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# BACTERIOLOGICAL EVALUATION OF ASEPTIC PROCEDURES ADOPTED FOR REPAIR OF COMPOUND FRACTURE OF RADIUS-ULNA IN DOGS

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The best possible, internal and external methods employed for immobilization of compound fracture may fail, if there is wound infection which is not taken care of. The knowledge of the sources of contamination viz-a-viz maintenance of asepsis, therefore, gains much more significance. Any laxity from pre-operative preparation to post-operative care and management of animals can also cause failure of an otherwise clean surgery. An evaluation of routine aseptic procedures and a knowledge of the common break points of asepsis can prove useful in adopting measures to reduce the chances and extent of infection.

The present investigation was, therefore, undertaken to evaluate the nature of infection while adopting the routine techniques for the repair of compound fracture of radius-ulna in dogs.

## Materials and methods

The present study was conducted on 15 mongrel dogs weighing 13.6 kg on an average and around one year of age. They were maintained in cages under similar conditions of feeding and management. Compound midshaft fracture of the right radius-ulna was created, under general anaesthesia. A cutaneous wound of about one and a half inches diameter was made on the lateral aspect of the limb over the site of fracture with the help of a scalpel blade. Repair of the fracture was done through retrograde intramedullary pinning with steinman pins and the cutaneous wound was left open. Routine antiseptic dressing was done daily for a week. The pin was removed, aseptically, after 45 days.

Samples (swab) were collected for bacteriological studies from skin of dog, before and after scrubbing, both hands of both surgeons before and after scrubbing, and after completion of surgery, wound just before surgery, before its closure, and before application of the antibiotic locally, wound on third, fifth and seventh postoperative days; intramedullary pin tip before its introduction and after its removal, and a piece of gauze

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from the surgical pack immediately after it was opened. Samples of water used for scrubbing and faecal sample of the animal on the operating day were also collected. Two blood agar plates were kept open in the operation theatre during the entire period of operation. Venous blood samples for haemoculturing were collected aseptically 24 hours before creating fracture, on the day of operation, and at 24 hours and 72 hours post operatively. Samples collected were processed for isolation of the bacterial organisms and for the total bacterial counts by the standard methods (Cruickshank, 1969). Sensitivity based antibiotic was used locally and parenterly, and the wound was dressed daily for a week.

**Results and discussion**

The dogs used in the present study had different types of pathogenic and non pathogenic bacteria on the skin (Table 1 and 2). The shaved but unscrubbed skin around the site of the fractured radius-ulna had an overall bacterial count of 1617.80 $\pm$ 1113.35 cfu per ml of swab sample. The organisms isolated were *Bacillus* spp., *Staph.* spp., *E. Coli, Pseudomonas* spp., *Klebsiella* spp., *Staph. aureus*, other gram-negative bacilli, *Edwerdsiella* spp. and diptheroids in decreasing order of frequency. Resident flora had been reported to vary quantitatively and qualitatively with location on the body and with individual host (Marples, 1969., Price, 1960). The method used to scrub the skin of dogs resulted in effecting an overall reduction of 99.95 per cent in the bacterial counts of unscrubbed skin. Inspite of a high degree of reduction in the number of bacterial flora, *Bacillus* spp. and *Staphylococcus* spp. organisms appeared to have resisted the scrubbing since these were isolated from the scrubbed skin of dogs. Observations of Singh (1985) confirm the findings of the present study, where *Bacillus* spp. from the skin of dogs were isolated inspite of 97.5 per cent reduction in bacterial counts after scrubbing. The method used in the present study to scrub the skin of dogs proved satisfactory.

Of the two surgeons engaged in the repair of radius-ulna fracture, the surgeon (A) had more experience in terms of length of service and have had handled more number of surgical cases than the other surgeon (B). Samples from the hands of the surgeons A and B before scrubbing revealed an overall mean bacterial count of 851.13 $\pm$ 425.8 and 165.4 $\pm$ 71.49, respectively. The hands of senior surgeon (A) had an over-all post-scrub mean bacterial count of 9.26 $\pm$ 3.09 cfu/ml, while that of the other surgeon (B) had 6.8 $\pm$ 2.26 cfu/ml of swab sample. *Bacillus* spp., *Staph* spp., *Staph. Aureus, Streptococcus* spp., *Klebsiella* spp., *Pseudomonas* spp., *Enterobacter* spp. and other gram negative bacilli were isolated before scrub from the hands of surgeons. After scrubbing *bacillus* spp. and *Staphylococcus* spp. were predominantly isolated. In addition, *Staph. aureus, Streptococcus* spp., *Klebsiella* spp. and gram-negative bacilli were isolated in case of surgeon (A). After the operations *Staphylococcus* spp., *Bacillus* spp. and gram-negative bacilli and *Staph. aureus* in descending order were isolated from hands of both the surgeons. There was an increase, in comparison to both pre-and post-scrub samples, in the number of *Staphylococcus* spp. and gram-negative bacilli in case of both the surgeons. The operation theatre air might be responsible for this increase.

