

Can the Automated Pump be an Alternative to Tourniquet in Knee Arthroscopy?

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ABSTRACT:

BACKGROUND:

Arthroscopic knee surgeries are performed in very large numbers worldwide, and in spite of relatively low complication rate, but the total number is significant. Some of these complications are due to tourniquet use and can be serious.

OBJECTIVE:

Is to asses if automated pump (with or without) dilute epinephrine saline irrigation can replace the tourniquet use in soft tissue arthroscopic knee surgeries.

PATIENTS AND METHODS:

36 patients (9 females 25 % and 27 males 75 %) were included in this prospective experimental nonrandomized study, and were necessitated soft tissue arthroscopic knee surgeries. Patients were divided into two groups, in group A (patients) tourniquet and automated pump were used. In group B (18 patients) automated pump with or without epinephrine irrigation fluid were used. For both groups, visibility, time of surgery, amount of irrigation fluid used, pressure of pump, postoperative pain and hemoglobin level before and after surgery were assessed and compared.

RESULTS:

There was no significant statistical difference(p value more than 0.05) in regard to visibility, time of surgery, amount of irrigation fluid used, pressure of pump and postoperative pain between the two groups. There was no significant statistical difference between hemoglobin levels before and after surgery in both groups.

CONCLUSION:

Automated pump (with or without) dilute epinephrine saline irrigation can replace the tourniquet in soft tissue arthroscopic knee surgeries.

KEY WORDS: arthroscopy , knee, pump, torniquete, epinephrine.

INTRODUCTION:

Arthroscopic knee surgery is one of the most commonly performed orthopedic operations. It is indicated for diagnostic and /or therapeutic purposes ,e.g. menisectomy, loose body removal, irrigation and debridement, chondroplasty, synovectomy, meniscal transplantation and reconstruction of ligaments⁽¹⁾. The arthroscopic knee surgery utilization rate is increasing e.g. between 1996 and 2006, the number of these surgeries performed in United States was doubled⁽²⁾. This increase may be due to advances in technology (diagnostic and therapeutic), increase in population growth and the good outcomes of these surgeries. These surgeries are not without complications, although the percentage of these complications is relatively low, the total number

is significant; this is because of very huge numbers of these surgeries performed worldwide. These complications can occur both intraoperatively and postoperatively e.g. intraarticular damage, compartment syndrome, instrument breakage, neurological injury, vascular injury, complications related to tourniquet use, postoperative pain, haemarthrosis, thromboembolism, infection, synovitis with effusion, synovial fistulae and complex regional pain syndrome. These complications are more likely encountered in complex arthroscopic surgeries, in patients over 50 years of age and in surgeries where the tourniquet time is more than 60 minutes⁽³⁾. The tourniquet use can be associated with localized complications such as (muscle injury, nerve injury, vascular injury, skin injury and tourniquet pain) and systemic complications such as (cardiovascular,

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pulmonary, neurological and hematological effects)⁽⁴⁾. In addition, tourniquet inflation causes blanching of the synovium, which leads to difficulty in diagnosing different synovial disorders⁽⁵⁾. The tourniquet use is contraindicated in cases like burn, skin graft, vascular graft, deep venous thrombosis in the involved limb, sickle cell disease, arterovenous fistula, severe atherosclerotic disease, severe infection in the limb and peripheral vascular disease⁽⁴⁾.

The aim of this study is to assess if we can use automated pump(with or without) dilute epinephrine saline irrigation as an alternative to tourniquet use in arthroscopic knee soft tissue surgeries.

PATIENTS AND METHODS:

A prospective Quasi experimental nonrandomized study was carried out on 36 patients (9 females 25% and 27 males 75%), with an average age of 37.4 years, ranging from 23 to 56 years, who had diagnosed to have intraarticular problems in their knee joints that necessitated arthroscopic knee surgeries, during the period from November 2012 till June 2014. All patients were prepared for surgery and admitted to hospital one day before surgery. Prophylactic antibiotics were given 30-60 minutes before skin incision. Skin preparations were just before the surgery in operative theatre, lateral post was used in all cases. Cases that need diagnostic arthroscopy, arthroscopic debridement and loose body removal, partial or complete meniscectomy for unstable tears (flap tears, radial tears, bucket handle tears), synovectomy and chondroplasty for small cartilage defect (no micro fracture) were included in this study, while cases that need ligament reconstruction and other bony procedures were excluded from this study. All surgeries were done under general anesthesia, in supine position. In all cases arthroscopic automated pump was used. All these surgeries were done by same surgeon. Patients were divided into two groups, in group A, which was made of 18 patients, pneumatic tourniquet were used and were inflated from the beginning of the surgery. In group B, which was made of 18 patients, pneumatic tourniquet were applied but not inflated and during the procedure, if the visibility was affected, then dilute epinephrine saline irrigation (1 milligram per liter) was used, if this failed to improve the visibility, the pneumatic tourniquet was inflated and the visibility was labeled as non satisfactory by using both automated pump and dilute epinephrine

saline irrigation. For both groups to prevent blistering of skin, which is frequently caused by passage of antiseptic solution beneath the tourniquet cuff, a plastic drape around the distal end of the tourniquet cuff was wrapped. For both groups, visibility (satisfactory or not satisfactory), time of surgery, amount of irrigation fluid used, pressure of automated pump, pain at 12 hours post operatively by visual analogue scale(VAS) were assessed and compared. In addition, hemoglobin levels before and 24 hours after surgeries were assessed and compared in both groups.

