INFECTION OF THE STERNUM AND COSTAL CARTILAGES FOLLOWING MEDIAN STERNOTOMY REPORT OF 4 CASES

GHUFRANULLAH KHAN, AKHTAR HUSSAIN AND MOHAMMAD REHMAN

Department of Cardiac Surgery,
National Institute of Cardiovascular Disease,
Karachi.

INTRODUCTION

Infection of the sternum and costal cartilages has infrequently been reported. Infection of the sternotomy wound has been reported in 1.8-5% of median sternotomies, and the involvement of cartilages is extremely rare. When infection of the sternum and costal cartilages occur, these have been extremely difficult to eradicate and are associated with severe morbidity. Multiple operations which was followed by continuing infection have been the usual course of events. This has often resulted from a failure to appreciate the pathogenesis and surgical measures necessary for effective control of infection.

We have, during the past one year (1995), treated 4 patients (all males), who developed chronic infection of the sternum and costal cartilages after coronary artery bypass grafting. Successful management in each patient comprised both surgical and antibiotic treatment.

The purpose of this report is to describe the course of these patients and to review the problem in the light of current knowledge.

CASE REPORTS

Case No. 1:

A 42 years old male patient was admitted in our unit on 22-02-95 with the diagnosis of 3 vessel disease with good LV function. He was nondiabetic. He had coronary artery bypass surgery on 22-03-95. He received 3 vein grafts in addition to IMA grafting. He made uneventful recovery. No reopening for excessive bleeding/tamponade was needed. He was discharged from the hospital on 10th postoperative day and the wound condition looked alright. He reported 3 months after the operation with signs of inflammation over the lower part of the wound. He also had fever and leucocytosis. On 01-08-95, a minor debridement of the wound was carried out. All the sternal wires except the upper 2 were removed. Wound was left open and pus for culture and sensitivity revealed growth of pseudomonas sensitive to Amikacin, Cefoperazone, Aztrenam, and Enoxabid.

Postoperatively he remained on Amikacin and cefoperazone. His wound condition, however, did not improve. He ultimately developed swelling over the right costal margin and complained of severe pain over whole of the right lower chest. Examination revealed swollen and tender right costal arch. He was discharged and advised to consult after 2 weeks. When he reported back after 2 weeks, upper part of his sternotomy wound which so far had remained quite, also showed signs of inflammation.

On 28-08-95, he had his upper part of wound explored and debrided. The remain-
ing 2 wires were extracted and the wound was left open. After the minor debridement he continued to complain of pain in the upper right chest. On examination, the right second costal cartilage was extremely tender and it was decided to get rid of it. After the removal of 2nd costal cartilage, healing of the upper part of the wound followed.

While these events were taking place, lower wound continued to exude pus and showed no signs of healing. Right costal margin was extremely tender and on pressing it, pus came out of the lower wound.

In view of the healing of the upper part of the wound following removal of the costal cartilage, it was decided to proceed with excision of the tender right costal arch.

On 01-10-95, his right 6th and 7th costal cartilages along with the costal arch were completely excised through a separate transverse incision. Wound was left open and packed with iodinated gauze. With daily dressing and antibiotic coverage the wound started to look better. The patient has finally achieved healing of his sternotomy wound.

Case No. 2:

A 45 years old nondiabetic male was admitted to our care with the diagnosis of three vessel along with left main trunk disease. He underwent CABG on 15-04-95. He had LIMA harvested and received 3 additional vein grafts. Early postoperative course was free from any major complication and he was extubated on the same day.

On the 10th postoperative day (at the time of discharge) his wound looked healthy and the sternum stable. He, however, never became normal after the operation and continued to complain of pain in lower part of the wound and around the lower chest. He consulted us again 3 months after the operation. His only complaint was intolerable pain at the above mentioned site.

Examination of the wound showed that it was apparently healed except that slight erythema and induration confined to its lower half was noticeable. The erythema/induration also extended on either side over anterior lower chest region. X-ray showed osteomyelitis of the sternum. It was decided to explore the area.

On 10-04-95, his wound was explored through the lower part of his sternotomy wound. The whole of the subcutaneous tissue was thick and sclerotic and deep to it a pocket of pus close to sternum was evacuated. The osteomyelitic sternum was nibbled away and lower 4 sternal wires were removed. The wound was washed and was loosely approximated with interrupted sutures after thorough packing with iodine soaked gauze. Culture specimens were taken but no growth was revealed. Postoperatively, he remained on broad spectrum antibiotic. He was discharge from the hospital when his wound showed some signs of healing.

