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Original Article

Efficacy of using an air arthrogram for EUA and injection of the hip joint in adults

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ABSTRACT

Aim: Hip arthrography usually requires the injection of iodine based dyes which can cause complications. We wanted to determine the accuracy of using air for hip arthrography.

Method: A prospective study was undertaken including all adults who had a hip arthrogram. We initially did an air arthrogram and subsequently injected iohexol to see if we were still in the joint.

Results: Forty injections were done. Mean age 32 years. There was a 100% success rate with obtaining a positive air arthrogram.

Conclusion: Air arthrogram of the hip offers a safe, cost free and accurate alternative to iodine based arthrograms.

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1. Introduction

Hip aspiration and arthrographic investigation are important clinical tools in the evaluation and treatment of the painful hip. These skills are utilized in both the adult and paediatric populations.

Methods to confirm entry into the joint include aspiration of synovial contents, injection of contrast material/air and injection and subsequent aspiration of sterile saline.^{1–4} More unusual methods to ascertain entry into the hip joint include a “waggle” sign, suction air arthrography⁵ and the “flexion sign”.⁶

The difficulty with needle placement in the hip joint is attributable to the fact that the hip lies deep in the soft tissues and is surrounded by neurovascular structures.

Needle placement in the joint is still heavily operator dependent. Even though the use of ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) are increasing, fluoroscopy remains the most frequent modality in the intraoperative setting.

Iodine based contrast agents are commonly used to determine entry into the hip joint. There are two main classes of these; ionic and non ionic. Ionic ones hyperosmolar and are associated with greater side effects than the non ionic hypo-osmolar types. Adverse effects of such contrast agents include pain, swelling sensation, muscle weakness, haematoma at the injection site and even an anaphylaxis reaction.^{7–10} There have also been reports of chemical synovitis being associated with intraarticular iodine contrast agents.^{10,11} They are also not recommended for patients with

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significant renal or hepatic impairment and can interact with epilepsy medication.¹²

We wanted to determine the accuracy of an air arthrogram in confirming hip joint entry and whether this could be used as a safer substitute to iodine based contrast media in the adult population.

2. Methods

This was a prospective study including all adults who had a hip arthrogram at the Royal Orthopaedic Hospital Young Adult Hip Unit over a three month period from 1st Sep to 31st Nov 2013. The arthrogram was performed by either the consultant or the orthopaedic specialist trainee (ST3 and above). Patient demographics were recorded.

2.1. Technique

The patient was placed supine and skin cleaned with Chlorhexidine Gluconate Solution 20% (Ecolab Ltd, Leeds, UK). For patients not undergoing a general anaesthetic, 10 ml of 1% lidocaine were infiltrated around the proposed site.

Using a 18G spinal needle and an image intensifier the joint was entered using an anterolateral approach. Once the needle hit the bone it was withdrawn by 1 mm and aspirated to ensure it was not in a vessel. The inner needle was removed and a syringe with 10 ml of prefilled air was attached and injected. An image was taken to check for an intracapsular air ring sign indicating the needle was in the joint (Fig. 1). If this was

negative then the needle was remanipulated and a further 5 ml of air injected. Once a positive result was obtained then 3 ml of contrast (iohexol [Omnipaque 240™] GE Healthcare), along with the steroid (1 ml of 40 mg of Triamcinolone Acetonide [Bristol-Myers Squibb, Middlesex, UK]) and 3 ml local anaesthetic (0.5% bupivacaine), was injected through the same needle. Another image was then taken (Fig. 2).

We recorded the number of positive air arthrograms and how many of these were confirmed as intraarticular once the iohexol dye was injected.

3. Results

There were forty injections done in total. Twenty-five were female. The average age was 32 years (18–57). Nineteen had the right hip done. Four were bilateral. The consultant performed nine of the procedures. Twenty-five had a general anaesthetic. There was a 100% success rate with obtaining a positive air arthrogram. The average number of attempts being 1.1 (1–2). All had a positive result when the iohexol was injected. One patient had leakage of the liquid contrast outside the joint but there was some within the joint. This patient had two attempts to get a positive air arthrogram (Table 1).

One patient had to be excluded from the study. She was allergic to iodine based dyes and so only had the air arthrogram which was positive on the first attempt.

