Clinical and pathological changes in the knee after accidental chlorhexidine irrigation during arthroscopy

CASE REPORTS AND REVIEW OF THE LITERATURE

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We describe six knees in five patients, referred to us after accidental irrigation with chlorhexidine 1% in aqueous solution during arthroscopy.

All six knees developed persisting pain, swelling and crepitus with loss of range of movement. Radiographs showed loss of joint space in all three compartments due to extensive chondrolysis, with many loose bodies and synovitis. Histological examination showed partial necrosis of the cartilage, with slight non-specific inflammation and fibrosis of synovial specimens.

Care is needed in checking irrigation fluids, and these should have a distinctive colour.

J Bone Joint Surg [Br] 1998;80-B:437-40.

Received 4 November 1997; Accepted 27 November 1997

Arthroscopy is now very common, and involves the use of an irrigating solution. Articular cartilage is a complex and active tissue which depends on diffusion from the synovial fluid for its nutrition and metabolism. The effect of different irrigating fluids on cartilage metabolism has previously been investigated in vitro and in animal studies; these have shown that those used most commonly have an inhibiting effect.^{1,2}

Chlorhexidine is not normally used in arthroscopy, but is a common irrigating fluid for surgical wounds, and has been shown to help to prevent infection with *Staphylococcus aureus*.³ Chlorhexidine 4% was shown to have no deleterious effect on the histological appearance of wound healing of the skin in guinea-pigs.⁴ Other data on the toxicity of chlorhexidine have been generally favourable, although, to our knowledge,⁵ no experiments on articular cartilage have been reported.

We describe the macroscopic and microscopic effect of the accidental use of chlorhexidine solution during arthroscopy in six knees in five patients.

Case reports

Three of the five patients were referred to us after the proven but accidental irrigation of the knee with 1% aqueous chlorhexidine during arthroscopy. There was no proof of the use of chlorhexidine in the other two patients, but the history and findings were similar.

Case 1. A 26-year-old man had an arthroscopy for a lesion of the lateral meniscus in his left knee. After the operation it was discovered that aqueous chlorhexidine 1% had been used for irrigation instead of normal saline.

Two months later he was referred to us with increasing pain, swelling and crepitus in the knee. He had severe loss of movement and atrophy of the quadriceps. Radiographs already showed loss of joint space in all compartments of the knee. Open debridement and synovectomy were performed, with biopsies taken for histology. The knee showed extensive chondrolysis and proliferative synovitis, but the procedure produced no improvement. After another two months arthroscopic arthrolysis and manipulation under anaesthesia also failed and progressive radiological degeneration was seen.

Three years after the initial arthroscopy a further open debridement with removal of loose bodies and periarticular calcification led to spontaneous fusion of the joint in 10° of flexion.

Case 2. A 21-year-old man had diagnostic arthroscopies of both knees for persistent pain with no clear diagnosis, and again it was found that chlorhexidine 1% in aqueous solution had been used. After two months he was referred to us with pain, swelling, loss of function, atrophy of the quadriceps, loud crepitus and progressive radiological destruction of both joints. Open debridement and synovectomies were performed at intervals of one month. The gross findings were as in case 1 with loose cartilage bodies and haemorrhagic synovitis.

After follow-up for eight years, the right knee had recovered an almost normal range of movement with little pain or crepitus. The left knee showed severe limitation of movement with much pain and loud crepitus.

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0301-620X/98/38519 \$2.00

Fig. 1a

Fig. 1b

Case 1. Radiograph before (a) and one year after arthroscopy with chlorhexidine as the irrigation fluid (b). There is severe narrowing of the joint space.

Case 3. A 24-year-old man also had chlorhexidine irrigation at arthroscopy for a lesion of the medial meniscus of the right knee. After three months he presented with pain, swelling and loud crepitus, but little quadriceps atrophy and an almost normal range of movement. Arthroscopic debridement and synovectomy were performed which showed chondrolysis with hundreds of small loose cartilage bodies. At four years, this patient had little pain and fairly good function but definite crepitus. He has since been lost to follow-up.

Case 4. A 30-year-old man had an arthroscopy of his right knee for a tear in the anterior cruciate ligament (ACL) with a possible meniscal lesion. There was no clear proof of the use of chlorhexidine irrigation, but at three months the patient had stiffness, pain and loss of function. He was treated conservatively and his symptoms improved. Seven months later, repair of his ACL was started, but at arthroscopy there was extensive chondrolysis with many large loose cartilage bodies. The patient was then referred to us with pain and loss of function. Clinical examination showed a small effusion, atrophy of the quadriceps, a limited range of movement and loud crepitus, while radiographs revealed progressive loss of joint space in all compartments.

