Management of Open Joint Injuries

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ABSTRACT: A retrospective study of 62 patients with open joint injuries admitted to the Philippine General Hospital, Department of Orthopedics from 1982-1987 (first half) was done. The knee was noted to be the most commonly injured joint. Patients were grouped into those associated with fracture, injuries without fracture,and gunshot wounds. Wounds were classified as to the degree of soft tissue involvement. The infection rate was noted to be 24% with almost all of the type III wounds developing infection. A general pattern of treatment approach based on basic principles has been noted although no definite protocol was being followed.

INTRODUCTION

Open joint injuries are considered as challenging conditions to orthopedic surgeons with regard to management. The development of infection to the joint resulting from the wounds is noted to be difficult to treat and has a less favorable prognosis than the hematogenous type.

Although little information relative to the treatment of these injuries is available in the English literature, most authors agree in the more aggressive approach to prevent the occurrence of infection. Rockwood believes that any wound that enters a joint mandates exploration.[1] In simple punctured wounds an arthrotomy of a conventional pattern maybe performed. According to Gustile, an open fracture entering into a joint or an open joint injury without a fracture demands an arthrotomy and cleansing of the joint.[2]

The purpose of this paper is to review cases with open injuries seen in this hospital and identify the different factors that will favor the increase in the infection rate so that a more effective treatment approach may be instituted.

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MATERIALS AND METHODS

Available medical records of 62 patients with open joint injuries admitted to the Philippine General Hospital, Department of Orthopedics from 1982 up to the first-half of 1987 were reviewed. Only those affecting the major joints were included in the study. Open joint injuries were confirmed by the following: 1) obviously visualized injured joints; 2) penetrating joint injuries with hemarthrosis; 3) radiologic evidence of air in the joint and 4) intraoperative findings of communication of the outside wound to the joint.

The study comprises 62 wounds of major joints in 62 patients. Fifty-five were males and seven were females. The average age was 27 years (range 5-80).

Wounds of knee were the most frequent constituting 48% of the total as shown in Table 1.

Patients were classified into three groups depending on the types of injuries sustained namely: 1) gunshot wounds – 23 patients (21 due to low velocity and two to shotgun blast); 2) open joint with fracture – 26 patients and 3) open joint without fracture – 13 (see Table 2). Two-thirds of the patients with gunshot wounds had associated fracture.

The patients were further grouped into three

TABLE 1
Distribution of 62 Injuries of Major Joints

Joint	Right	Left	Total	Percent of total
Hip	0	1	1	2
Knee	10	20	30	48
Ankle	7	4	11	18
Shoulder	1	4	5	8
Elbow	3	12	15	24
Total	21	41	62	100

depending on the amount of soft tissues involved as well as the osseous and cartilage status and the presence of foreign material as shown in Table 3.

All cases were considered as emergency cases with the average time from injury to initiation of treatment (giving of antitetanus and antibiotics) as 3.3 hours in general – 4.4 hours for gunshot wounds, 2.5 hours for open joint with fracture and 3.3 hours for open joint without fracture. The average time for surgery from the time of injury was 14 hours in general – 16 hours for gunshot wound, 13 hours for both open joint with and without fracture. There were seven patients with delay of more than 24 hours before surgery and a number of these were referrals from other hospitals.

TABLE 2
Distribution of the Different Types of Injuries

	Type of injuries	No. of patients	Per cent of total
I.	Gunshot Wound	23	37
II.	Injuries with Fracture	26	42
	A. vehicular accident	11	
	B. foreign body	0	
	C. stab wound	1	
	D. hacking wound	12	
	E. mauling	1	
	F. grinder	1	
III.	Injuries without Fracture	13	21
	A. vehicular accident	5	
	B. foreign body	1	
	C. stab wound	2	
	D. hacking wound	3	
	E. fall	2	

Review of the treatment approach showed no definite protocol that was being followed although a general pattern has been noted which included the giving of preoperative systemic antibiotics consisting mainly of Cephalosporin and Penicillins (Table 4) as well as antitetanus. All patients underwent debridement or cleansing of joint with removal of foreign body as necessary. Preoperative and intraoperative cultures were noted to be not routinely done in all cases (32 patients with cultures done).

Fifty-two patients had their joints primarily clased with 46 without a drain, four had rubber drain and two with closed suction drainage. Ten patients had joints that were maintained open because of the extensive sort tissue injuries and severe soiling of the joint.

