Meeting the NHS Targets: Day Case Arthroscopic, Anterior Cruciate Ligament Reconstruction: A Tourniquet-less Technique using a Pressure Controlled Saline Epinephrine Irrigation System.

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This is a report of 28 patients who underwent arthroscopic, Anterior Cruciate Ligament (ACL) reconstruction without the use of a tourniquet, but using saline and epinephrine, pump regulated, irrigation. Each case was performed as a day case by the same surgeon for the period May 2003 to November 2004. 5 patients had their tendons reconstructed with the use of patellar tendon grafts, the remainder, 23 patients, had hamstring tendon grafts. The study included 4 women and 24 men. This prospective study assessed cost effectiveness, clinical efficacy by measuring post-operative pain and post-operative results and finally whether this procedure remained the "patient choice". The mean age was 30.6 years, (range 17 – 46). In addition to assessing level of immediate post operative pain the patients were also assessed at two weeks and six weeks for pain, range of movement, swelling and for the occurrence of any early post-operative complications. We were able to show that there was a significant cost benefit, approximately one third to a half in comparison to other local surgeons; that the study was clinically effective and that there were no reported early complications; and that all 28 patients would choose to have the surgery again as a day case procedure with this technique. We would like to present day case ACL reconstruction as a safe option for the carefully selected patient and as a procedure that could perhaps be included in the orthopaedic basket for day case surgery in the UK.

There is increasing pressure on hospitals to provide elective surgical procedures on a Day Case basis. This pressure, whilst once vague, has materialised in very real targets set by the government. These targets have two deadlines, in 2005 and 2008. It is the stated aim of the government[i] that by 2005 no one will wait more than 6 months for their operation and that the patient and GP will be able to choose where and when that operation will take place. There are approximately 3,200,000 day case surgeries undertaken every year by the NHS[ii]. This is roughly 50% of all surgeries. The government would like to see 75% of all elective surgery performed as day cases increasing the figures by some 120,000 per annum. This has been backed up by an increase in spending for the NHS of some £68 million[iii].

Day case ACL in the UK was reported as early as 1998[iv]. Despite Governmental pressure to increase the use of Day Case Surgery there has been no appreciable increase in the

number of centres performing this procedure. Improved operative techniques have reduced operation times and decreased the risk of complications. These advances make outpatient ACL reconstruction surgery a real alternative. Day case surgery should be clinically beneficial, cost effective and the patients' choice. Many surgeons have found that ACL reconstruction cannot be effectively performed as a day case procedure due to the complications of using a tourniquet to achieve an adequate intra-operative, bloodless surgical field. Furthermore post-operative pain associated with tourniquets and their potential for a reactionary haemarthrosis, necessitates the use of regional nerve blocks that often delays mobilisation and early discharge.

Until now it has been generally accepted that haemostasis should be achieved with the use of a tourniquet. We present 28 patients treated without the use of a tourniquet. Instead all patients had epinephrine added to their saline irrigation, the infusion rate of which was pump regulated. This system has been shown to be safe in several papers and if well controlled poses no dangers of local or systemic toxicity.[v,vi]

MATERIALS AND METHODS

28 patients had day case arthroscopic ACL reconstructive surgery in the day units of The Royal Centre for Defence Medicine (RCDM), Good Hope NHS Trust and The Nuffield Hospital in Birmingham. The same surgeon performed the surgeries using the same technique but with a variance of 5 patients having bone – patellar tendon – bone grafts (BTBg) and 23 patients having hamstring tendon grafts (HTg). The lead author of this paper (AP) learned this technique whilst working in Canada where it is a proven day case procedure. The mean age of the patients was 30.6 years, (range 17 – 46). There were 24 male and 4 female patients. Graft selection was based on well-established clinical criteria including the nature of the individuals' sport, the presence or absence of anterior knee pain and general patient profile.

