

USAGE OF PLATELET RICH PLASMA IN FOOT AND ANKLE PATHOLOGY

Aimee A. Boyette, DPM

G. Daniel Shanahan, IV, DPM

INTRODUCTION

In recent years, there has been an increased trend in the use of autologous blood products to promote healing in a variety of situations in podiatry. Platelets have been extensively researched and have been found to possess many important bioactive proteins facilitating tissue regeneration and wound healing in addition to their function in blood clotting. There has been found to be an in vitro dose-response relationship between the concentration of platelets and the proliferation of adult mesenchymal stem cells, fibroblasts, and the production of Type I collagen. When platelets are placed into areas of the chronically injured body, they release factors necessary for growth and can aid in activating the healing process.

Blood is composed of plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets. Plasma is the liquid portion of the blood composed mainly of water and acts to bind platelets to a wound site to form a clot. RBCs are responsible for oxygen transfer and carbon dioxide removal. WBCs are responsible for fighting infections and removing dead blood cells from areas of infection or injury. Platelets historically were once thought only responsible for hemostasis but they have been found to be key to healing.

Platelets are cytoplasmic fragments of megakaryocytes, formed in the bone marrow, are disc-like in morphology and have a lifespan in the circulation of 7-10 days after which they are removed by macrophages. Platelets are found intravascularly and are highly concentrated in the spleen. Platelets contain glycogen, lysosomes, and 2 different types of granules. The alpha granules are responsible for the release of clotting and growth factors when stimulated by thrombin. The primary growth factors stored within the alpha granules are transforming growth factor beta (TGFbeta), vascular endothelial growth factor (VEGF), epithelial growth factor (EGF), and platelet-derived growth factor (PDGF). When thrombin stimulates the platelets, the alpha granules then release the above named and other growth factors, which begin the inflammatory cascade and the healing process. The

secreted, activated growth proteins bind to the membrane of target cells and activate a signal protein that causes the expression of the gene sequence. This directs cellular proliferation, the formation of matrix, osteoid production, collagen synthesis, and other processes.

Blood is normally composed of about 93% RBCs, 6% platelets and 1% WBC. Normal platelet concentration in the blood is approximately 200,000 platelets/ul. Clinical usage of platelet rich plasma (PRP) works to increase the blood ratio of platelets to 94% and decrease the ratio of RBCs to 5% as RBCs are less helpful in the healing process. PRP is defined when the volume of the plasma portion of the blood has a platelet concentration above the baseline of 200,000 platelets/ul. Platelet concentrations that are increased 4 times the baseline amount have shown to be clinically effective in healing. Because of PRP's high concentration of platelets and growth factor release potential, it plays a significant role in tendon, ligament, bone, and wound repair in foot and ankle pathology.

PROCEDURE

The Mini GPS III system from Biomet (Mini GPS III Platelet Concentration System, Biomet Biologics, Warsaw, IN) is the one utilized in our office because of the ease of use and the small amount of PRP usually required for the treatment of foot and ankle pathology. The Mini GPS III system includes the dedicated centrifuge used for spinning down the blood and specialized disposable, one-time use materials for collecting and processing the blood product. There are other larger systems available for platelet concentration if larger quantities of platelets are required. The items needed in the office for the procedure in addition to the Mini GPS III system are: 8.4% sodium bicarbonate buffer; betadine skin prep; 4 x 4 gauze; local anesthetic with epinephrine; 1 ml syringe for the sodium bicarbonate; 5cc syringe for the local anesthetic; 22-gauge needle for the buffered platelet concentrate; 27- or 25-gauge needle for the local injection; a staff member who is proficient in drawing blood; and an ultrasound (optional but recommended).

The centrifuge can be brought to the office by your Biomet representative or can be loaned or purchased. The one-time use supplies including the blood canisters and other materials are present in packs and can be stocked in your office or brought as needed by your representative. This will most likely depend on how many procedures the physician is performing in the office regularly.

Once all of the supplies have been assembled and the Mini GPS III system has arrived at the office, the procedure can begin. A citrate anticoagulant (ACD-A) is provided with the system to prevent clotting. At this time 3 ml of the ACD-A is drawn into the provided 30 ml syringe. Next, 27 ml of the patient's blood is drawn into the same syringe for a total of 30 ml of blood and anticoagulant solution. The blood/anticoagulant solution is then loaded in the Mini GPS III port and the canister is placed in the centrifuge. A Mini GPS counterbalance is filled with 30 ml of water and placed opposite of the blood canister to balance the system. The speed of the centrifuge is set to 3,200 RPM and the timer is set for 15 minutes.