Two months after the debridement, he consulted us again. This time his complaint again was lower chest pain bilaterally and the wound seemed completely healed. The pain was so severe that he became dependent on powerful analgesic injections to get relief, from what he described as unrelenting and continuous agony. On examination whole of lower costal margin was tender and swollen.

He underwent 2nd operation on 15-06-95. Bilateral transverse incisions were made which were later connected with the main wound. Through these incision, whole of the costal arch (both right and left) were removed i.e. 6th to 10th costal cartilages. The cartilages were practically eaten away. Culture sensitivity specimen taken at the time of operation revealed no growth. The wound was partially closed with deep tension stitches after packing with iodine soaked gauze. The dressing were changed on regular basis and after 2 weeks the
wound finally showed signs of healing and was completely healed in 4 weeks.

Case No. 3:

A 45 years old diabetic male was operated on 17-06-95. He had three vessel disease and received 3 vein grafts in addition to LIMA grafting. His immediate postoperative course was uneventful.

He, however, came back 2 month after the operation with a discharge from the median sternotomy wound. He was also febrile and had leucocytosis. On examination, the whole of the wound was swollen and erythematous and exuded seropurulent discharge. He initially had debridement of the wound and removal of the sternal wire. Wound condition improved and it started to granulate. After a fortnight stay in hospital, he was discharged but he soon returned, this time with severe pain localised over the right costal margin. On 2nd exploration which was done approximately 3 months after the operation, the whole of the right costal arch (cartilage 6 through 10) was excised through a separate transverse incision. Again the wound was reapprorximated by the same technique described in case no. 2. Frequent dressing changes with Eusol soaked gauze finally resulted the wound to progress to a healthy healing state. Postoperatively he remained on broad spectrum antibiotic although repeated cultures were negative.

Case No. 4:

A 50 years old nondiabetic male patient who underwent CABG on 12-09-94. LIMA was dissected. Early postoperative course was uneventful.

Unfortunately, on the 4th postoperative day, he developed fever. His wound became septic and sternum unstable. He underwent sternal wound debridement and sternal rewiring. He recovered and was finally discharged 2 week after the operation. His culture and sensitivity of the wound discharge grew pseudomonas sensitive to carbenicillin, cefoperazone, cefotaxime, enoxabid and aztreonam.

On follow up visit, his wound had healed except for couple of sinuses localised at lower end of the wound. These sinuses discharged seropurulent material.

One month after the operation on 10-10-94, lower sinuses were explored. The wound was laid open and the area was debrided with removal of lower 4 sternal wires. The wound was left open.

During the follow up visits, the wound showed delayed healing but sinuses connected to the upper part of the wound appeared. The sinuses were explored at about 3 months after the operation and were found to lead to 2nd and 3rd costal cartilages. Both these costal cartilages were removed. The excision of the cartilages resulted in healing of the upper part of the wound.

The lower part of the wound however, never completely healed. A swelling would appear, burst and discharge its contents through sinuses connected with the main wound.

A couple of months after the excision of 2nd and 3rd costal cartilage, he was admitted to our unit again with swelling over the right subcostal region. This swelling was tender, soft and fluctuant. It was not accompanied by fever. He was operated again and incision and drainage of the swelling was done by a short oblique subcostal incision. Pus was evacuated but no attempt was made to locate its source. The wound was packed and left open. During the follow up visits the wound had healed but a sinus resulted in the said area. He was again operated and whole of the area was completely debrided. Frequent changes of dressing resulted in almost complete healing of the wound.
But one month after the last debridement, he again developed a sinus in the same area. In addition to it he also complained of severe pain localised to right lower chest and his right costal margin was tender.

He is still visiting us. In more than one year after the operation, his sternotomy wound has not yet healed.

DISCUSSION

Clinical Picture

Isolated costo- chondritis and sternal osteomyelitis are unusual but serious wound infections.

The clinical picture has been that of a painful swelling or a sinus originating from the sternum. In our cases, 50% of the patients showed pseudomonas infection. Various organisms have been incriminated in the past (including staphylococcus aureus, mycobacterium tuberculosis, salmonella typhi, diplococcus, pneumococcus, beta-hemolytic streptococci and fungi). However, pseudomonas has predominantly represented in our series of 4 patients.

Pseudomonas invade the walls of small blood vessels and produces inflammatory arteritis and thrombosis with arterial occlusion and development of small areas of necrosis. Pseudomonas is particularly troublesome in lesions containing necrotic material.