Pre-operative Selection and Management

All patients had their diagnosis confirmed before operation by clinical evidence alone. It is the belief of the senior author that ACL rupture is a clinical diagnosis and does not require investigations to confirm this. MRI was only performed in those patients where concomitant injuries were suspected. Patients were selected for day surgery if they met the RCDM criteria; these are based on the Royal College of Surgeons Guidelines for Day Case Surgery (1992). All patients were given a copy of the surgeons Knee Arthroscopy and Day Case ACL Information Pack. For optimal infection control, they were asked to Imac™ the affected limb between mid thigh and ankle the evening prior to theatre and issued a betadine/chlorhexadine impregnated scrubbing sponge for use on the morning of the operation.

Intra-operative Management

All operations were performed on the morning list and a single anaesthetic consultant (AI) was responsible for all of the operations.

At surgery all patients had general anaesthesia and laryngeal masks. A total of 20 ml of local anaesthetic (1% lidocaine with adrenaline 1 in 200,000) was infiltrated at the donor site, the portal sites, and into the knee joint. No regional anaesthetic block was used. Single dose, prophylactic, intravenous antibiotics were administered intra-operatively.

A clear operative field was achieved with the use of pump controlled, continual irrigation of 20ml of 1 in 1000 epinephrine diluted in a 3-litre bag of saline. No tourniquet was applied. It was rarely required, for the intra-articular operative field to be made dry at which point the infusion was temporarily stopped. The flow was maintained at no more than 30 – 40 mmHg with a rate of 50 – 75%. There were no complications associated with the irrigation. The volume of irrigation fluid used was 4.2L (2L – 8L).

Harvesting of the graft was performed first and prepared by the assistant whilst the surgeon proceeded to do the arthroscopic notch clearance, notchplasty and subsequent reconstruction. Fixation of the graft was achieved using well-described techniques.

The operation time was on average 71.5 minutes (range 55 – 85).

Post-operative Pain Control

On completion of the operation, a total of 20ml of 0.5% marcaine was injected into the harvest site and the knee joint.

Just prior to discharge the pain team assessed the pain level of the patients and one of three regimens was chosen. 1) Paracetamol 1g qds for 7 days. 2) Paracetamol 1g qds and diclofenac 50 mg tds for 7 days. 3) Paracetamol 1g qds, diclofenac 50mg tds and codeine phosphate 60mg qds for seven days. No patient was discharged unless the pain was subjectively and objectively assessed to be manageable. Subjective assessment was determined using the Visual Analogue Pain Scoring system.

Criteria for discharge

Patients were discharged once they fulfilled the following criteria. 1) Adequate pain control. 2) Able to weight bear on the affected limb. 3) No adverse bleeding, swelling or oozing. 4) No nausea, vomiting or anaesthetic sequalae. 5) That their overnight accommodation was within 1 hours travel of the hospital.

Rehabilitation

A modified version of the ACL Rehabilitation Protocol of the University of Calgary, Sport Medicine Centre[vii] was used, Appendix 1. Patients were discharged with a single layer of tubigrip™ over mepore™ dressings. The joint was protected in a cricket pad splint and they were allowed to fully weight bear with crutches for support. The 23 patients who had HTg were not permitted to begin the programme until 14 days post operation.

Follow up evaluation

Patients were initially seen in clinic two weeks post-op. At this time the patients were asked to gauge their pain on a scale of 1 (no pain) to 10 (intolerable pain).

Patients were assessed for undue bleeding and oozing. Subjective assessment of the injured knee was undertaken by measuring the scale of swelling, mild, moderate or significant, and the range of movement.

Patients were next followed up at 6 weeks. The same measurements were assessed as at the two-week stage. At this appointment leg strength was checked clinically.

At a period of at least 2 months post operation, questionnaires were sent to all those in the study. Patients rated pain immediately post-operatively, at two weeks, and at six weeks, and for how long analgesia was required. They were also asked if in the first two weeks any undue swelling, bleeding or oozing was noted. The patients also indicated whether or not they had visited their family doctors due to any pain, swelling, fever or weeping wounds. Finally all 18 patients gave their opinion on recommending the procedure as a day case to others and if necessary, would they have the procedure again using this technique.

