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PLATELET RICH PLASMA (PRP) APPLICATION IN TOTAL KNEE ARTHROPLASTY (TKA)

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ABSTRACT:

PURPOSE: To find out the PRP application effects in TKA on pain syndrome, wound healing, postoperative blood loss, range of motion and the knee circumference (centimetry).

MATERIAL AND METHOD: The preparation of the platelet-rich plasma is based on our treatment algorithm. 20 patients have been subject to TKA within the period from October 2012 to November 2014 and underwent TKA, as platelet rich plasma was used intraoperatively. The average patient age is 72,3; 9 male and 11 female patients. Control group consisted of 17 patients, who underwent surgery in the same period but no platelet rich plasma was used during surgery. Average patient age 73,1; 8 male and 9 female patients.

RESULTS: The following results have been reported for the PRP group of patients: the average amount of blood in the aspiration drainage tube in 24 hours - 285 ml.; postoperative pain on the 1st postoperative day was - 7 p., on the 5th day - 5 p., on the 10th day - 2 p., average circumference (centimetry) of the knee between the 1st and the 10th postoperative day decreased on average by 1,5-2 cm., range of motion – reported average degrees per patient on the 1st postoperative day in sagittal plane: 0-10-20 degrees; on the 10th postoperative day: 0-0-55 degrees, surgical wounds of all patients healed primarily without any complications. No PRP group: average amount of blood in the aspiration drainage in 24 hours – 300 pl., postoperative pain on the 1st, 5th , and 10th postoperative day - 8 p., on the 5th day - 6 p., on the 10th day - 3 p., average knee circumference (centimetry) between 1 and 10 postoperative day has decreased by 1 cm on average, range of motion - reported average degrees per patient on the 1st postoperative day in sagittal plane 0-5-20 degrees, on the 10th: 0-0-50 degrees, surgical wounds healed primarily without any complications in 10 patients, but in 7 patients we observed superficial wound edge skin necrosis.

CONCLUSION: Our results unequivocally show that platelet-rich plasma reduces postoperative blood loss and the use of narcotics, improves the range of motion and the circumference of the operated joint and it is crucial for the most common postoperative complications of TKA: namely dermal wound problems.

Keywords: platelet rich plasma, range of motion, total knee arthroplasty, wound healing

INTRODUCTION

Over the last decade platelet rich plasma (PRP) finds its place in total knee arthroplasty (TKA). Its application helps postoperative hemostasis, improves range of motion, reduces postoperative pain and edema, and helps wound healing [1].

The successful outcome of TKA depends on a number of factors, and one of the most important of them is the adequate intraoperative hemostasis in order to avoid the formation of postoperative hematoma and to minimize blood loss in aspiration drainages. Achieving the necessary postoperative range of motion largely depends on adequate primary hemostasis of soft tissue [2].

Persistent bleeding may lead to prolonged postoperative pain, wound hematoma, seroma formation and arthrofibrosis. Varios analgesics including opioids may be administered in order to reduce postoperative pain thus increasing treatment costs [3]. Furthermore, they have a number of side effects such as sedation, respiratory depression and constipation. These complications are more pronounced in elderly patients, who represent a substantial proportion of patients, who undergo TKA. There are a number of perioperative techniques for reducing the need for postoperative analgesia. Thus the beginning of postoperative physical therapy is accelerated, and postoperative hospitalization is reduced [4].

TKA is a major surgical procedure, with significant blood loss sometimes up to 1500 ml, which often requires hemotransfusion[5]. Hemotransfusion, in turn is associated with low risk of viral transmissible infection (AIDS, hepatitis cytomegalovirus), and transfusion reaction [6]. Therefore, various biological methods for hemostasis have been developed. One of these methods is the use of fibrin sealant, which is a safe technique, but has a number of side effects [7, 8]. Another alternative to this is the use of PRP for biological hemostasis. This blood component contains concentrated platelets with their growth factors: specific PDGF and TGF-β, associated with many useful hemostatic and wound healing effects [9]. It reduces bleeding and pain by mechanical sealing of tissue, blood and lymph vessels. At the same time it supports wound-healing cascade and restores the range of motion. No risk of transmitting infections exists [10].

MATERIAL AND METHOD

PRP preparation follows our treatment algorithm. Venous blood for 30 blood collection tubes is drawn (with

3,8 % sodium citrate) from the patient approximately 1 hour before the surgery. Tubes are centrifuged with speed of 1800 rev./min. for 8 minutes. By using pipettes the plasma is drawn off (fraction 2 and fraction 3). The centrifuged blood results in approximately 20 cm3 plasma, which is divided into two equal parts. Activator of 10% of CaCl2, is added to one of the parts at a ratio: 1 ml. plasma to 50 microliters of activator. The resulting mixture is active in 5 minutes and is ready for infiltration. Fibrin clot is formed after approximately 40 minutes. The other portion of the plasma is used at a later stage of the surgery.