Although there was a significant reduction in the number of bacteria after

**Table 1** **Type of organisms isolated from different sources of contamination on the hands of surgeons, skin of dog and on wound in operative and post-operative phases**

| Sl. No. | Organisms | Air | Water sample | Faecal sample | Skin of dog | | Surgeons' hands after operation | Wound | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Shaved | Scrubbed | | Before operation | Just after operation | Post-operative |
| 1 | Gram negative Bacilli | + | + | - | + | - | + | + | + | - |
| 2 | *Bacillus* spp. | + | + | - | + | + | + | + | + | + |
| 3 | *Staph.* spp. | + | + | - | + | + | + | + | + | + |
| 4 | *Staph. aureus* | + | - | - | + | - | + | + | + | + |
| 5 | *Pseudomonas* spp. | - | + | - | + | - | - | - | - | - |
| 6 | *Proteus* sp. | - | - | + | - | - | - | - | - | - |
| 7 | *Klebsiella* spp. | - | - | - | + | - | - | - | - | - |
| 8 | Diptheroid | - | - | - | + | - | - | - | - | - |
| 9 | *Streptococcus* spp. | - | - | - | - | - | - | - | - | - |
| 10 | *E. coli* | - | - | + | + | - | - | - | - | - |
| 11 | *Providencia* spp. | - | - | + | - | - | - | - | - | - |
| 12 | *Salmonella* spp. | - | - | + | - | - | - | - | - | - |
| 13 | *Edwardsiella* spp. | - | - | - | + | - | - | - | - | - |

**Table 2 Mean bacterial counts of samples taken from the skin of dogs and the surgeons' hands**

| Sl. No. | Site | Sample | Mean bacterial counts (cfu/ml) ± SE | % reduction after scrubbing* Number of times increase after surgery** |
|---|---|---|---|---|
| 1 | Skin of dogs | After shaving | 1617.80 ±1113.35 | |
| 2 | Skin of dogs | After scrubbing | 0.80 ±0.27 | 99.95%* |
| 3 | Surgeons' hands | Before scrubbing | A 851.13 ± 425.80<br>B 165.40 ± 71.49 | |
| 4 | Surgeons' hands | After scrubbing | A 9.26 ±3.09<br>B 6.80 ± 2.26 | 98.91*<br>95.88* |
| 5 | Surgeons' hands | After surgery | A 21.93 ±7.35<br>B 15.20 ±4.31 | 1.36**<br>1.23** |

scrubbing, the differences in the bacterial counts on the hands of surgeon A could not be levelled off to those on the hands of surgeon B. Handling of a variety of infected clinical cases over a variable period of time, more by surgeon A than by surgeon B, may be contributing towards the pre-scrub difference in bacterial counts on the hands of surgeons. The bacterial counts on the hands of surgeon (A) was found to be higher in the post-operative samples as well. Arnold *et al.* (1930) observed that the experienced surgeons have many bacteria under their finger nails even after a thorough scrub. Singh (1985) opined that it may be possible that an experienced surgeon may develop a sense of complacency towards even routine scrubbing while the fresher has a more cautious approach. However, the technique employed for scrubbing surgeons' hands, in the present study, is adequately satisfactory. The use of sterile gloves should level off the scrubbing and individual differences.

