Самая низкая средняя плотность мощности для 6-минутного интервала составляет <0,1 мкВт / см², а максимальная - 0,7 мкВт / см². Все результаты намного ниже предела 10 мкВт / см².

На охраняемых территориях (детские, образовательные, медицинские учреждения) и на открытых площадках наименьшее измеренное мгновенное значение <0,1 мкВт / см², а наибольшее 1,7 мкВт / см² при максимальном пределе концентрации 10 мкВт / см², что ниже ПДК. Это свидетельствует об отсутствии риска для здоровья населения.

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**ЗАМЕНА ПОВРЕЖДЕННОЙ БЕДРЕННОЙ АРТЕРИИ ТРОЙНЫМ АУТОЛОГИЧЕСКИМ ВЕНОЗНЫМ НЕОГРАФТОМ**

**ABSTRACT**

Limbs’ gunshot injuries are considered to be one of the most difficult surgical issues, due to large amount of injured tissues, multiple types of trauma, the fact of being initially infected. Situation become even harder if magistral vessels have been damaged. All the above mentioned cause the high rate of death due to blood loss, infectious complications, primary or delayed limb loss.

**АННОТАЦИЯ**

Огнестрельные травмы конечностей считаются одной из самых сложных хирургических проблем из-за большого количества травмированных тканей, множественных видов травм, факта первичного инфицирования.

Ситуация усугубляется, если магистральные сосуды повреждены. Все вышеперечисленное является причиной высокой смертности от кровопотери, инфекционных осложнений, первичной или отсроченной потери конечностей.

**Ключевые слова:** Огнестрельные травмы, повреждение магистральных сосудов, аутологичная венозная нейографт

**Keywords:** gunshot injuries, damage of magistral vessels, autologous venous neograft
compressed left groin himself and was able to decrease blood loss till assistance coming. He was evacuated to the nearest hospital just after temporary bleeding stopping and bandaging. The most intensive bleeding was registered from the thigh wound – thus, eight-form bandaging was placed which was not totally effective and not intensive bleeding periodically restarted.

No fractures have been diagnosed at the hospital; all the body injuries were soft tissue damages with no life-threatening injuries (multiple small sharpnels up to 5-7 mm have been revealed), but brain and pulmonary contusion were suspected additionally. Metallic foreign body (approx. 25 mm) was revealed on left thigh x-ray somewhat medial to upper third of femur. Left limb’s inlet wound (up to 35 mm) was situated at the lateral side of upper thigh with continuous low intensity bleeding (on present bandage). Patient was taken to operation-room, incision was made on the femoral vessels’ projection under distal tourniquet and proximal femoral/femoral artery compression. After femoral vessels dissection and clumping, distal tourniquet and proximal compression were released. The following injuries have been revealed: SFA subtotally damaged at the 2 sm of branching from CFA, distal end where thrombosed, proximal end were bleeding. SFV was partially parietally damaged and thrombosed, proximal GSV was injured and thrombosed. Debridement and foreign body’s evacuation. After refreshing the ends of SFA and distal thrombectomy the 7 sm defect of SFA was replaced with 8 mm PTFE graft (as the patent part diameter of GSV was just 3 mm).

After what patient was evacuated to central side of country to specialized vascular clinic.

Patient admitted to the clinic with left limb’s compensated arterial flow, swollen lower leg, somewhat impaired left femoral nerve function (due to just nerve contusion as diagnosed later), severe anemia (Hb 56 g/l), hipoalbuminemia, left side pneumonia (negative COVID-19 PCR), fever up to 39°C. Left groin wound was infiltrated, small amount of discharge from inlet wound was present.

Duplex ultrasound: Left CFA 10-11 mm, SFA 7-8 mm, DFA 5-6 mm, the distal arterial flow of left limb is magistral. Superficial femoral vein was duplicated up to the groin with patent one and thrombosed second branch. Left GSV is ligated, distal part has small caliber (less than 3 mm). Right GSV 3-6 mm at the thigh, 2-3 mm at the lower leg.

CT-scan: Infiltration around the femoral arteries and veins up to 4 sm, no liquid cavities.

Because of high probability of secondary infectious complications and rebleeding second stage procedure was expected after anemia and pneumonia correction. Antibacterial, anticoagulant therapy started, in conjunction of 2 dose of blood transfusion and ferrum replacement therapy.

The fever continues at 37,5-38,0°C despite pneumonia resolving after 10 days of therapy, Hb 95 g/l. Groin infiltration becomes smaller, but discharge from inlet wound increases and changes to more purulent, with poli-resistant microbial culture. So, it becomes clear that second stage procedure is unavoidable.

The most important issue was the possible need of inserted PTFE graft replacement. Left GSV was already injured and ligated and had small distal caliber. Right GSV could appear at inadequate diameter. Biograft of appropriate size was unavailable. So, silver impregnated Dacron graft was reserved, but right GSV state was planned being checked at the operation.

Operation was performed on the appointed day of admission (X days after injury and first operation).

Under general anesthesia left femoral vessels were exposed. Purulent fistula from vessels to inlet wound was present. After removing the blod clot from the bottom of the wound venous bleeding started – 1 sm longitudinal injury of SFV was revealed, parietally sewed. PTFE graft was excised, the refreshed ends of superficial femoral artery had 8-9 mm at the proximal end (just at the debranching from CFA) and 7-8 mm at the distal end, the deficit was up to 9 sm. Then right GSV was exposed and harvested from the groin to the knee. GSV had native diameter 3-5 mm which becomes 4-6,5 after hydraulic enlargement. In order to avoid any synthetic implant use in infected wound we decided to try to duplicate the vein longitudinally. So, the harvested GSV was incised longitudinally, then splitted side to side (remembering the blood flow direction and valves), then sewed side to side with polipropylene 6:0 suture. After calculating the width of conduit it becomes clear that it’s not enough to replace the SFA without stenosing. So, the third stripe of conduit was sewed to the side. Afterwhat the tripled conduit was wrapped over the 7 mm tube (sterile suction tube was used) and sewn to form the tube. So, we got venous autograft with up to 10 sm length and 8 mm external diameter, with 3 ends of suture at the each end of the graft. After distal and proximal end-to-end anastomoses where performed with polipropylene 5:0 suture (knotting this suture with matching 6:0, existing on graft). Then reestablishing of magistral flow few additional 6:0 sutures were needed to secure hemostasis. Proximal end of m.sartorius was wrapped over femoral vessels after final debridement and antiseptic treatment. Wound was closed over active drains, connected to NPWT device. The operation wounds was treated primarily, patient has magistral flow of the foot arteries at the time of discharge.

Control DUS in 5 months – autovenous neograft is patent, slightly externally enlarged to 10-11 mm with somewhat thickened wall (1.5 mm) and no thrombotic parietal layers. Patient has clinical signs of venous and lymphatic insufficiency of left leg, which are controlled with elastic compression stockings and venoactive drugs. Hence he returned to his activities almost fully, the rivaroxaban 20 mg was taken off, with acetylsaliclyc acid 100 mg lost for continuous use. The further autograft diameter control is planned after 3-4 months.

Conclusion. Despite the difficulty of limbs’ arteries’ gunshot injuries management, the use of autologous vein with described non-standard technique could enable the use of GSV even with non-adequate caliber to replace the injured magistral artery. The possible future enlargement of venous conduit
should be taken into account measuring the diameter of autovenous neograft.

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