While the centrifuge is spinning, it is a good time for the doctor to anesthetize the patient locally at the area of treatment. For plantar fascia treatment, a posterior tibial nerve block is usually performed and for other tendon procedures a local field-block is used. It is important to palpate and mark the area of maximal tenderness before the block is performed for accurate placement of the injection later. At our office we employ the use of a diagnostic ultrasound to measure the thickness of the plantar fascia and to localize the area of greatest thickness of the ligament. Once the centrifuge has stopped, the canister containing the blood is removed. At this point the blood solution has been separated into a red blood cell layer, the PRP layer (the buffy coat) and PPP (platelet poor plasma). The 30 ml syringe is connected to the canister and the PPP is withdrawn and set aside. The canister containing the PRP is then shaken vigorously for 30 seconds to re-suspend the platelets. The 10 ml syringe is then attached to the canister and 3-5 ml of PRP is withdrawn. The 8.4% sodium bicarbonate solution is then added to the PRP according to the PRP buffering table. The 22-gauge needle is then attached to the syringe and handed to the doctor for injection.

The technique for plantar fascia injection will be described here. The area for injection is prepped with the betadine solution and may be draped in a sterile manner if desired. The local anesthetic block can be accomplished at this point or may have been performed as the PRP was in the centrifuge. After the PRP is buffered with the 8.4% sodium bicarbonate solution as described above, a 22-gauge needle is used to inject 3-5 ml of the PRP

solution into the area of maximal tenderness. This can be performed under ultrasound guidance, which is very helpful. Approach for the injection is made from the plantar aspect of the foot. The technique utilized for this is "peppering" or a single skin poke with many penetrations in the plantar fascia. Utilization of an ultrasound is very helpful for the step as it allows for very easy visualization of the fascia, the needle, and the PRP as it is being injected. Once all of the PRP has been injected, the injection site is dressed with a sterile band aid and the patient is kept in the supine position for 15 minutes to allow the PRP to settle into its new surroundings. This procedure can be easily adjusted for Achilles tendon or other tendon pathology by altering the patient position on the table, the local anesthetic block area and the area visualized with the ultrasound.

POSTPROCEDURAL PROTOCOL

There is a specific post-procedural protocol utilized for each patient receiving PRP therapy. The patient is placed in a boot-type immobilizer and kept strictly non-weight bearing for the 48 hours following the PRP injection on the operative limb. The patient may begin to weight bear after 48 hours but the boot immobilizer should be worn at all times. This is done to protect the delicate platelets and allow the growth factors to work optimally. The patient should not be on any anti-inflammatory medications or receive steroid injections for 2 weeks prior to and 2 weeks after PRP injection. The presence of an anti-inflammatory in the body will impede the growth factors as they require the cascade of inflammation to be activated. The doctor may elect to prescribe a narcotic pain medication after the procedure for any discomfort. The use of ice is recommended for 20 minutes up to 3 times daily but this is at the doctor's discretion.

A stretching/strengthening program is outlined and provided to the patient. They may begin the stretching portion of the program 72 hours after the injection and the strengthening program may be initiated 2 weeks post injection. The stretching exercises consist of some straight forward seated and standing posterior leg movements and the strengthening exercises are some standing heel raises.

CASE PRESENTATIONS

AK is a 57-year-old woman with a history of left-sided plantar fasciitis since 3/27/08. Conservative treatment consisting of taping, 5 steroid-type injections, padding and a walking boot immobilizer had been utilized with minimal success. A 7.5 MHz diagnostic ultrasound was performed showing an increase of the thickness of the left

plantar fascia to 6.10 and 5.65 mm at the widest points compared with a thickness of 3.98 mm and 3.60 mm on the right. The normal thickness should be close to 4.0mm for the plantar fascia. PRP injection was performed on 5/6/09 and standard post-procedural protocol was followed. Her next office visit on 5/13/09 found her doing well with minimal complaints. One week later she noted some positive changes and by 5/28/09 she had 50% reduction in her pain on the left side. A phone progress report on 6/25/09 found the patient back to wearing her orthotics for over 8 hours with minimal soreness and at a phone report from 8/11/09 she stated that she was over 80% improved compared with 3 months prior.

