Microbial isolates in open fractures seen in the accident and emergency unit of a teaching hospital in a developing country.

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Summary

In this prospective study, superficial and deep swabs of all open fractures seen at the accident and emergency unit of our hospital between January and June 2000 were taken (before wound debridement was done or anitibiotics commenced). Routine microscopy, culture and sensitivities for aerobic and anaerobic organisms were carried out on these specimens. The organisms were cultured and identified using standard techniques and the antibiotic sensitivity testing was carried out using the disc diffusion method of Stokes. Within six hours of injury, single-organism isolates were commonly found whilst after 48 hours a mixed or poly-microbial organism load were isolated. In 90% of the positive isolates, the organisms isolated form the superficial and the deep swabs were the same. The antibiotic sensitivity pattern of all the isolates shows that pefloxacin, ciprofloxacin and ceftriaxone were more effective compared to cefuroxime and amoxycillin which had substantial resistance to most of the isolates. 41 fractures were followed to union and 4 (9.7%) developed osteomyelitis.

Keywords: ***Open fractures, Microbial isolates, Osteomyelitis, Anti-microbial agents***

Résumé

Dans cette étude en perspective, on avait fait le recensement de prélèvements superficiels ainsi que profonds des cas de tous les fractures ouvertes qui se sont présentées au service des urgences de notre hôpital entre le janvier et le juin 2000 (avant le commencement du traitement de la blessure ou la consommation des antibiotiques). La microscopie de routine, la culture et la sensibilité par rapport aux organismes aérobics et anaerobics ont été effectuées sur ces prélèvements

Les organismes ont été cultivés et identifiés à travers les techniques normales et l'essai de la sensibilité antibiotique (antibiotic sensitivity testing) a été effectué à travers la méthodes diffusion disque de stocke. En moins de six heures de blessure, on avait ordinairement remarqué les isolâtes mono organisme tandis que après 48 heures, un mélange un tas d'organismes poly microbiens ont été isolés. Dans 90% des isolés positifs, les organismes isolés étaient les mêmes et ils constituent les prélèvements superficiels et profonds. Le modèle de la sensibilité antibiotique de tous les isolés a montré que les pefloxacine, ciprofloxacine et ceftriaxone étaient plus efficaces par rapport aux cefuroxime et amoxycilline qui avaient une résistance enorme sur la plu part de isolés. 41 cas des fractures ont été suivis jusqu'à la union et 4 cas soit (9,7%) ont atteint la ostéomyélite.

Introduction

Open fractures are fairly common in developing countries often as a result of poorly maintained vehicles and roads, unlicensed drivers and lack of government regulations on road usage. The exact incidence of open fractures seen in the accident and emergency unit of the University College Hospital, Ibadan Nigeria is unknown, but it accounts for a third of the trauma referrals. Gustillo and Anderson[1] and Patzakis and Iver[2] have shown that between 60 and 70 per cent of open fractures will have positive wound cultures before treatment begins in a hospital and this is because microbial proliferation is time dependent[3]. The organisms isolated in these fractures have been shown to be representatives from numerous genera, but aerobic as well as anaerobic micro-organisms are consistent isolates and *staphylococcus aureus* has been found to be the main infecting organism[1,4]. Therefore, it is now generally agreed that the use of antibiotics in conjunction with adequate wound debridement is mandatory in the management of open fractures. However, the choice of the appropriate antibiotic is dictated by the potential bacteria contamination[1]. On account of the findings in their environment, Wilkins and Patzakis[4], have suggested the use of a combination of a cephalosporins, a penicillin and an amonoglycoside in the treatment of open fractures after adequate wound debridement. In our environment, there has been no study to elucidate the types and pattern of microbial isolates from open fractures. The aim of this study was to evaluate the microbial isolates from open fractures seen in the accident and emergency unit of a teaching hospital in a developing country with a view to formulating an antibiotic policy.

Materials and Methods

All the patients who presented at the accident and emergency unit of the University College Hospital, Ibadan with open fractures between January and June 2000 were entered into this prospective study. In all there were fifty-two patients and this forms the focus of this study. Two pairs of samples were collected from the fracture sites using sterile swab sticks - a pair each for superficial and deep-labelled samples. A swab from each superficial and deep pair was inoculated aseptically into sterile glucose broth for anaerobic culture and the other into sterile Brain Heart infusion broth for aerobic culture. The samples were incubated at 37°C for 24 hours for aerobic cultures and 72 hours for anaerobic cultures. The samples were sub-cultured aseptically into solid media using blood, chocolate and MacConkey agar plates incubated at 37°C aerobically and the open plate technique was used for anaerobic cultures. The colonies of organisms obtained were isolated using standard biochemical techniques to confirm the species of organisms. The antibiotic sensitivity testing was carried out using the disc diffusion method of Stokes[5]. After collecting the samples, the wounds were sketched in the patients case file (since the accident and emergency department of the hospital does not have a polaroid camera), betadine soaked swab was then applied to the wound, anti-tetanus prophylaxis given and the limb splinted.