Fig. 1 – Intraoperative image showing an intracapsular air ring after injection of air.

Fig. 2 – Intraoperative image of the same patient showing a positive arthrogram after the injection of iohexol (Omnipaque™).

Table 1 – Patient demographics and results.

Patients	M: 15 F: 25
Mean age (range)	32 (18–57)
Side (bilateral)	L:21 R:19 (4)
Anaesthetic	GA: 25 LA: 15
Air arthrogram attempts (number of patients)	1 (36) 2 (4)
% positive air/iohexol arthrograms	100/100

No adverse events were seen or reported by the patient that could be ascribed to the use of air during the study.

4. Discussion

Our results demonstrate that using air is just as efficacious as using contrast based dye in hip arthrography.

Confirmation of intraarticular injection is particularly important in diagnostic injections. One of the more common differential diagnosis of hip pain is psoas tendinopathy.¹³ The psoas sheath lies directly in front of the hip capsule and can easily be injected by mistake giving an incorrect result.

Complications of intraarticular administration of contrast material have been well reported. A large retrospective questionnaire of radiologists who regularly performed arthrography captured 262,000 procedures. They reported a complication rate of 3.6%, of which 0.03% were severe reactions e.g. anaphylaxis.¹⁰ A similar study had 126,000 cases. They reported no deaths, three cases of infection, and 61 cases of hives. Other acute reactions included hypotension, seizures, air embolism, and laryngeal oedema.¹¹ Related complications included sterile chemical synovitis, severe pain after the procedure, and vasovagal reactions. The incidence of death from intravascular iodinated contrast administration is small with a reported rate of 0.005%.^{14,15}

Another article reported post-arthrography severe delayed onset pain of 66% in 135 patients following MR arthrography using gadolinium. We have noticed that some patients do experience severe pain post iodine based arthrography. This can give a false negative result if used for differentiating whether pain is coming from the hip or referred from elsewhere. Post procedure pain and discomfort is well documented in the product literature.¹²

There have been no reported cases of hip arthrography using air as a contrast medium causing serious complications in adults. However, there have been cases in the paediatric population. The first case describes a 3-month-old weighing 6 kg who was scheduled for a left hip arthrogram. The authors report that after injection of 10 ml of air into the hip joint the child became hypoxic. The child was subsequently given atropine and made a good recovery.¹⁶ We believe that giving 10 ml of air is far too much in a 6 kg child as they have an effectively small circulating volume compared to adults. A similar case was reported with a 5-month-old being given 14 ml of air.¹⁷

Another reported case involved a 4 month old with suspected bilateral hip dislocations. Using radiography they injected 30 ml of CO₂ into each side. Furthermore, they did not state if they aspirated prior to injection to ensure they were not in a vessel. When they tried to remove the CO₂ after the

child desaturated the joint was full of blood.¹⁸ The cause of this desaturation could possibly be the large volume of CO₂ injected and not aspirating prior to air entry to check no vessel has been entered.

What these cases show is that the complication could be due to the volume of air injected or the fact the joint was not aspirated prior to injection. We would not recommend injecting air into neonates or infants.

A recent case highlighted a four month old who underwent hip arthrography for a dislocated hip. A successful air arthrogram was performed followed by introduction of contrast material. During this the child desaturated. The authors were not sure if the complication was due to an air embolism or a reaction to the dye. It was noted that the child had a previous reaction to a penicillin based antibiotic.¹⁹

No such cases have been reported in the adult literature.

There is also the issue of financial benefits with using air. For ten vials of Omnipaque™ it costs £208.01.¹² Our unit does approximately 20 injections a month which annually equates to £4992.24. This represents a reasonable cost saving in times of financial austerity.

Mini-air arthrograms to confirm correct needle placement for intraarticular knee injections has been described, but no articles have described this technique for the hip.²⁰

Criticisms of this study include the numbers of patients used. However, in view of the fact that we had 100% rate of air arthrogram to contrast arthrogram further patients would unlikely have changed the outcome.

Air arthrogram of the hip offers a safe, cost free and accurate alternative to conventional contrast arthrograms. Avoiding contrast reduces the risk of postoperative discomfort resulting in a more precise diagnostic test, without increasing the complication profile.

Conflicts of interest

All authors have none to declare.

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