At open debridement and synovectomy we found exactly the same macroscopic damage as in cases 1, 2 and 3 in which the knees were proven to have been irrigated with chlorhexidine. The patient developed total ankylosis of the joint. The orthopaedic surgeon who had treated the patient initially found that aqueous chlorhexidine 1% was held in the operating theatre in containers with the same appearance as those for normal saline.

Case 5. Sections of synovial tissue were sent to us from another hospital for a histopathological opinion. The tissue had been taken arthroscopically from a patient who had undergone arthroscopy and partial medial meniscectomy nine weeks earlier and had developed a painful swollen knee with crepitus. Arthroscopy had shown extensive chondrolysis and the presence of many loose bodies. No further treatment had been undertaken, but the patient has deterior-

ating function in a painful and swollen knee.

All five patients were men, aged from 21 to 30 years, and none had any signs of rheumatoid or other inflammatory joint disease, infection, systemic disease or chronic use of medication. All had developed pain, loss of function, stiffness and swelling with loud crepitus at between one and three months after the initial arthroscopy. All showed radiological loss of joint space in all three compartments (Fig. 1).

An open debridement with synovectomy had been performed in two patients (three knees) and three patients had been treated arthroscopically.

Loose cartilage bodies gave the appearance of a snow-storm, with erosion of cartilage to bare bone and thickened inflamed synovium (Fig. 2).

Histopathological examination of several irregular cartilaginous fragments showed decreased staining of the cartilage matrix with absence of chondrocytes in many lacunae, particularly in the centre of many fragments (Fig. 3). The synovial specimens showed fibrosis and increased vascularity with small thick-walled capillaries. There was a sparse lymphocytic infiltrate (Fig. 4).

Even after debridement and synovectomy four of the five patients had severe impairment of function, and the only knee with reasonable use showed severe radiological deterioration of the joint space.

Discussion

The apparent effect of chlorhexidine 1% on the articular cartilage and synovial tissue contrasts with the reported effects of chlorhexidine on other tissues; most studies have shown that chlorhexidine in the appropriate concentrations has no negative effects.⁵

Chlorhexidine in a concentration of 0.02% has been advocated for the treatment of infection in the genitourinary tract, the peritoneum, skin, the subcutaneous tissues and bone.⁶⁻⁹ Revascularisation studies in the rat have shown that 0.05% concentrations of chlorhexidine were well tolerated by vascular endothelium,¹⁰ and other work has

Fig. 2

Case 1. Photograph during arthrotomy of the knee, showing typical extensive chondrolysis with erosion of cartilage down to bare bone. The synovium is thickened and inflamed.

Fig. 3

Fig. 4

Figure 3 – Case 1. Photomicrograph showing loose cartilaginous bodies with a blurred surface. Many lacunae are empty (E), but some chondrocyte nuclei are still visible (C) (haematoxylin and eosin $\times 40$). Figure 4 – Case 1. Photomicrograph showing synovial specimen with fibrosis and increased vascularisation. There is only a sparse diffuse lymphocytic infiltrate (S, synovial lining cells; F, fibrosis) (haematoxylin and eosin $\times 70$).

demonstrated no adverse effects on wound healing.^{3,11,12}

We have found few reports of chondrolysis due to irrigation of a joint with chlorhexidine. Tricoit et al¹³ reported destruction of the knee in a 29-year-old man after irrigation with a solution of chlorhexidine of unknown concentration during an open meniscectomy. Histopathological examination in this case showed the same findings as in our patients, with chondrocyte necrosis, no signs of regeneration and limited inflammation in the synovium. These authors also refer to a previous report of chondrolysis by Boulleret.

In 1986 Rombouts et al¹⁴ reported chondrolysis of the knee in a 21-year-old man after arthrotomy and irrigation with aqueous chlorhexidine 0.5%. They also described an experimental study on dogs, using chlorhexidine concentrations of 0.5% and 0.02%.¹⁴ In the 0.5% group, typical chondrolysis and loss of cartilage staining were seen, but

no pathological changes in the synovium were observed. A concentration of 0.02% did not seem to affect cartilage metabolism, but other researchers have shown that chlorhexidine 0.05% has a serious effect on the joint.¹⁵

Our series and these studies show that chlorhexidine, even in very low concentrations, may have a deleterious effect on joints. The surgeons who treated the cases which we report were not aware of the unfortunate use of similar containers of normal saline and colourless chlorhexidine 1% solution, but even without specific proof, the typical history, extensive chondrolysis, and specific findings in the synovium make the accidental use of chlorhexidine very likely.

The errors in selecting the irrigation fluid were probably due to the identical appearance of their content, and it seems advisable that chlorhexidine should always be col-

oured to prevent such serious mistakes. We also emphasise that orthopaedic surgeons should carefully check all irrigation fluids.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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