DF is a 50-year-old man with a history of bilateral heel pain for 2 years with the right side being more symptomatic than the left side. He had seen 2 podiatrists in the past, beginning in November of 2007 and had a series of injections, tapings, physical therapy, and orthotics fabricated. When he arrived at our office, the treatment was additional tapings, padding, new custom orthotics, and magnetic resonance imaging (MRI) was performed bilaterally. He had some mild improvement from our treatment protocol but was still having severe pain. PRP injection was performed on the right on 3/4/09 and standard post-procedural protocol was followed. At an office visit on 3/17/09, the patient indicated the right heel felt “less tight” and was feeling better. The patient indicated by a phone progress report on 3/24/09 that his right foot was 50% improved and he then scheduled a PRP injection for the left side. PRP injection was performed on the left on 4/1/09 and at the follow up visit on 4/7/09 he related that he already felt somewhat better on the left and his right side was continuing to improve. A phone progress report on 5/7/09 found the patient 80% improved on both the right and left side and very happy with the results.

RC is a 64-year-old active man with a history of left ankle pain and swelling. He was first seen in our office on 2/23/09 with symptoms of decreased range of motion, pain, and edema to the lateral ankle extending to the foot. A diagnostic ultrasound was performed of the peroneals and severe tenosynovitis was demonstrated without frank tearing of either tendon but intratendinous damage was suspected. The patient was initially treated with rest, ice, and an ankle brace, and anti-inflammatories and an MRI was performed to fully evaluate the tendon complex. An intrasubstance tear of the peroneus longus was demonstrated and at this point surgical repair was discussed with the patient but the patient was strongly against this approach. The patient continued to have mild

improvement of his symptoms over the next 60 days and on 6/3/09 he underwent PRP injection of the peroneal tendons on the left side utilizing standard protocol. At his follow up visit on 6/22/09 the patient was having no pain with ambulation and edema had begun to improve. His next visit on 7/13/09 found him much improved from his preoperative state and a continued decrease in edema was demonstrated. By 8/3/09 the patient was back to working out daily and was without pain with day to day activities. He still experiencing some pain with his exercise activities and repeating the procedure is currently being discussed with him.

DISCUSSION

PRP injections are very safe as they use the patient’s own blood and the risk of immune reactions or disease transfer are eliminated. Contraindications to the use of PRP are: presence of a tumor, metastatic disease, active infections, low platelet counts, pregnancy, and active breastfeeding. Patients should be advised that there may be a temporary increase in pain symptoms following the injection because of the body’s response to inflammatory mediators. Remote risks of the procedure include no relief of symptoms, infection, scarring or calcification at the injection site, and neurovascular injury.

PRP injection is also an excellent adjunct for tendon repair surgeries performed in the operating room. The PRP can be prepared by the company representative or the operating room staff and handed to the surgeon in a sterile manner. Once the PRP is injected into the area of repair it is important to ensure that no sponging of the surgical site is performed after that or the PRP will be removed from the wound. If a tourniquet is utilized, the PRP should be applied and then closure of the wound with a compressive bandage applied before the tourniquet is released. Alternatively, the tourniquet can be released and reactive bleeding allowed to occur before the PRP is applied to the surgical site.

PRP can be very helpful for posterior heel surgery involving the Achilles tendon. Generally with Achilles insertional calcific tendinosis or retrocalcaneal exostoses, there is some tendon damage and thickening. The tendon is usually surgically debrided and re-attached to the calcaneus utilizing a bone anchor with this type of procedure. PRP can aid the tendon in healing and becoming stronger. The PRP portion of the product can also be used for any surgical incision to improve the appearance of the scar. The PRP will clot and form a gel-like substance that can be either placed on the dressing or easily held in place with steri-strips to the

incision site. The possibilities for the use of PRP in virtually any tendinous or ligamentous foot and ankle procedure are huge.

Barrett et al performed a pilot study of 9 patients treated with PRP injections for plantar fasciitis. These patients did not have conventional conservative therapy performed and were all determined to have thickened plantar fascia by ultrasound examination. The thickness of the plantar fascia was measured before injection and after the injection at scheduled intervals. Six of the 9 patients had complete relief of symptoms at 2 months post injection and 1 patient had an additional PRP injection at a later date and then achieved complete relief. At one year 77.9% of the 9 patients had and continued to have complete resolution of their symptoms. In our office, we have gotten very good results with most patients becoming 80% improved at 3 months post PRP injection. We currently are following several other patients to monitor their progress but we are very encouraged by our early results.

CONCLUSION

Studies along with basic science up to this point support the hypothesis that when super-concentrated platelets are placed at the site of tissue injury, healing is enhanced. PRP has been used in a variety of situations where ligament, tendon, and wound healing have been compromised and has given excellent results. PRP injection in the office or intraoperatively should be considered in cases of chronic injury for enhanced repair of foot ankle pathology.

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