All patients in this study didn't need blood transfusion or intravenous fluid both intraoperatively and postoperatively. Electrocautry was not used in all patients. Same dose of nonsteroidal anti-inflammatory drug was given postoperatively to all patients. The patients were discharged home after 24 hours of surgery and seen two weeks later. All of them were without complications.

RESULTS:

The results of current study showed that visibility was satisfactory and adequate in all patients in group A, while it was satisfactory and adequate in 17 cases out of 18 cases in group B where tourniquet was not inflated (figure 1,2,3 and 4), the dilute saline irrigation was needed in only 3 cases in group B and it made the visibility satisfactory and adequate in 2 cases and failed to improve it in one case, which necessitated tourniquet inflation and in this case the visibility labeled as not satisfactory by pump and epinephrine saline irrigation fluid(figure 5). So there was no significant statistical difference between group A and B in regard to visibility (p value was 1 which is larger than 0.05)

There was no significant statistical difference between the two groups in regard to time of surgery (p value was 0.979 which is larger than 0.05), the mean surgical time for group A was 45.11 minutes and for group B was 45.17 minutes.

There was no significant statistical difference between the two groups in regard to amount of irrigation fluid used (p value was 0.206 which is larger than 0.05), the mean amount of irrigation fluid used in group A was 10.89 pints, and in group B was 11.39 pints.

There was no significant statistical difference between the two groups in regard to pump pressure in millimeters mercury (p value was 0.513), the mean pump pressure for group A was

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74.72 mm mercury and for group B was 73.61 mm mercury.

There was no significant statistical difference between the two groups in regard to postoperative pain (p value was 0.106), the mean visual analogue scale value for group A was 5.39 and for group B was 4.78.

There was no significant statistical difference between hemoglobin levels before and 24 hours after surgery in group A (p value was 0.102) and there was no significant statistical difference between hemoglobin levels before and 24 hours after surgery in group B (p value was 0.076).

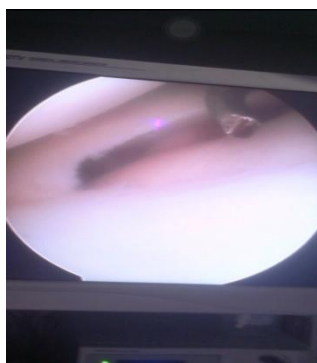


Figure 1



Figure 2

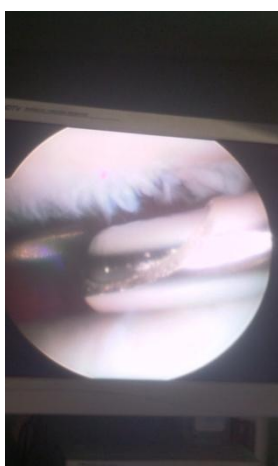


Figure 3



Figure 4

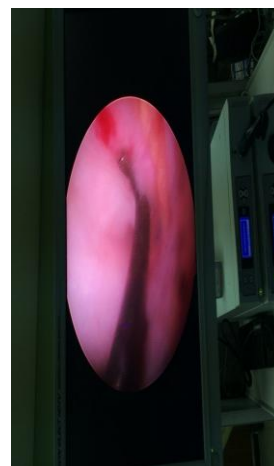


Figure 5

DISCUSSION:

Arthroscopic knee surgery is one of the commonest orthopedic procedures, it is very advancing and it has relatively rare complication rate⁽³⁾. In 1998, Small carried out a prospective study on more than 10,000 arthroscopic knee procedures, he found an overall complication rate of 1.68%⁽⁶⁾. Although the complication rate is relatively low, but the total number is significant due to very large numbers of these surgeries performed worldwide. Many of these complications are directly associated with tourniquet use and can occur both intraoperatively and postoperatively. Since its

first discovery in 1904 by Harvey Cushing, the pneumatic tourniquet was widely used in orthopedic procedures and its design was improved to become wider and conical to give better fit and to reduce the complications⁽⁷⁾, however, its complication still occur. Tourniquet complications can be localized or systemic, and are due to mechanical compression, ischemia, and reperfusion injury and can be serious causing permanent damage⁽⁸⁾. Nerve injury is the most common complication of tourniquet use, its pathophysiology is still unclear, and it can range from mild neuropraxia to severe irreversible

