Injury, Int. J. Care Injured 47 (2016) 1744–1749

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Efficacy of knee joint aspiration in patients with acute ACL injury in the emergency department

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ARTICLE INFO

Article history:
Accepted 16 May 2016

Keywords:
Anterior cruciate ligament
Emergency department
Physical examination. joint aspiration
Hemarthrosis

ABSTRACT

Purpose: To evaluate the influence of joint aspiration on the sensitivity of physical examination for diagnosing acute anterior cruciate ligament (ACL) lesion in the second outpatient-department (OPD) follow-up referred from emergency department (ED).

Methods: This retrospective study included sixty patients underwent ACL reconstruction with initial visit at ED. They were divided into two groups based on the presence or absence of joint aspiration at ED. All participants were referred to second OPD follow-up within 7–14 days after the injury. Clinical manifestation (including visual analogue scale (VAS) for pain, range of motion (ROM), and severity of knee effusion) and physical examination (Lachman test and pivot shift test) were checked in ED and the second OPD follow-up.

Results: The group of patients with joint aspiration (G1) showed substantial decreases in mean values of VAS for pain ($p = 0.005$), ROM ($p = 0.001$), and effusion level ($p < 0.001$), even higher VAS and effusion level and lower ROM at the initial visit of ED than the other group (G2). The sensitivity of positive Lachman and pivot shift test was significantly ($p < 0.05$) increased following knee joint aspiration. Positive Lachman test was recorded at 76.5% in the second follow-up in G1, which was significantly ($p = 0.047$) higher than that (47.6%) in G2. The percentage of positive pivot shift test was recorded at 76.5% in the second follow-up in G1, which as significantly ($p < 0.001$) higher than that (31.0%) in G2.

Conclusions: Knee joint aspiration in acute ACL injury with suspected hemarthrosis could be considered as a diagnostic procedure. Joint aspiration in early medical attendance might be able to lower pain scores or raise the sensitivity of physical examination for diagnosing acute ACL injury at follow up visit in orthopedic outpatient department.

Level of evidence: Retrospective cohort study III.

Introduction

Rupture of the anterior cruciate ligament (ACL), a severe knee injury, is often acquired during sporting activities [1,2]. It often results in instability. Symptoms may include sudden pain in the knee joint at the time of injury with an audible pop or crack. Patients may feel instability. Rapid swelling may occur due to bleeding within the joint. Many cases are initially missed in primary care [3]. These undiagnosed ACL injuries are of concern because they can results in a high risk of subsequent damage to the menisci and the articular cartilage [4–8] as well as premature knee osteoarthritis [9]. Several studies have reported that only about 10% of patients with ACL injury has been correctly diagnosed by the first physician. The average delay from the first presentation to diagnosis is reported to be 2–21 months [3,10–13].

With acute knee injury, physicians in the emergency department (ED) primarily put their aims to rule out fractures of the knee by utilizing radiography. If ligamentous or meniscal injury is suspected, the physician should arrange for expedited follow-up with the primary care physician or an orthopedic specialist for an MRI for further management. There is an increasing number of patients with low-acuity complaints of musculoskeletal injuries because physicians rely heavily on the mechanism of injury and clinical tests [14,15].

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http://dx.doi.org/10.1016/j.injury.2016.05.025
0020-1383/

On characteristics of ED patients with acute injury, accurate diagnosis of ligament laxity caused by ACL injury has fundamental limitations. Recently, Parwaiz et al. have reported that the diagnosis rate of ACL for patients with ACL injury who visited ED as their first medical attendance is very low [10]. Therefore, more distinctive diagnostic features might be needed to recommend patients to visit orthopedic special clinic to aid early diagnosis of ACL injury. Nevertheless, the initial diagnosis of acute ACL injury in ED based on clinical examination is difficult because painful muscle guarding often associated with acute injury can mask physical examination findings [16]. In addition, emergency physicians may not be familiar with specific knee physical examination techniques necessary to diagnose these injuries.

Clinical manifestations in acute ACL tear with hemarthrosis include painful swelling and protective muscle guarding, restrictions in range of motion due to possible disruption to mechanoreceptors with substance- P nerve positive endings distributed in intact and ruptured human anterior cruciate ligament[17–21], and emitted inflammatory mediators [22]. Hemarthrosis identified by following joint aspiration has been known to be able to provide clues to assist the diagnosis of knee ligament injury, including ACL [23].