Surgical technique

Median skin incision and medial parapatellar arthrotomy is the technique we use to open the joint. Patella is laterally dislocated without eversion. Prosthetic device was applied for all patients without preserving the posterior cruciate ligaments. Both components are fixed with bone cement. Tourniquet is used during the entire operative intervention and finally it is loosened and thorough hemostasis is applied by use of electrocautery. Then PRP in the form of gel is applied to posterior and suprapatellar recess, lateral gutters, protruding bone surfaces of the tibia and femur. The liquid part of PRP is used to infiltrate the extensor apparatus, prepatellar adipose tissue and the place of the arthrotomy. Layer closure of wound by using aspiration drainage followed. The rest of the liquid part of the activated PRP is used to infiltrate subcutaneous tissue. Aspiration drainage is closed for 4 hours and then is set to gravity-driven mode of aspiration up to 24th hour.

For the period from October 2012 to November 2014 a total of 20 patients underwent TKA with intraoperative application of PRP at the clinic. The average patient age is 72,3 years; 9 males and 11 females. Control group consisted of 17 patients operated within the same period without application of PRP. The average age of those patients is 73,1 years; 8 males and 9 females. Monitored indicators for both groups as follows: quantity of drainage blood within 24 hours, pain intensity (based on VAS [11]), knee joint circumference and range of motion, surgical wound healing. Both groups of patients have been examined postoperatively by one team.

RESULTS

The following results are reported for the group of patients on whom PRP have been applied:

1. **Average amount of blood in the** aspiration drainage on the 24th hour– 285 ml.

2. Postoperative pain was monitored on the 1st, 5th, and 10th day after the surgery. Based on the VAS scale, pain intensity is evaluated from none – 0 p., to strong – 10 p. The average pain intensity for one patient on the 1st postoperative day – 7 p., on the 5th day – 5 p., on the 10th day – 2 p.

3. Average circumference (centimetry) of knee between 1st and 10th postoperative day has decreased by 1,5 - 2 cm on average.

4. Range of motion– reported average degrees for one patient on the first postoperative day in sagittal plain: 0-10-20 degrees, on the tenth day: 0-0-55 degrees.

5. Surgical wounds of all patients healed primarily without any complications.

For other group of patients who underwent unilateral TKA without applying PRP, we reported the following results based on the criteria:

1. Average amount of blood in the aspiration drainage on the 24th hour – 300 ml.

2. Postoperative pain was monitored on the 1st, 5th, and 10th day after the surgery as follows: on the 1st postoperative day – 8 p., on the 5th day – 6 p., on the 10th day – 3 p.

3. Average circumference (centimetry) of knee between 1st and 10th postoperative day has decreased by 1 cm on average.

4. Range of motion– reported average degrees for one patient on the first postoperative day in sagittal plain: 0-5-20 degrees, on the tenth day: 0-0-50 degrees.

5. Surgical wounds of 10 patients healed primarily without any complications but in 7 patients we observed superficial wound edge necrosis, which required additional surgical procedures.

DISCUSSION

The term PRP may be defined as the volume fraction of blood plasma, where there is an increased concentration of platelets in comparison with the reference serum level. It is a concentrate of platelets in plasma, in combination with minor amounts of white blood cells and other blood components [12]. Apart from the high concentration of platelets and growth factors, cytokines and fibrin products, its application carries no risk of transmissible infection. PRP contains other proteins, such as thromboxane A2, thrombin and adenosine diphosphate. Those, in turn, attract an additional amount of platelets to the damaged area, amplify their activity, support the wound healing cascade, and allow a more effective hemostasis and recovery [13].

The skin wound healing process is dynamic and involves a series of complex phenomena – hemostasis, inflammation, granulation tissue formation, epithelialization, neovascularization, and collagen synthesis and wound contraction [14]. The PRP mechanism of action is molecular and cell induction of the normal wound healing response, similar to the one of platelet activation. PRP application accelerates all phases of wound healing, mostly angiogenesis. Important growth factors and other proteins, particularly PDGF and TGF-β, come with platelets and lead to an increased deposition of collagen matrix, and accelerate wound healing and tensile strength .

The first randomized controlled study on the use of PRP in TKA was published in 2009 and it did not report any benefits [15]. Later in 2011 Horstmann et al published another randomized study for the use of PRP in TKA in order to reduce blood loss. They did not take into account significant differences, although there was a positive effect

with respect to postoperative bleeding, the level of postoperative pain was lower [1].

Quite recently, Guerreiroa et al. published an interesting communication on the application of PRP in the form of spray in order to reduce blood loss. Hemoglobin values have been evaluated before and 24 hours after the surgery for this study. Significant reductions in hemoglobin and hematocrit within 24 to 48 hours after the surgery has been observed [16].

In analyzing our results we did not report a significant difference in the quantities of the postoperative blood in both groups studied. More significant differences we reported in the other parameters, and they were beneficial for patients with TKA with the application of PRP. We would like to emphasize that these visible improvements have been reported for a very short period of time - 10 days. Based on our results the average circumference (cm) of the knee joint and the range of motion are indexes that are mostly affected. Pain syndrome is affected less. We think that the best effect of PRP application is observed in wound healing - 100%. However, a limitation of this study may be the considered the relatively small number of patients as compared to the requirements the contemporary evidence-based medicine for greater statistical reliability. There are not sufficient number of reports in medical literature on the use of PRP in TKA.

CONCLUSIONS

The use of PRP is a secure and easy procedure in TKA Our results unequivocally show that platelet-rich plasma reduces postoperative blood loss and the use of opioids, improves the range of motion and the circumference of the operated joint and it is crucial for the most common postoperative complications of TKA: namely dermal wound problems.

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