damage and paralysis^(9,10). There is high incidence of pulmonary embolism after tourniquet use; embolism can be caused by limb exsanguinations, tourniquet inflation and deflation⁽⁴⁾. Compartment syndrome, chemical burn and localized skin injury can also occur with tourniquet use^(11,12,13,14). The patient will develop a dull pain half to one hour after tourniquet inflation in spite of adequate regional anesthesia, and this pain will be manifested by tachycardia and increased blood pressure in those patients under general anesthesia, this pain is transmitted through unmyelinated slowly conducting C fibers which are continuously stimulated by skin compression, because the inhibition of this pain by larger myelinated A delta fibers is lost due to mechanical compression of the tourniquet⁽⁴⁾. The cardiovascular system is affected by both inflation and deflation of the tourniquet. While the limb is exsanguinated and the tourniquet inflated, there will be increase in systemic vascular resistance, central venous pressure and circulating blood volume by up to 15 % (800 milliliter), this can lead to cardiac failure in patients with poor reserve and during deflation there may be reperfusion injury by ischemic metabolites which may cause cardiac arrest. The incidence of deep venous thrombosis in lower limb surgery is the same with or without tourniquet use⁽⁴⁾.

So if the arthroscopic knee surgeries can be performed without tourniquet use, this may aid in reducing the complications associated with tourniquet use in these surgeries and will help in cases where tourniquet is contraindicated. There is some debates in the literatures about whether to use or not to use tourniquet in knee arthroscopic surgeries e.g. George HL, et al⁽¹⁵⁾ analyzed the outcome of knee arthroscopic surgeries performed without tourniquet use in regard to visibility, and postoperative complications, and they found that there was no problem with visibility noted in any of their cases, and no any significant postoperative complications, so they concluded that soft tissue arthroscopic knee surgeries can be performed adequately without tourniquet usage. While Hoogeslag A.G et al⁽¹⁶⁾ who performed a randomized double blinded controlled trial study to assess intraoperative visibility in knee arthroscopic surgeries with and without use of tourniquet, they showed that routine knee arthroscopy with the use of tourniquet significantly improved the visualization, but it didn't decrease the time of surgery. Olszewski

AD et al⁽¹⁷⁾, did a prospective randomized double blinded study and they found that the dilute epinephrine saline irrigation significantly reduced the need for tourniquet in arthroscopic knee surgeries, but they used gravity flow pump and not automated pump.

In the current study, the automated arthropump (with or without) dilute epinephrine saline irrigation was assessed to see if they can be a safe and adequate alternative to tourniquet usage in arthroscopic soft tissue knee surgeries. The results of the current study showed that there was no significant statistical difference between group A and B in regard to visualization, only 3 cases out of 18 cases in group B needed dilute epinephrine saline irrigation and the visualization was not satisfactory in only one case out of 18 cases in group B, which necessitated tourniquet inflation, the bleeding in this case came from shaving the hypertrophied fat pad.

There was no significant statistical difference between group A and B in regard to time of surgery, pressure of the pump and amount of irrigation fluid used. There was more postoperative pain in group A, but the difference was not statistically significant, this finding was also shown by Kirkley A et al⁽¹⁸⁾ and Hooper J et al⁽¹⁹⁾.

There was no significant statistical difference between preoperative and postoperative hemoglobin levels in both groups, and no blood transfusion was given neither intraoperatively nor postoperatively for all patients.

There was no compartment syndrome or severe fluid extravasations as a complication from using automated pump in current study. Bomberg BC⁽²⁰⁾, reported only four cases of severe fluid extravasation out of 283 cases underwent automated pump assisted knee arthroscopic surgeries, only 2 cases out of these 4 cases developed compartment syndromes and necessitated fasciotomy.

The use of dilute adrenaline saline irrigation was safe and without complication in the current study. In the literatures, Augustus D et al⁽²¹⁾ reported a case of severe cardiopulmonary collapse during arthroscopic assisted anterior cruciate ligament reconstruction, in which dilute adrenaline saline irrigation was used, this collapse occurred immediately after drilling of intraosseous tibial tunnel, which suggests that adrenaline rapidly accessed the circulation through intraosseous route. Jensen et al⁽²²⁾ found no significant statistical difference in the elevated levels of serum adrenaline between placebo

group and adrenaline group after shoulder arthroscopy and he explained this elevated levels of serum adrenaline after arthroscopy as a result of systemic reaction to surgery and not because of irrigation fluid absorption.

In current study any bony surgery was excluded. It is recommended to use dilute adrenaline saline irrigation with caution in any arthroscopic bony surgery.

CONCLUSION:

It is concluded that the automated pump with dilute epinephrine saline irrigation (when it is needed) can be safe and adequate alternative to tourniquet use in soft tissue arthroscopic knee surgeries.

Further studies are needed for arthroscopic bony surgeries.

The limitation of this study is that its sample size and it was non randomized and it would be better if it was double blinded to exclude subjective feeling of surgeon in regard to certain parameters e.g. visibility.

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