Results

In 37 (71%) cases, the same organisms were isolated in the superficial and deep cultures and in 4 (7.7%) cases, the isolates from the superficial and deep cultures were different. 7 (13.5%) isolates *grew anaerobic spore bacilli* (ASB) alone both in the superficial and the deep cultures and ASB in combination with another micro-organism was isolated in 2 (3.8%) and no organism was isolated in 2 (3.8%) cases. Of the 22 single-organism isolated (excluding ASB), 9 (40.9%) isolates were *Escherichia Coli*, 7 (31.8%) were *staphylococcus aureus*, 4 (18.1%) were *Klebsiella species* and 2 (9%) were *Proteus species*. For the two-organism isolates, *proteus species* and *staphylococcus aureus* accounted for 53.3% of the cases, and a combination of *proteus species, staphylococcus aureus* and *Eschericia Coli* accounted for 50% of

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the three-organism isolates (Table 1). Within 6 hours of injury, single organisms were commonly isolated and of these, *Eschericia Coli* was the most predominant. However, after 48 hours, poly-microbial or a mixed flora of organisms were isolated (Table 2).

The fracture sites is shown in Table 3. The femur was the bone commonly affected. In 90 per cent of the patients, the open fractures were as a result of road traffic accidents while in 10 per cent, the patients sustained gun injuries to the affected limb. The antibiotic sensitivity pattern is shown in Figure 1. Of the 41 fractures with positive microbial isolates which were followed to union, 4 (9.7%) developed chronic osteomyelitis.

Table 1 Microbial isolates

Organism	Frequency	%	Single organism Freq. (%)	Two organism, (Freq. (%)	Three organism Freq. (%)
Staphylococcus aureus	24	37.5	7(32)	14(46.7)	3(25)
Proteus spp.	15	23.4	2(9)	9 (30)	4(33.3)
Eschericia Coli	14	21.8	9(41)	2 (6.7)	3(25)
Klebsiella spp.	9	14	4(18)	4(13.3)	1(8.3)
β Haemolytic strep.	1	1.5	-	1(3.3)	-
Pseudomonas spp.	1	1.5	-	-	1(8.3)

Table 2 Relationship between the type of microbial isolates and the time of presentation.

Time from injury	Single organism	Poly-microbial	ASB	No growth
< 6 hours	14	1	5	0
7 - 12 hours	2	1	2	2
13 - 48 hours	11	6	1	0
≥ 49 hours	1	9	0	0

Table 3 Site of open fracture

Site of fracture	Number	Percentage
Tibia and Fibula	18	34.6
Femur	21	40
Ulnar and Radius	9	17.3
Skull	1	1.9
Hand (Phalanges)	2	3.8
Humerus	1	1.9