In orthopaedic surgery of compound fractures, when intramedullary pinning is done, it is likely the pin may carry with it the infection which may be harboured till the pin is removed, and / or the infection from the cutaneous wound may travel to deeper tissues including the bone. The risk of development of a post-operative wound infection is determined by the number and species of bacteria present in the wound, condition of the wound at the end of operation and the host resistance (Beggard and Weidema, 1985). An analysis of the wound samples indicated that the wounds were more contaminated at the end of surgery than their post-scrub status. The pins were found mildly infected after passing through the medullary cavity and its emergence at the radio-carpal joint. The increase in the wound had primarily occurred in *Staphylococcus* spp. The organisms isolated from the pins were *Bacillus* spp., *Staphylococcus* spp., *Staph. aureus* and the gram-negative bacilli. These were the organisms which had also been found on the skin of dog, surgeons' hands and the operation theatre air. In the present study the overall mean settle plate count of the

operation theatre air was found to be 29.6 ± 5.78 cfu/ml. Also the presence of *Staphylococci* and *Bacillus* spp. in the operation theatre air evidently substantiate environmental contamination. Surgical packs being sterile, the other contributing factor appears to be the skin of dogs. Singh (1985) observed that the type of organisms (Staphylococci; *Bacillus* spp., and yeast) found in the subcutaneous area were isolated from the operation theatre (air) also. Samples of water used for scrubbing were subjected to bacteriological examination in the present study. Mean bacterial count in water was 34.53 ± 10.02 cfu/ml. The water samples contained *Bacillus* spp., *Pseudomonas* spp., *Staphylococcus* spp. and gram-negative bacilli in descending order (Table 1). Thus, the tap water used for scrubbing can also act as a possible source of wound contamination. Regular testing of tap water for its sterility status is recommended.

In the present study though wound healing was satisfactory, bacteria were isolated from the swab samples taken from the wound on third, fifth and seventh post-operative days. The bacterial count decreased post-operatively with the passage of time. *E. Coli* organisms were present throughout the post-operative phase. *Staphylococcus* spp. and *Bacillus* spp. were the other organisms isolated. *Staph. aureus* was isolated from one pin on 45th post-operative day. Haemocultures taken upto 72 hours after fracture repair were bacteriologically sterile. The results of the present study indicated that there was no evidence of systemic infection. Nominal localized infection existed, but clinically healing had occurred. The wounds were found usually dry when opened for routine dressing. In a few cases where bandage slipped or was undone by the dogs, a sudden spurt in the bacterial counts was noticed, though the wounds healed without any complication. This fact highlights the importance of proper bandaging and maintaining the bandage intact to avoid wound contamination. The radiographic evidence indicated satisfactory healing of the fractured radius and ulna as well. Holmberg (1985) in a study on 30 dogs presented for open surgical repair of compound fracture (radius-ulna, tibia, pelvis, femur, metacarpus and metatarsus) reported that most bones had similar incidence (23%) of infection following fracture repair.

Of the various organisms isolated from faecal samples of dogs in the present study, *E. coli* was the most commonly isolated one both from faecal samples as well as from the wounds on third, fifth and seventh post-operative day swab samples. This finding indicates a strong possibility of wound contamination through the faecal matter. The results of the present study revealed that Staphylococci and *Bacillus* spp. were present on both the scrubbed and unscrubbed skin of dogs, hands of surgeons, in wound tissue and on tip of the intramedullary pin. The increase of about 1.36 and 1.23 times in the number of organisms on the hands of the experienced (A) and comparatively less experienced (B) surgeons respectively during the period of operation was primarily in *Bacillus* spp. and *Staphylococcus* spp. Both these organisms were isolated from water and the operation theatre air samples as well. Logger and Megchelenbrink (1979) on conducting bacteriological studies in animal operation theatre observed the air borne contamination to be of major importance.

**Summary**

The study was conducted on 15 clinically healthy mongrel dogs. Experimentally created compound mid-shaft fracture of the radius-ulna was repaired by intramedullary pinning. Bacteriological samples were taken during various phases of surgery, from the skin of dogs, hands of surgeons, surgical packs, intramedullary pins, cutaneous wounds, operation theatre air, water and faeces. Haemoculturing was also done. Skin of dogs was found heavily contaminated with different types of micro-organisms. Its scrubbing with savlon (1 : 30) for 6 times reduced the microbial population by 99.9%. Scrubbing of the hands by surgeons three times each with a detergent soap and with savlon (1 : 30) resulted in significant reduction in number of micro-organisms. However, *bacillus* spp. and *Staphylococcus* spp. did not yield to scrubbing completely. Significant spurt in bacterial count occurred, when the bandage slipped from the wound. Haemocultures taken upto 72 hrs. after fracture repair were bacteriologically sterile. There was no evidence of systemic infection, though nominal local infection was noticed. *E. coli* was isolated from faecal samples as well as from the wounds. *Bacillus* spp. *and* Staphylococcus *spp.* were isolated from both the scrubbed and unscrubbed skin of dogs, hands of surgeons, wound tissue, tip of intramedullary pin, water and operation theatre air.

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