We have explored the possible risk factors contributing to infection of the costal cartilages. The possibility of IMA harvesting resulting in devascularisation of sternum and costal cartilages is at best conjectural, as it does not account for infection of right sided costal cartilages seen in our cases. The possibility of local trauma from modified IMA retractors (local made), providing entry site for pseudomonas cannot be discounted. All our patients were relatively healthy and only one of the them was diabetic. No other risk factors could be identified. The important point about this small series is that all coastal cartilage infections followed CABG operations.

Although it seems logical to consider the infections of the sternum and costal cartilage together, it is important to differentiate between them since the pathogenesis and treatment are different.

The cartilage is unique in its structure and has meager blood supply. When delicate perichondrial capillary network is injured in the presence of infection or trauma, the cartilage acts as foreign body.

Work on the anatomic and pathologic features of the problem at the turn of century by Moskowicz and Murphy\textsuperscript{[1]} led to the development of surgical procedures which stressed the removal of entire length of cartilage when cartilage 1 to 5 were involved. Because of the continuous anatomic arrangement, removal of the entire costal arch was recommended if cartilage 6 through 10 were affected. Failure to understand this principle may be responsible for our inability to control infection in case No. 4.

The chronicity of these infections has been cited by a number of authors. Wilcox\textsuperscript{[2]} in reflecting upon 25 years of reported experience, noted the large number of surgical procedures extending over long period with the major problem being failure to appreciate the anatomic and pathological features and inadequacy of limited surgical procedures. Four patients described here exemplify the chronicity of these infection with course extending over 8,5,2 and 14 months respectively.

Antibiotic treatment

Antibiotic treatment of the pseudomonas infection involving bone and cartilage has been unsatisfactory because of resistance of the organism, the location of involvement and the drug toxicity. Penicillin and ampicillin are of no use. Polymyxin B is not available here. Aminoglycosides
(gentamicin, amikacin and tobramycin) have been more effective. Carbenicillin has shown superior results in nosocomial pseudomonas infections and has also been shown to be synergistic with gentamycin.

Carl malt and associates reported tobramycin in 21 serious pseudomonas infection. This drug although more active in vitro than gentamycin, was not clinically superior to gentaticin. Although patients generally responded well to aminoglycosides, additional surgical procedures were necessary in patients with bony involvement.

In another report, tobramycin alone failed in the treatment of four cases of osteomyelitis and one case of sternal osteomyelitis reported by Perkin et al., but was effective with local surgical debridement in two cases of sternal osteomyelitis in patients addicted to drugs. The adverse effects of tobramycin and gentamycin on the kidney and vestibular system were similar but there may be less ototoxicity with tobramycin.

We have generally relied on culture and sensitivity reports for the proper selection of antibiotics. We would like to make one point for amikacin. This drug has been effective in gram negative infection and may be of particular value when resistance to gentamycin is present. Our experience with amikacin in other gram negative infections including pseudomonas infection of median sternotomy wound has been encouraging.

We have been using eusol (sodium hypochlorite) liberally for local wound packing and in our view this is consistently effective against pseudomonas and this may be the reason for negative culture in 2 patients for our series. We routinely use eusol until the wound shows healthy red granulation tissue. Persistence with its use beyond this period is believed to be injuries to immature granulation tissue.

Although the precise duration of antibiotic treatment is not known, at least 4 week course along with surgical excision is recommended in these cases of osteomyelitis. Importance of adequate surgical debridement cannot be over emphasized.

Surgical Treatment

Incisions should be planned to provided flaps and permit adequate exposure of the area. Any involved bone should be removed, sinus tracts completely opened, and involved soft tissues excised. With cartilaginous involvement the entire length of the chondral segment should be removed subperichondrially if ribs 1 to 5 are involved. The entire costal margin will require removal if rib, 6 to 10 are involved.

Although wound converge must be individualised, primary skin coverage is desirable. Mandatory use of open drainage has been changed now with the availability of effective antibiotic and tube suction drainage, and the use of flaps to cover infected cavities.

In our case we used a modified approach whereby wound margins are brought together by interrupted deep silk or prolene stitches and enough space remains for wound discharges to come out. The wound is initially packed daily with eusol soaked dressings. When signs of good granulation is seen, wound packing is omitted and only dry sterile dressings are applied. Keeping the margin close together allows healing to progress rapidly and over a shorten period of time. It is our belief that once infected bone or cartilage is taken care off, healing proceeds apace.

CONCLUSION

Infection of the costal cartilages are extremely rare following median sternotomy. Treatment should be aggressive and aimed at early removal of all infected costal cartilage and systemic antibiotics. They should be selected according to culture and
sensitivity report, and should be given for at least 4 weeks. Local dressings with sodium hypochlorite has been particularly useful because of its efficacy against pseudomonas.

REFERENCES


