Does a Saline Load Test Combined with Direct Compression to the Knee Increase Sensitivity in the Assessment of a Traumatic Open Knee Injury?

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Purpose: *To determine whether a saline load test combined with direct compression to the knee increases sensitivity for the assessment of traumatic arthrotomy of the knee.*
Methods: *A total of 40 patients scheduled for elective inpatient knee arthroscopy and total knee arthroplasty (TKA) were prospectively enrolled. A 7 to 8 ml stab wound for arthrotomy was performed at the inferolateral site of the knee for cases who would receive arthroscopy and at the inferomedial site for the TKA cases. Then, 50 ml of normal saline was injected into the knee joint while observing fluid leakage from the arthrotomy site. It was considered a positive saline load test if there was any leakage. If not, subsequent direct compression was applied to the knee. Any leakage incurred was considered a positive compression test.*
Results: *The saline load test was positive in 13 out of 40 patients and additional 18 patients showed a positive compression test. The sensitivity of the saline load test was 32.5% while that of the compression test was 77.5%.*
Conclusion: *Additional direct compression to the knee increased the sensitivity of saline load tests in the assessment of a small traumatic knee arthrotomy (open knee injury).*

Keywords: *Saline load test, traumatic knee arthrotomy, open knee injury, direct compression*

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Introduction

Traumatic arthrotomy of the knee can be clinically diagnosed by the mechanism of injury, type of wound and physical examination. Combined clinical, radiographic and saline load tests also help achieve the diagnosis. Delayed or missed diagnosis may result in severe complications such as septic arthritis or septicemia. The saline load test is a simple method and is easily diagnosed by evidence of saline leakage from the wound. However, in cases of small wounds, the diagnosis is frequently difficult. Many articles have been published about the accuracy and sensitivity of saline load tests to diagnose traumatic arthrotomy of the knee[1-6]. Most of them indicated that the saline load test has a low detection rate[3-6]. However, this method has been routinely used in clinical practice despite insufficient literature discussing its effectiveness. In this study, direct compression to the knee joint after a saline injection was performed and hypothesized that the use of a combined method may increase sensitivity of the diagnosis. To our knowledge, there are no studies that describe the saline load test combined with direct compression.

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Patients and methods

Our study was designed as a prospective analytical study conducted by two orthopaedists at Lampang Hospital, from November 2012 to April 2013. Forty patients scheduled for elective inpatient knee arthroscopy and total knee arthroplasty (TKA) were enrolled, comprising of 22 males and 18 females. The patients' data of sex, age, height and weight were obtained from medical records and their body mass index (BMI) calculated. Exclusion criteria were history of traumatic knee injury, clinical manifestation of septic arthritis and revision knee surgery. This research was approved by the Ethics Committee of Lampang Hospital prior to data collection. Informed consent was given by all patients who participated in this study.

After preparation for the knee operation, a stab wound arthrotomy was performed at the inferolateral parapatellar site for arthroscopy and inferomedial site for TKA, with a No.11 blade at 30-degrees of knee flexion. The length of the incision was approximately 7-8 mm (Fig. 1) that of which is required for operative procedure. A blunt probe was inserted and the knee was extended, the probe was advanced into the suprapatellar pouch to ensure intraarticular placement (Fig. 2). After removal of the blunt probe, the knee was placed in full extension. Fifty ml of saline was then injected intraarticularly via an 18-gauge needle, at the superolateral or superomedial site, at a rate of

approximately 5 ml per second (Fig. 3). The surgeon and assistant observed for fluid leakage from the arthrotomy site. If there is saline leakage, the result was considered a positive saline load test. In contrast, if there was no leakage, the result was considered negative. In the latter group, further direct compression over the upper portion of patella was applied by the surgeon (Fig. 4). The compression force was approximated at 5-7 kg controlled by practicing the compression on the baby weighing scale (Fig. 5). If there was any leakage, the result was considered a positive compression test, and considered a negative compression test if there was no leakage. After completing the test, the planned operative procedure was performed.