However, it is currently unclear whether early joint aspiration of hemarthrosis in acute knee injury in ED might relieve pain and decrease the levels of inflammatory mediators inside the joint capsule, thus aiding the diagnosis of ACL injury by physical examination of the ligament laxity at referred special knee clinic. Therefore, the objective of this study was to determine whether knee aspiration at initial visit of ED would be beneficial to relieve pain and improve the diagnostic accuracy of physical examination of ligament laxity for detecting ACL lesions in the second visit to outpatient department (OPD) in knee special clinic (OPD follow-up). We evaluated the influence of joint aspiration on the sensitivity of physical examination for diagnosing acute ACL lesion in the second OPD follow-up referred from ED by comparison patients who were referred to OPD following joint aspiration to those without joint aspiration. Our hypothesis was that knee joint aspiration would have clinical efficacy in relieving pain in patients with hemarthrosis caused by complete ACL lesion and in demonstrating ACL laxity in the second OPD follow-up.

Materials and methods

We identified all patients aged more than 18 years who had ACL reconstruction performed by a single surgeon between April 2010 and October 2015 with complete data set available. Data were extracted retrospectively from hospital notes and a dedicated patient database. Patients with knee injuries were referred from the emergency department (ED) to the senior authors' knee clinic if there was any confirmed or suspected knee pathology requiring further specialist investigation and management. All patients verified that they had some swelling of their knees within 48 h of injuries and indicated whether they had a previous injury or surgery to their knees. In patients with severe knee pain or swelling in ED, knee joint aspiration was performed to identify the presence or absence of hemarthrosis or for pain relief by orthopedic surgeon in ED. All participants were referred to a second OPD for a follow-up within 7–14 days after injuries while maintaining no motion with an immobilization brace without physical therapy. Only anti-inflammatory medication was prescribed for all patients. Participants were divided into two groups and referred to the second knee special clinic. One groups had joint aspiration while the other group had no joint aspiration. For all participants, ACL reconstructions were performed under standard arthroscopic ACL diagnostics consisting of a physical examination under anesthesia by comparing the index and control knee, inspection of the ACL and PCL origin and insertion, inspection of a possible empty wall sign at the femoral attachment, inspection of the course of fibres and bundles, and inspection and palpation of the ACL tension using a probe [24].

Exclusion criteria included: (1) chronic ACL injury (Patients with a previous history of ipsilateral knee injury or surgery were excluded from this study); (2) selective bundle rupture; (3) MCL combined injury of medial collateral ligament; (4) multiple ligament injury; (5) previous diagnosis of ACL injury or joint aspiration in other institution; (6) combined other injury requiring immediate admission for operation; (7) age over 60 years; (8) previous history of joint stabilization surgery in the contralateral knee; or (9) old ACL injury on opposite knee. However, patients with combined meniscal of cartilage injury were included (Fig. 1). Informed consent to participate in this study was obtained from each participant. This study was approved by the Institutional Review Board of our hospital.

Physical examination was carried out immediately by orthopedic surgeons in ED and by a senior knee surgeon (J.H.W.) with more than 10 years' experience in performing physical examinations for patients with knee injuries and more than 10 years' experience in diagnostic research [25] on second OPD follow-up according to a standardized protocol. The senior examiner was blinded to the history of knee aspiration in ED at the second knee special clinic.

Physical examination of both knees consisted of inspection of alignment and assessment of joint effusion, palpation of temperature, palpation of the collateral ligaments, joint line tenderness, assessment of effusion, and active range of motion in flexion and extension [35]. Cruciate and collateral ligament integrity were assessed by means of anterior drawer tests, posterior drawer tests [26], the Lachman test [26], pivot shift [27], and valgus and varus stress tests [34]. Based on clinical tests from history (popping sound at time of injury, giving way, effusion, pain, ability to continue activity) and physical examinations (anterior draw test, Lachman's test and pivot shift test), the diagnostic accuracy of ACL injury was determined as described previously [28].

Measured parameters

VAS for pain (0–10) was recorded in ED and in the second OPD follow-up. Range of motion (ROM) was recorded for all patients in supine position immediately after injury at ED and at follow-up after measuring with a goniometer. The severity of *knee effusion* was recorded with a grade from zero to two. Major effusion (when the joint was distended by a large effusion, referred to as a ballotable patella) was graded as two (Fig. 2). Minor effusion (the loss of peripatellar groove on either side of the patella) was defined when there was not enough fluid to ballot the patella. To test minimal effusion, the examiner kept the patient's knee in extension so that the "milk" or the fluid from the suprapatellar pouch and lateral side could flow into the medial side of the knee. When the joint fluid traversed the knee to create a fullness on the lateral side, it was graded as one [34]. No effusion was graded as zero.

The Lachman test was performed with the patient lying supine and the involved extremity was facing the examiner. The femur was stabilized with one hand. The patient's knee joint was in 20° to 30° of flexion. The examiner's other hand was applied to the posterior aspect of the proximal tibia. The lower leg was then given a brisk forward tug. A discrete end point should be felt. A positive test was one in which the end point was not discrete with an increased anterior translation of the tibia [26].

The (lateral) pivot shift test combined a valgus stress (pushing the outside of the knee medially) with a twisting force while the knee was being flexed. In Losee's 20 version of the test, the patient rested on his/her back with the knee at 45° flexion. The examiner