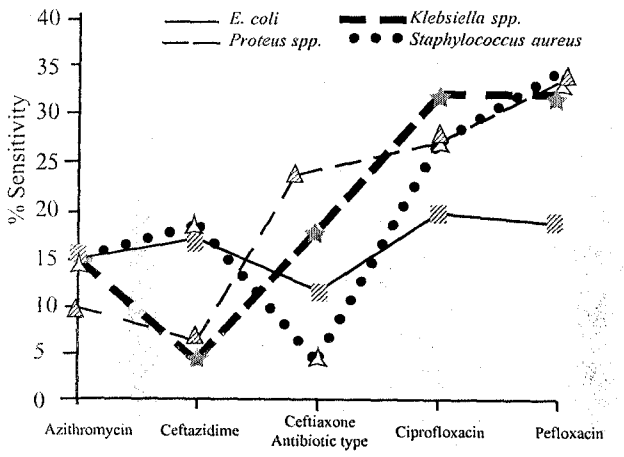

Fig. 1 ***Antibiotic sensitivity pattern***

Discussion

Open fractures are fairly common in developing countries not least because of poor vehicle maintenance, ignorance and illiteracy on the part of commuter drivers. The most common complication that often results from poorly treated open fractures is chronic osteomyelitis which in itself is a distressing bone disease. The reduction in bacterial infection in open fractures can be achieved by adequate surgical irrigation and debridement along with the use of effective anti-microbial agents[4]. There is however a need to select and and administer the appropriate antibiotic based on the organism(s) isolated from the open fracture[5]. In 90% of the positive isolates in our study, the organisms isolated from the superficial and deep swabs were the same and this suggests that in open fractures, the infecting organisms are probably driven into the fracture site from without. The predominant microbe in the single-organism isolate was *Eschericia Coli.* This is at variance with the findings of Wilkins and Patzakis[4] who isolated gram positive cocci and rods predominantly in the single-organism group. Again in our study, the femur was the bone most commonly affected which is in contradiction to earlier studies[7] in which the tibia was the bone commonly affected. In this study also, gram negative organisms seems to be more prevalent in our single-organism isolates although *staphylococcus aureus* was the most predominant microbe in the two-and three-organisms isolates. The consistent isolation of particular aerobic and anaerobic micro-organisms point to the possibility of skin, faecal or environmental contamination of open fractures[4].

Late presentation has been a hindrance to the effective management of most medical problems in resource poor environments as obtains in most develoing countries. The findings of a poly-microbial load after 48 hours following an open fractures makes it imperative that singular anti-microbial agent may not be sufficient in the management of open fractures and that the agents to be chosen should have both gram positive and gram negative activities[4]. The anti-microbial agents so chosen should not be seen as prophylactic anti-microbial agents but as the agents of choice in the treatment of open fractures. Prior to this study, parenteral cefuroxime, gentamicin and metronidazole were the antibiotics used (in combination) in our hospital. This choice was based on 'best guess' or tradition. These antibiotics were commenced in the accident and emergency room after wound swabs had been taken because this specimen (taken before the commencement of any modality of treatment) is the one that most likely will isolate an organism that will cause infection[7]. The antibiotic resistance pattern in this study reveals a high resistance to cefuroxime and amoxycillin. However, the anitibiotic sensitivity pattern of all the isolates shows that pefloxacin, ciprofloxacin and ceftriaxone were more effective compared to the other antibiotics. In view of the late presentation of our patients and the colonisation by poly-microbial organisms after 48 hours of wounding, we suggest the use of a combination of parenteral in the management of open fractures. Although we did not evaluate the sensitivities of the isolates with metronidazole, we suggest that these drugs (pefloxacin, ceftriaxone or ciprofloxacin) should be used in combination with metronidazole in view of the anaerobic organisms that are commonly encountered in these fractures. Although limited prospective data suggest that the preventive efficacy of the antibiotics administered to forestall the development of bone infections in open fractures is similar whether they are given for 6 hours, 1 day or 5 days[8], we still recommend that these antibiotics be administered for between three and five days in our environment bearing in mind the late presentation of these cases.

Conclusion

We have evaluated the pattern of microbial isolates in fifty-two consecutive open fractures seen in a busy accident and emergency unit in Nigeria. Single-organisms were isolated when the patients presented early whilst poly-microbial isolates predominate after 48 hours of wounding. The isolation of *anaerobic spore bacilli* (ASB) in almost 17% of cases is probably a reflection

of the contamination of the swabs taken in the accident and emergency room. Although we found that Pefloxacin, ciprofloxacin and ceftriaxone were the antibiotics which exhibited relatively higher sensitivity to the micro organisms isolated, the summation of the sensitivity values was less than 40%. We therefore recommend various combinations of these antibiotics along with parental metronidazole in the management of open fractures in our environment.

References

1. Gustilo RB and Anderson JT.: Prevention of infection in the treatment of one thousand and twenty five open fractures of long bones, J Bone J Surg. 1976; 58-A : 453-458.

2. Patzakis MJ and Ivler D.: Antibiotics and bacteriologic considerations in open fractures. Southern Med J 1977; 70:46-48.

3. Worlock P. Frontiers in fracture management. *In* The prevention of infection in open fractures Bunker TD, Colton CL, Webb JK (eds). (16-28). Martin Dunitz Ltd, London. 1989.

4. Wilkins J and Patzakis M.: Choice and duration of antibiotics in open fractures. Ortho Clin N Amer. 1991; 22(3): 433-437.

5. Stokes EJ and Watersmonth TM.: Antibiotic sensitivity testing by disc diffusion method. Ass of Clin Pathologist Broadsheet 55. reviewed December 1972,

6. Sanford JP, Evans JR, Prendergast GA, Balch HH and Hughes CW.: An experimental evaluation of the usefulness of antibiotic agents in the early management of contamined traumatic soft tissue wounds, Surg., Gynea. and Obstet. 1957; 105:5-15.

7. Patzakis MJ, Harvey PJ, Ivler D. The role of antibiotics in the management of open fractures. 1974; J Bone J Surg. 54-A (3) : 532 - 541.

8. Dellinger EP. Antibiotic prophylaxis in trauma: Penetrating abdominal injuries and open fractures. Rev. Infect Dis 1991; 13 (suppl 10): S847-857.