Twelve fractures were internally fixed. All operated joints were immobilized postoperatively; 45 in splint, 11 in cast, 2 in external fixature, one in Jones bandage and two in traction. Several repeat debridement had to be done in seven of the cases because of the extent of the injury and subsequent development of infection. The diagnosis of infection was done in the presence of physical and systemic findings with culture from the wound as positive for organism. Two groups of infection were noted, namely: 1) superficial – development of soft tissue and subcutaneous acscess, and 2) deep – involving the joint itself.

RESULT

The overall average stay of the patients in the hospital was 14 days. For the gunshot wounds, the average hospitalization lasted 11 days (range 4-30);

TABLE 3
Distribution of the Different Types of Wounds

Type	Description of damage		Foreign Body	No. of Patients	Percent of Total
	Soft Tissue	Bone & Cartilage			
I	slight	virtually uninjured	None	17	27
II	relatively extensive but slight maceration and necrosis	moderate or severe	little	35	57
III	severe	marked necrosis	plenty	10	16
Total				62	100

TABLE 4
Summary of Definitive Treatment

Treatment	Hip	Knee	Ankle	Shoulder	Elbow	Total
Antibiotics						
Pen G	1	13	3	1	5	45
Aminoglycoside	–	4	3	–	1	8
Cephalosporin	–	15	10	3	10	38
Chloramphenicol	1	11	2	2	2	18
Cloxacillin	–	3	–	–	1	4
Antitetanus	all	all	all	all	all	62
Immobilization						
Splint	–	24	4	3	14	45
Cast	–	4	5	1	1	11
External fixation	–	–	2	–	–	2
Jones bandage	–	1	–	–	–	1
Traction	1	–	–	1	–	2
Procedures						
Debridement/Arthrotomy	all	all	all	all	all	62
ORIF	–	2	5	1	4	12
FUSION	–	–	1	1	–	2
Repeat Debridement	–	1	3	2	1	7
Advancement flap	–	1	–	–	–	1
Neurorrhaphy	–	–	–	–	2	2
Skin grafting	–	2	4	–	1	7
Removal of Foreign Body	–	12	1	3	–	16
Myorrhaphy	–	–	–	1	3	4

for open joint with fracture, 17 days (range 5-51); for open joint without fracture, 14 days (range 4-42). The more prolonged hospitalization of patients with fractures was expected and those without fractures were due to the more extensive soft tissue injuries.

The distribution of the above patients as to the type of open joint wound is shown in Table 5.

There were 15 patients who manifested infection thus an infection rate of 24%. Half of these were superficial infections with the other half involving the joint itself (deep infection). Of the fifteen infections, six came from the patients with gunshot wounds – all of the two shotgun injuries developed infection – six from open joint with fracture, and three from open joint without fracture. The three groups showed almost similar infection rates: 26%, 23%, 23% respectively.

Cultures were positive in all infected joints. Bacterial growth showed gram negative organisms with predominance of Pseudomonas. No gram positive organisms were isolated (Table 6).

TABLE 5
Distribution of the Different Types of Open Joint Injuries

According to soft tissue	Gunshot wound	Open joint w/fracture	Open joint w/o fracture	Total
I	6	3	8	17
II	15	18	2	35
III	2	5	3	10
Total	23	26	13	62

There was note of increased incidence of infection for those patients who underwent surgical debridement and cleansing of the joint 24 hours or more after the injury as shown in Table 7.

As to the extent of soft tissue injuries, invariably most patients with Type III wound would develop infections. Such wounds had the most extensive damage to soft tissues and bone and thus were more likely to become infected (Table 8).

TABLE 6
Bacterial Flora of the Wound Infection

Organisms	Number isolated
Pseudomonas	7
Enterobacter cloacae	5
Acinetobacter	3
Klebsiella	2
Proteus mirabilis	1
E. coli	1
Providencia	1
Total	20

TABLE 7
Infection Rate According to Time of Surgery From Injury

Time of surgery	No. of patients	Infection	Per cent
0–8 hours	19	2	10
9–16 horus	20	5	25
16–24 hours	16	4	25
> 24 hours	7	4	57

TABLE 8
Infection Rate According to Type of Wound

Type	No. of patients	Infection	Per cent
I	17	0	0
II	35	6	17
III	10	9	90

It did not seem valid to compare the incidence of infection in joints with and without closure of the capsule because in most instances in which the capsule was not sutured, the extent of the wound precluded closure. Two of the four patients with closure of the capsule with a rubber drain resulted in infection (superficial). No infection was noted in the two patients with closed suction drainage (Table 9).

