the emergency and operated for debridement and stabilization. Patients with type 1 and type 3C fractures were excluded in the study. Early wound wash and splinting were done in emergency followed by anti-tetanus prophylaxis and administration of injectable cephalosporin, aminoglycoside, and metronidazole. The patients were then taken for emergency debridement of the wound and definitive or temporary stabilization, as planned preoperatively. Intraoperatively, after debridement of the wound, swab and tissue specimens were collected and sent to the same laboratory. The swab was collected using Levine's technique, and for tissue sample, a piece of muscle from the central deep part of the wound was taken. The time taken to reach hospital following fracture, time taken to begin operative debridement, and time taken for sample collection were noted. The results of the cultures were then collected for comparison after the necessary incubation period. The outpatient records of the study group were then reviewed for information on wound status, infection, and subsequent culture growth if any.

Results

A total of 30 open fractures were included in the study (Table 1). There were 28 patients, with two patients presenting with two open fracture wounds at different sites at the same time. The most common mechanism of injury was road traffic accident (63.3%) followed by workplace injury (26.7%) and fall (10%). Type 2 open fractures were the majority in the study (63.3%) followed by type 3A (20%) and 3B (16.7%). 30 samples of swab and tissue cultures collected post-debridement in the operation theater were studied. Only 13 samples grew an organism either in swab/tissue culture or both (Table 2). Nine tissue samples and eight swab samples showed growth. In four cases, both swab and tissue showed growth, but the same organism grew in only one instance. The other three cases showing growth in both tissue and swab had different organisms. Of 23 patients showing

Swab result	Tissue result	Follow-up
MRSA	No growth	Nil growth
Skin commensals	No growth	Nil growth
Environmental contaminants	No growth	Nil growth
No growth	Skin commensals	<i>S. aureus</i>
Skin commensals	Enterococcus	Trichosporon
No growth	Non-fermenting GNB	Non-fermenting GNB
Aeromonas	Environmental contamination	Nil growth
Enterococcus	Enterococcus	Nil growth
No growth	Coag.-negative <i>S. aureus</i>	Not available
No growth	Coag.-negative <i>S. aureus</i>	Skin commensals
No growth	Enterococcus	Nil growth
Environmental contaminants	<i>E. coli</i>	Not available
Skin commensals	No growth	<i>P. aeruginosa</i>

Coag.-negative *S. aureus* : Coagulase-negative *S. aureus* , *P. aeruginosa* : *Pseudomonas aeruginosa* , *E. coli* : *Escherichia coli* , GNB: Gram-negative bacilli, MRSA: Methicillin-resistant *S. aureus*, *S. aureus*: *Staphylococcus aureus*



Table 3: Swab culture versus tissue culture				
Swab	Tissue		Total	
	Negative	Positive		
Negative	17	5	22	
Positive	4	4	8	
Total	21	9	30	
Kappa coefficient 0.26, SE 0.182. The agreement between swab culture and tissue culture is fair				
	Specific organism	Others	Others	Total
Swab	3	5	5	8
Tissue	7	2	2	9
Total	10	7	7	17
Fisher's exact test: P= 0.15				

no growth in swab reports, 18 did not have any growth according to tissue. Statistically, based on if growth was seen or not in swab and tissue culture, the kappa coefficient was found to be 0.26 and the agreement between swab and tissue culture was found fair (Table 3). However, the kappa did not account for the species of the organisms, which were different in swab and tissue cultures. Both swab and tissue cultures showed skin commensals (Table 1). The number of environmental contaminants was two in the swab group and one in the tissue group (Table 1). A specific organism was seen in three cases of swab culture, while seven were seen in tissue culture cases. Tissue samples showed more number of specific organism growing in them, compared to swab culture samples, although it was not statistically significant ($P= 0.15$:Table 3). The time taken to reach hospital following fracture, time taken to begin operative debridement, and time taken for sample collection were noted, in both groups showing growth and no growth. There was no statistical difference between the two groups, probably due to the small sample size of our study. Follow-up records of all the cases were seen to check if any signs of infection or discharge from wound site were detected subsequently. Of 13 cases that grew an organism in either swab or tissue or both, two patients were lost to follow-up. The remaining 10 patients who had initial growth in swab/tissue or both, follow-up in five of them had a growth of organism from the wound at a later date. Except for one patient who grew the same organism as before, the growth isolate in the rest of the patients was different from what was grown initially. Only one patient, who had no growth initially both in swab and tissue, showed growth from culture at wound site discharge, detected at 3-week follow-up.

Discussion

Isolation of bacterial growth in wounds is a commonly followed procedure. However, its efficacy and the ideal technique to isolate bacteria are not yet fully understood. Tissue biopsies are preferred in chronically infected diabetic wounds [10] and found even more reliable when associated with osteomyelitis

[11]. Studies have shown superiority of intraoperative tissue biopsy samples for bacterial culture in prosthetic joint infections [12] and infected pressure sores of spinal cord injury cases [13]. In cases of implantable cardiac device infection, studies have shown patients with clinical infection, having positive cultures more frequently by pocket tissue culture than by swab culture [14]. Sepsis in patients with burns was also found to be better correlated to quantitative burn tissue biopsy cultures than surface swab cultures [15]. Our study shows that tissue culture technique may be better in identifying a specific organism. However, its clinical significance could not be established as the same organism is not seen to be mostly grown subsequently, if infection arises. Studies previously have compared pre-debridement swabs and post-debridement tissue cultures, where the latter have been more predictive about subsequent infection [3, 8]. The correlation of post-debridement cultures with subsequent infection rates has been attributed to the possibility of hospital-acquired infections playing a role [9, 16]. Therefore, in this setting, we collected swab and tissue culture samples post-debridement of the open fracture wound in the operation theater. Our results show fair agreement between swab and tissue cultures in terms of growth seen, but dissimilar organisms on most occasions. The follow-up in five cases which showed a growth eventually did not correlate with the initial growth in four cases. This is in agreement with other studies, where initial cultures in open extremity injuries were not the same organisms that eventually led to wound infections [4, 17]. This is our preliminary findings of the pilot study comparing swab and tissue cultures in acute open fractures. We are continuing the study, to include larger sample size and see the results of it. Limitations of the study include lack of longer follow-up and small sample size, as this represents results of the pilot study. The study further with a larger sample size and other variables such as mechanism of injury, longer follow-up, time taken to reach hospital, time taken to surgical debridement, and time taken for sample collection, should give an insight into the role of wound cultures and the best technique to employ between the two.

Conclusion

The ideal technique of taking samples for culture in acute open fractures is still not yet established. Tissue culture may be better in isolating specific organisms in an acute open fracture wound. However, it is not certain whether the organisms isolated at the post-debridement stage will be the same organism to cause infection subsequently at the wound site.

Clinical Message

The ideal technique of obtaining wound cultures in acute open fractures is still not certain, while tissue cultures may be useful in identifying specific organisms.

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Conflict of Interest: Nil
Source of Support: Nil

How to Cite this Article

Cherian JJ, Lobo JO, Ramesh LJ. A Comparative Study of Bacteriological Culture Results Using Swab and Tissue in Open Fractures: A Pilot Study. *Journal of Orthopaedic Case Reports* 2019 Jan-Feb; 9(1): 33-36.