RESULTS

28 patients were included in the study. 5 patients had their tendons reconstructed with the use of BTB grafts, the remainder, 23 patients, had HT grafts. The study included 4 women and 24 men. The mean age was 30.6 years, (range 17 – 46). All patients were involved in sport or regular physical training ranging from recreational to professional and including occupational (military personnel).

Cost Effectiveness

The costs of the complete intra-hospital treatment of the patients involved in the study were compared against the expenditures incurred using similar techniques, within the same trusts and others, table 1. The study was competitively priced with savings of at least two thirds. The majority of the savings were made in hotel services.

Clinical Efficacy

Intra-operative factors

In all of the above procedures, clear visualisation was obtained during each and every step of the ACL reconstruction (Will get figures). Careful attention was paid to obtain accurate tunnel positioning, the avoidance of graft impingement and the achievement of secure fixation.

Readmission

No patients were readmitted in the course of the study.

Post-operative pain control

All patients were discharged on the day of the operation. No patient felt that their pain was not adequately controlled at the time of discharge or at any later stage, and all were able to leave with crutches, cricket pad splint and fully weight bearing.

Clinical examination

By six weeks all patients had full extension of the injured knee and flexion to within 10° of normal flexion. No patients presented with haemarthrosis, arthrofibrosis or required manipulation. No patient presented with undue swelling, bleeding or oozing. At six weeks, graft stability was assessed using the Lachman, the anterior Drawer and the Pivot-Shift tests and no instability was noted on comparing it to the contralateral knee.

Patient Choice

In all cases, the study has shown that this type of surgery is the patients' choice. There were two patients included in the study who had had previous surgery on the contra-lateral knees at a different institute. These patients also expressed their preference to have this procedure as a day case.

DISCUSSION

There is increasing pressure on trusts to provide surgery as day cases. The Government has stated that trusts should be performing 75% of elective procedures as day case surgeries in order to meet the 2005 and 2008 waiting list targets. These drives are designed to increase Day Case procedures by 120000 from the 3.2m currently performed annually in the UK.

Day case arthroscopic ACL reconstruction was described as early as 1995[viii] but is still not a widely accepted or practiced technique. The use of Day Case arthroscopic ACL reconstruction has been described before both in specialist centres and in District General hospitals where resources are often limited. This study aimed to show that it is a technique that is cost effective, amenable to patients and is in no way detrimental to the recovery of the patient.

Many surgeons elect to admit their patients in order to adequately control their pain relief and initiate physiotherapy. We were able, primarily by not utilising a tourniquet for intra-operative haemostasis, and by not using regional blocks for analgesia, to discharge all of our patients with adequately controlled pain relief on the same day.

Post-operative complications associated with the use of Tourniquets

Tourniquets are often used in limb surgery to create haemostasis and produce a bloodless surgical field. This is assumed to be important for visibility during an operation particularly in procedures where visibility is limited or reduced by the approach.

Tourniquets are known to produce neurovascular injuries such as arterial occlusion[ix] and nerve compression[x]. They are also linked to muscle damage[xi], compartment syndromes[xii] and thromboembolic events[xiii]. This may explain the accepted view that tourniquets also produce pain due to ischaemia and through reperfusion injuries. Clinical studies also point to the use of a tourniquet causing post-operative haemarthrosis[xiv] through reactionary vasodilatation. There is a known adverse effect on rehabilitation by delaying recovery of muscle strength[xv]. We found that tourniquets were not necessary to provide a clear visual field in knee arthroscopy; this confirms previous studies that looked into their use.[xvi,xvii]

Regional Block

There are also questions raised over the use of regional blocks to provide analgesia both for the operation and the use of the tourniquet. There is certainly no doubt that it may be necessary to hospitalise a patient whilst the effects of the anaesthesia and paralysis produced have the time to wear off.