There were two patients who ended up having fusion of the involved joints – one in the ankle with very severe soft tissue injuries who developed septic arthritis; another one in the shoulder with circumferential avulsion of soft tissue and marked comminution of shoulder articulating bones.

Nine patients had had other fractures aside from the area of the involved joints. Other associated injureis were: hemothorax (1), pneumothorax (1), nerve injuries (4), urethral transection (1), and cerebral concussion (1).

TABLE 9
Infection Rate According to Leaving the Wound Closed or Open

Wound	No. of patients	Infection	Per cent
Closed	52	9	17
No drain	46	7	15
Rubber drain	4	2	50
Closed suction drainage	2	0	0
Open	10	6	60

There were no reported cases of amputation secondary to the joint involved.

No mortality was seen among the cases reviewed.

DISCUSSION

One of the prime objectives in the management of open joints as in open fractures is to prevent or eliminate wound infection which may develop in several ways. Thorough wound debridement is considered crucial to eradicate retained contaminated dead and devitalized tissues that may give rise to wound sepsis.

After a complete debridement, it is recommended to close the capsule and synovium of the joint if this can be done primarily and provided they are seen early and antibiotics are used.[3] However, if primary closure is impossible, the joint should be carefully protected from further infections by an occlusive dressing. The likelihood of infection is great in joints left open. In our series, however, it is very hard to assess significantly. Although 60% of those joints left open developed infection, the very fact that closure was impossible makes comparison invalid. Nevertheless, an exposed joint will have a greater chance of acquiring mixed infections and cartilage degenerating rapidly. Therefore, definitive wound closure should be accomplished as soon as allowable not only to decrease infection risk but also shorten the patient's hospital stay. From our series who had substantial prolongation of hospital confinement were from those with extensive soft tissue injuries rendering the joints to remain open.

If closure is to be done, it is advised that under no circumstances should gauze, rubber drain, tubes or other drainage material be placed within the joint cavity.[4] In our patients, two out of the four patients with a rubber drain developed superficial infection. Patzakis made a prospective study of 140 patients with open joint injuries all treated with antibiotics, surgical debridement and irrigation, and installation of polyethylene tubes into the joint as a system of postoperative closed drainage.[5] Results showed that the irrigation system can be a source of contamination.

The timing of surgery is also an important factor. Delay of several hours will allow time for the infecting organism to invade living tissues taking origin in dead and devitalized tissue in the wound.[6] In our series, the evidence of infection is increased two-fold if surgery is postponed in more than 24 hours. The synovial membrane and the articular cartilage are vulnerable to infection and together with progressive damage caused by retained foreign bodies and unattached bone fragments will produce poor result. If an early operation has not been possible, a delay of from one to several days is not a containdication to debridement, even in the presence of infection.[3]

The most significant factor in the development of infection is the degree of soft tissue damage compounded with the associated bone and cartilage involvement. Nine out of ten patients belonging to type III open joint injury resulted in infections. These wounds were left open adding more insult to an already compromised joint. An aggressive operative approach is recommended which aims for an early wound closure achieved by proper wound coverage, e.g. advancement flaps, skin grafting, etc. Only when all hope that function can be restored have been abandoned should one leave the wounds open. Short of an amputation, one may elect to do an outright fusion.

Reviewing the bacterial flora from our series, all were due to Gram negative bacteria with no note of Gram positive organisms. Burns, Young and Mueller also noted a remarkable lack of Gram positive infections in a large series of war wounds of the knee that were treated with Penicillin.[7] Most of their infections were caused by Gram negative infections of the colon group and of Proteus vulgaris. Knowing the probable organism is important in the choice of antibiotics to be given. There is no question of the importance of giving antibiotics before and after surgery in open wounds of joints. Antibiotic penetration into normal and inflamed synovium and joint fluid has been demostrated. However, it should be emphasized that antibiotic therapy is not a substitute for proper and thorough debridement.

CONCLUSION

The following general principles are being reemphasized in the management of open joint injuries:

1. A thorough and painstaking primary debridement of joint wounds is imperative for good results.
2. Emphasis must be placed on the prevention of infection.
3. Wounds having most severe and extensive damage to soft tissue are more likely to become infected.
4. The choice of treatment in wounds of joints depends on two major factors: the time since surgery and the type of wound.
5. An immediate, aggressive operative approach towards early wound closure to decrease hospitalization time is being recommended.
6. The role of antibiotics as well as preoperative and intraoperative culture studies should be taken into consideration.
7. Drains should not be left within the joint cavity.

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