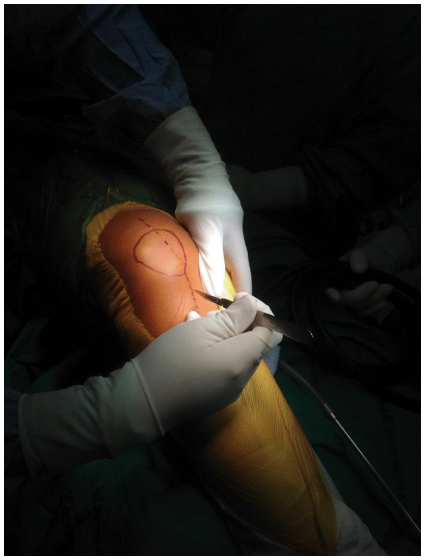

Fig. 1 A standard stab wound arthrotomy at the inferomedial site of the knee

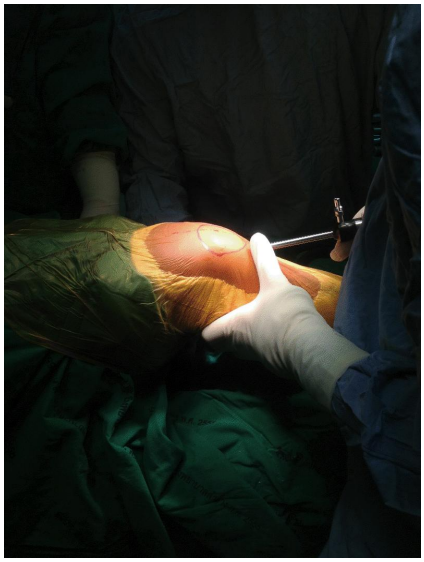

Fig. 2 Intraarticular placement is confirmed with a blunt probe

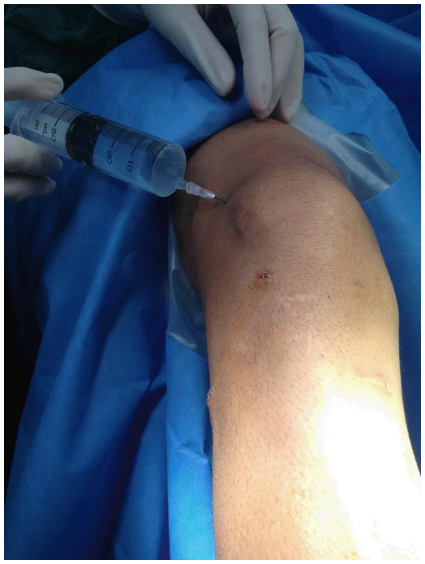

Fig. 3 A saline load test was performed and observation of saline leakage from the arthrotomy

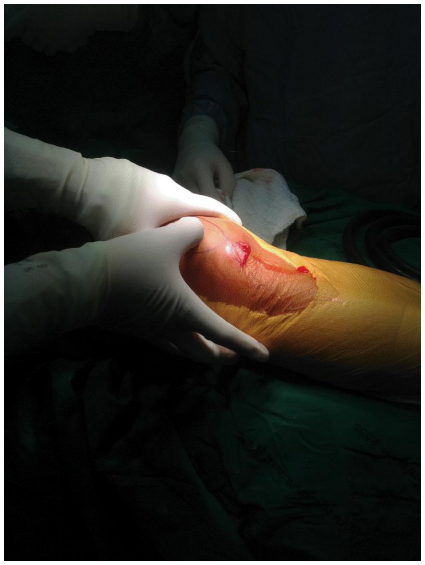

Fig. 4 Compression test on the knee and saline leakage from the arthrotomy wound

Fig. 5 Test of compression force on electronic baby weighing scale

Table 1 Patient demographic data

	Male	Female	Total
No. of subjects	22	18	40
Age (years)	47.5 (20-74)	61 (32-79)	53.6 (20-79)
BMI (kg/m^2)	23.7 (18.0-31.0)	23.5 (17.9-30.4)	23.6 (17.9-31.0)

Table 2 Saline load test and additional compression test

	Total No. of case	No. of positive test	Sensitivity	95% Confidence Interval
Saline load test	40	13	32.5%	18.6%-49.1%
Saline load test with additional compression test	40	31	77.5%	61.5%-89.2%

Results

There were 40 participants: 22 male and 18 female patients. The average age was 53.6 years (range 20-79 years) and the average BMI was 23.6 (range 17.9-31.0) as shown in table 1.

In this study, 13 of the 40 patients had a positive saline load test alone without compression on the knee. Eighteen additional patients had a positive test with subsequent direct compression to the knee. Thus, the sensitivity of the saline load test alone was 32.5% (95% confidence interval 18.6%-49.1%) and with the additional compression was 77.5% (95% confidence interval 61.5%-89.2%), as demonstrated in table 2. The false-negative rate of saline load tests and additional compression tests were 67.5% and 22.5%, respectively.

Discussion

Large traumatic arthrotomy of the knee can be diagnosed clinically, but small arthrotomies may require a saline load test for diagnosis in routine clinical practice, despite little documented effectiveness of this test[3-6]. In this study, we performed small artificial arthrotomies in elective patients that received arthroscopy and TKA surgery. We found that the saline load test of 50 ml had poor sensitivity in the diagnosis of known small knee arthrotomies. The sensitivity was found to be only 32.5% and lower than the previous studies that have found the sensitivity to be between 36% and 46%[3-6], using 50 to 60 ml of normal saline.

This study used a fixed saline volume of 50 ml. Nevertheless, previous studies have used higher volumes of saline to determine if the sensitivity of saline load tests improved. Keese et al.[3] found that, in order to increase the sensitivity to 95%, 194 ml of saline had to be used. Nord et al.[5] discovered that, as much as 175 ml of normal saline had to be used to increase the sensitivity to 99%. However, this amount of normal saline cannot be used in clinical practice because of the pain from massive joint stretching.

