Intra-articular injection of the acromioclavicular joint

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Intra-articular punctures and injections are performed routinely on patients with injuries to and chronic diseases of joints, to release an effusion or haemarthrosis, or to inject drugs. The purpose of this study was to investigate the accuracy of placement of the needle during this procedure.

A total of 76 cadaver acromioclavicular joints were injected with a solution containing methyl blue and subsequently dissected to distinguish intra- from peri-articular injection. In order to assess the importance of experience in achieving accurate placement, half of the injections were performed by an inexperienced resident and half by a skilled specialist. The specialist injected a further 20 cadaver acromioclavicular joints with the aid of an image intensifier. The overall frequency of peri-articular injection was much higher than expected at 43% (33 of 76) overall, with 42% (16 of 38) by the specialist and 45% (17 of 38) by the resident. The specialist entered the joint in all 20 cases when using the image intensifier.

Correct positioning of the needle in the joint should be facilitated by fluoroscopy, thereby guaranteeing an intra-articular injection.

Intra-articular aspirations and injections are performed routinely on patients with acute injuries and chronic conditions of their joints to aspirate an effusion or haemarthrosis, or to inject drugs. Corticosteroids, hyaluronic acid, local anaesthetics and miscellaneous agents are frequently injected into joints to alleviate pain caused by acute injuries or chronic diseases.¹⁻³ Serious complications following unintentional peri-articular injection of corticosteroid are well documented as far as major joints and those of the fingers are concerned.⁴⁻⁶ However, only a few reports exist regarding the frequency of unintentional peri-articular injections in acromioclavicular joint.^{7,8} The objectives of this study were to estimate the overall frequency of peri-articular injections using a cadaver model, to investigate the degree to which experience contributes to successful injection of the joint and to compare the results using an image intensifier.

Materials and Methods

There were 76 acromioclavicular joints (38 left, 38 right) from 38 cadaver specimens (20 male, 18 female) with a mean age of 74.8 years (59 to 98) at the time of death. The cadavers were preserved using the method of Thiel.⁹ In the image-guided control study the specialist injected 20 acromioclavicular joints (ten left, ten right) in a further ten cadaver specimens.

This special embalming technique, which was developed over a period of 30 years, preserves the original colour, consistency and degree of transparency of the tissue, with a full range of passive movement of the joints.⁹ Joints with advanced arthritis, evidence of trauma or other pathological changes detected by radiography were excluded from the study. An inexperienced resident (SG) in his first year of training and a skilled specialist surgeon (WG) with 15 years of experience were chosen to perform the injections. Each punctured a total of 38 joints, 19 on the right and 19 on the left. A 14-gauge needle was connected to a 5 ml syringe and filled with methyl blue; 0.2 ml was injected into each joint. The current literature suggests that injection of the acromioclavicular joint should be carried out by positioning the needle almost perpendicular to the joint (Fig. 1).¹⁰ This technique was used in the study group without the use of radiographs or an image intensifier in order to simulate routine clinical practice. After completion of the injections an arthrotomy was carried out and the location of the injected methyl blue recorded in each case. In the group in which an image intensifier was used the cadaver lay supine and the image intensifier was placed in an anteroposterior direction. An identical technique and equipment were used (Fig. 2). All results were

Fig. 1

Photograph showing injection of methyl blue into the acromioclavicular joint of a human cadaver.

Fig. 2

Photograph showing injection of the acromioclavicular joint guided by an image intensifier. The patient lies in a supine position. The image intensifier is replaced anteriorly. The small figure on the left side shows the image intensifier monitor.

entered into a computer database and analysed using Microsoft Excel 2003 (Microsoft Headquarters, Redmond, Washington). A chi-squared test was used to assess correlations and p -values < 0.05 , and chi-squared values > 3.84 were deemed to be statistically significant.

Results

In the study group the rate of unintended peri-articular injection was unexpectedly high, with 33 of 76 (43%) of injections outside the joint. The specialist had a failure rate of 42% (16 of 38) and, surprisingly, the resident's rate was similar at 45% (17 of 38). No significant correlation between experience and the rate of successful punctures could be detected. No correlation between gender ($p = 0.12$,

chi-squared 2.42) or side ($p = 0.17$, chi-squared = 1.88) and the rate of peri-articular injection was found. Of the injections that were misplaced, 13 of the 33 (40%) were superior, nine (27%) were inferior, six (18%) anterior and five (15%) posterior to the joint. In the injections guided by the image intensifier the specialist placed the needle in the joint on all 20 attempts.

Discussion

Injections into the acromioclavicular joint are frequently carried out to effect relief of pain in acute traumatic and chronic degenerative diseases.^{1,2,10,11} Injection of corticosteroids may lead to a significant reduction of pain.^{1,7,8,12} There is a paucity of literature describing the frequency of peri-articular injections in acromioclavicular joints.^{7,8} Technical difficulties in introducing a needle into the joint may arise from its orientation and the variations of its inclination. Urist¹³ first examined the variations of inclination in 1946 and described four types of joint orientation: lateral inclination with an 'over-riding' clavicle (49%); vertical orientation (27%), medial inclination with an 'under-riding' clavicle (3%), and incongruous joints (21%).¹⁴ The angles of inclination may vary by up to 50°.¹³

We were unable to find any reports of complications following unintended peri-articular injection of the acromioclavicular joint, but problems with major joints and finger joints are common. Gerster and Fallet¹⁵ described four cases of peri-articular calcification related to injection of corticosteroid into the small joints of the hands, and such changes are known to be caused by triamcinolone hexacetonide and by prednisone in particular.^{4,16,17} Several studies *in vivo* and in animal experiments have described the effects of local corticosteroid injection on tendons such as tendon rupture and reduced strength of bony attachment of ligaments.^{5,6,18,19} Diagnostic injections of acromioclavicular joints are carried out frequently and an unintended peri-articular injection, giving no benefit, may possibly lead to a misinterpretation of symptoms. The patient could therefore subsequently undergo inappropriate surgery as a result of failure of awareness of the inaccuracy of the injections.

Jones et al⁷ injected various joints in 109 patients with a mixture of methylprednisolone and a radiographic contrast medium in order to determine the frequency of successful intra-articular delivery. In this study only a single injection of the acromioclavicular joint was performed, and this was found to be extra-articular. Partington and Broome⁸ studied the success of injection into the subacromial space and the acromioclavicular joint in 12 cadaver specimens. The rate of peri-articular injection was 34%, slightly lower than in our study.

In this study we decided to exclude specimens with high-grade arthrosis in order to demonstrate that even the puncture of a healthy acromioclavicular joint is a demanding procedure. In clinical practice many patients suffering from acromioclavicular pain have a high-grade arthrosis, making this procedure even trickier. When our specialist used an

image intensifier to guide his injection all procedures were successful. By using fluoroscopy the type of joint orientation as well as overriding osteophytes may easily be detected, and the needle may simply be inserted into the joint under direct vision. We recommend this simple technique in difficult cases in order to ensure an intra-articular injection.

In conclusion, our results suggest that accurate intra-articular injection of the acromioclavicular joint is a challenging procedure, as even an experienced physician cannot guarantee success. The ability to aspirate synovial fluid is a sure sign that the needle is in the joint. If aspiration of synovial fluid is impossible, physiological salt solution may be injected and subsequently aspirated to confirm the intra-articular position of the cannula. Local swelling or a smooth injection do not necessarily indicate correct intra-articular placement of the needle.¹² In cases of doubt, injections guided by fluoroscopy are to be recommended as a means of preventing unintended peri-articular injection and subsequent complications.

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