Published opinion varies as to the need for femoral nerve block post day-case ACL reconstruction. Mulroy found it to contribute significantly to a multimodal postoperative analgesic regime, providing analgesia for the first post-operative night[xviii]. On the other hand Frost found that while femoral nerve block did improve post-operative analgesia, the difference in pain scores between this and a sham block technique was small and unlikely to be clinically significant[xix].

Using nerve blocks for postoperative analgesia increases the length of the procedure, exposes the patient to a further range of possible complications, and may not be necessary for a non-tourniquet based surgical technique. It is the opinion of these authors that satisfactory analgesia can be provided in the majority of cases for day-case ACL repair without the use of nerve blocks. There is anecdotal evidence that acute onset rebound pain can occur once the effects of the block have worn off which may then necessitate the use of supplemental morphine or patient controlled analgesia pumps. We came across no such problems in our study.

Epinephrine Saline Irrigation

Several papers have shown that arthroscopic surgery can be safely performed under irrigation and that there is adequate visual clarity and haemostasis. Although there is anecdotal evidence to suggest there is a danger of systemic effects from epinephrine entering the blood stream we were able to demonstrate that close control of the intra-

operative pressures and fluid volume and the creation of 'leaky portals' negate this danger.

Rehabilitation

Using proven outpatient rehabilitation protocols we believe that we are still able to return our patients to their previous levels of competition. We were able to demonstrate that at the six-week point there was no difference in outcome using BPTBg or HTg. We also show that performing the procedure in the day surgery unit does not compromise clinical results. Due to the current follow up period, we are unable to confirm the long-term outcome of this study and or the return to full physical function though the early batch of patients (currently 10 at a years follow up) have had excellent results and have returned to their pre-injury level of sporting activity.

Cost

The cost of the procedure, materiel and hotel services required for this operation were compared against two other surgeons performing ACL reconstruction surgery in the same hospitals as this study. The major expenditure incurred by inpatient procedures is hotel and overnight costs. We were able to confirm that standard costs across the other NHS trusts makes this procedure cost effective regardless of the centre in which it is practiced. Our study shows that using well-documented techniques, the most appropriate equipment and simple splintage/support materiel, this procedure is approximately two thirds cheaper than non-outpatient procedures. This represents a substantial saving over other forms of ACL reconstruction and frees up beds for other orthopaedic cases.

The importance of pre and post operation communication between surgeon and patient was felt to be critical in this study. Clear indications of the time lines and onus on the patient, and his/her family or carers, for full recovery were clearly stated and presented in our pre-operative information pack. The input of a well trained theatre team and physiotherapists familiar with the rehabilitation protocol were seen to be invaluable. Many of our patients were from the military environment and did not stay within the catchment areas of the hospitals. A copy of the rehabilitation protocol was made available to all of those involved. In these cases extra care was taken to ensure that their physiotherapy and medical support was well informed and that any excessive travel pre or post op was limited by the use of local military accommodation.

We also felt that infection risk was effectively limited by keeping day case patients separate from the general hospital population and by promoting a hairless, sterile field.

CONCLUSION

We have demonstrated that admission on the day of surgery and postoperative complications can be reduced by the use of epinephrine instilled into the joint as an alternative to tourniquet haemostasis and regional block.

This study shows that arthroscopic ACL reconstructive surgery is a feasible alternative to in-patient procedures. In a time of increasing pressure to increase the use of day case surgery we believe that it is time to revisit this procedure.

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Table 1.

Surgeon	Surgical Costs	Hotel Costs In Patient 3 – 7 days	Hotel Costs Out Patient	Cricket Pad Splint	Don Joy Splint	Antiseptic Brush	Total (£)
1 Arthro	773.86	735 - 1715			315		1824.86 – 2803.86
2 Open	207.46	735 - 1715			315		1257.46 – 2237.46
3 (AP)	857.04		199	16.50		0.30	1072.84