Tornetta et al.[4] performed dynamic tests by subsequent passive range of motion of the knee 0 to more than 90 degrees and also found low sensitivity of only 43%.

Metzger et al.[6] in 2012, compared normal saline (NS) and methylene blue (MB) injections and found that the sensitivity of saline load tests were 31% in the MB group and 34% in the NS group. They concluded that the saline load test, with or without the addition of MB dye, may not be an appropriate diagnostic test for traumatic knee arthrotomies.

In our study, additional subsequent compression upon the knee joint was performed in the group of negative saline load tests. We found an improvement of sensitivity of up to 77.5%. This could be from the increase of capsular distention by the pressure effect, resulting in extravasation of fluid from the incision wound. However, the limitation of this study was that the accuracy of the additional compression force may vary. Although the surgeons practiced pressing on baby weighing scales several times before starting the research for the required weight of approximately 5-7 kg, the force of compression in routine clinical practice will vary depending on the individual physician, size of the knee and tolerance of pain in each patient.

Conclusion

Our study suggested that subsequent direct compression to the injured knee increased sensitivity of saline load tests in the diagnosis of traumatic knee arthrotomies. However, a negative

test may not be able to exclude traumatic knee arthrotomies. We thought that increase of capsular distention by pressure effect is the key success factor, resulting in extravasation of fluid from the incision wound.

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การฉีดน้ำเกลือเข้าช่องข้อร่วมกับการกดบริเวณข้อเข่าช่วยเพิ่มความไวในการวินิจฉัยภาวะแผลทะลุเข้าช่องข้อเข่าหรือไม่

สุรสิทธิ์ พงษ์เลาหพันธุ์, พบ, ชลทาน เอี่ยมสำอางค์, พบ

วัตถุประสงค์*: เพื่อศึกษาการฉีดน้ำเกลือเข้าช่องข้อเข่า ร่วมกับการกดเพื่อเพิ่มแรงดันบริเวณข้อเข่า สามารถช่วยเพิ่มความไวในการตรวจวินิจฉัยภาวะแผลทะลุเข้าช่องข้อเข่าหรือไม่*

วิธีการศึกษา*: ทำการศึกษาในผู้ป่วยในจำนวน 40 ราย ซึ่งนัดมารักษาโดยการผ่าตัดบริเวณข้อเข่า ได้แก่ การผ่าตัดเปลี่ยนข้อเทียม และการผ่าตัดโดยการส่องกล้องข้อเข่า ทำการศึกษาเมื่อเตรียมผู้ป่วยพร้อมสำหรับทำการผ่าตัดแล้ว ศัลยแพทย์ทำการเจาะข้อเข่าบริเวณที่จะใช้เป็นแผลในการผ่าตัดตามมาตรฐานต่อไป คือบริเวณ inferomedial หรือ inferolateral ของข้อเข่า โดยใช้ใบมีดเบอร์ 11 เจาะจนทะลุเข้าช่องข้อ จากนั้นใช้ blunt probe ตรวจยืนยันว่าแผลนั้นทะลุเข้าช่องข้อจริง จากนั้นศัลยแพทย์ทำการฉีดน้ำเกลือปริมาณ 50 มิลลิลิตรเข้าภายในช่องข้อเข่า แล้วสังเกตว่ามีน้ำเกลือไหลออกมาจากแผลที่เจาะเข้าข้อเข่าหรือไม่ ถ้ามีถือว่าเป็นผลบวก ถ้าไม่มีน้ำเกลือไหลจากแผล ศัลยแพทย์จะใช้มือกดบนข้อเข่าแล้วสังเกตต่อว่ามีน้ำเกลือไหลออกจากแผลหรือไม่ ถ้ามีน้ำเกลือไหลจากแผลถือว่าเป็นผลบวก จากนั้นศัลยแพทย์เริ่มทำการผ่าตัดตามแผนการรักษาของผู้ป่วยแต่ละรายต่อไป*

ผลการศึกษา*: ผู้ป่วยที่เข้าร่วมการศึกษาทั้งหมด 40 ราย ภายหลังการฉีดน้ำเกลือเข้าข้อ พบว่ามีน้ำเกลือไหลออกจากแผล 13 ราย ในกลุ่มที่ไม่มีน้ำเกลือไหลจากแผลแล้วทำการกดบริเวณข้อเข่าต่อ พบว่ามีผู้ป่วยที่มีน้ำเกลือไหลออกจากแผลเพิ่มขึ้นอีก 18 ราย ความไวในการตรวจวินิจฉัยจากวิธีฉีดน้ำเกลือเข้าข้อเข่าเพียงอย่างเดียวคิดเป็นร้อยละ 32.5 แต่เมื่อทำการกดข้อเข่าร่วมด้วย สามารถเพิ่มความไวในการตรวจเป็นร้อยละ 77.5*

สรุป*: การกดบริเวณข้อเข่าร่วมกับการฉีดน้ำเกลือเข้าช่องข้อสามารถเพิ่มความไวในการตรวจวินิจฉัยภาวะแผลทะลุเข้าช่องข้อเข่า*