Reconstruction of a combined defect of the lateral surface of the torso after an explosive injury

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According to Zarutskyi and Bilyi [1], the number of pelvic injuries accounts for 5% of all injuries and 3 to 4% of sanitary losses. Combined injuries were noted in 80% of the wounded, and in 25% of them there were fractures of the pelvic bones, both comminuted and perforated, as well as detachment of bone fragments. The mortality rate for pelvic injuries ranges from 13-75%.

Wound treatment using vacuum therapy is a well-known method of sanitising an infected area using negative pressure [2], which removes wound discharge, keeps the wound in a humid environment, reduces bacterial contamination, improves perfusion in the wound, and results in faster formation of granulation tissue, and allows for much less frequent wound debridement and dressing than standard wound treatment, which involves dressing with antiseptics. We chose vacuum therapy to clean the wound and prepare it for plastic surgery. This made it possible to perform surgical interventions under general anaesthesia once every 3 to 4 days, depending on the nature of the wound discharge through the drains.

For the reconstruction of such defects, vascularised soft tissues, including skin and fascia, should be used. According to the literature [3-7], these are local or separated muscle or skin-muscle flaps, stretched tissues, or free transplantation of tissue complexes. As a rule, tissues including the rectus and internal oblique abdominal muscles are used as local flaps, and the rectus femoris, broad fascia tensioner muscle, lateral thigh muscle group, and thin muscle are used as separated flaps.

On 13.07.2023, at 02.40 a.m., patient P. was admitted to the Kyiv City Clinical Emergency Hospital, a municipal non-profit enterprise. 19 years old was admitted on an urgent basis with a diagnosis of explosive trauma: open third-degree multiple fragment fracture of the wing of the right ilium with its defect; linear fracture of the body of the right ilium with its defect; extensive wound of the right pelvic area with skin and muscle defect; closed chest injury, right-sided haemothorax; closed abdominal injury, extraperitoneal pelvic haematoma (Fig. 1); traumatic shock of the third degree.

The patient’s condition is serious, she complains of pain in the wound area on the right side of her torso. She was injured as a result of an enemy drone explosion and its fragments entering her apartment and exploding. The skin is pale. Pulse 108 in 1 minute, weak filling in the radial arteries. Blood pressure (BP) 80/40 mm Hg. Diuresis up to 70 ml via catheter.

In the right gluteal-inguinal area, the dressings are moderately saturated with bloody discharge. Under the bandages, there is a 25 × 25 cm wound, up to 15 cm deep, located on the right gluteal and right pelvic areas with a transition to the anterolateral surface of the abdominal wall.

Abdominal ultrasound (ultrasound) on admission: no free fluid in the abdominal cavity. After 6 hours, free fluid was detected in the pelvis. Chest X-ray: parietal pneumothorax on the right. Spiral computed tomography of the pelvis shows a multiple fragment fracture of the right iliac wing with medial displacement of the fragments and a 7 × 7 cm defect.

Рис. 1.
Вигляд рани (а) та рентген–знімок ураженої ділянки (б) хворої П. при госпіtalізації.
Upon admission, the laboratory values were as follows: haemoglobin 81 g/l, red blood cells $2.76 \times 10^{12}$/l, white blood cells $18.3 \times 10^9$/l, haematocrit 0.23, platelets $26 \times 10^9$/l, total protein 48 g/l, total bilirubin 53 μmol/l, prothrombin index 100%, prothrombin time 16 s, fibrinogen 1.11 g/l, international normalised ratio 1.

The patient was operated on for vital signs. A rightsided thoracentesis was performed in the 6th intercostal space, air was obtained, Bühlau drainage was established, laparocentesis was performed below the navel along the midline, and traces of blood were obtained. After that, the primary surgical treatment of the wound of the right pelvic area and the open fracture of the pelvic bones was performed. A microbiological examination was performed: no microflora growth was detected in the wound discharge.

After the operation, the patient was admitted to the intensive care unit in an extremely serious condition: artificial lung ventilation, body temperature 36.4 - 36.8 °C, blood pressure 57/33 mm Hg, pulse 106 per 1 min, blood oxygen level 99%. The patient was treated with infusion (plasma substitutes, crystalloid solutions, red blood cell mass, albumin 20%), antibacterial (cefepime 2 g 4 times a day, metronidazole 1 g 3 times a day), haemostatic (tranexamic acid, ethamsylate) therapy, and pain relief.

17.07.2023 - repeated surgical treatment of the wound, application of a vacuum system. Ultrasonography: right lung contusion, right-sided exudative pleurisy and polyserositis on the right flank, pelvic haematoma. Laboratory tests: haemoglobin 103 g/l, erythrocytes $3.43 \times 10^{12}$/l, leukocytes $5.7 \times 10^9$/l, haematocrit 0.29, platelets $72 \times 10^9$/l, total protein 55 g/l.

Microbiological examination on 17.07.23: no growth of microflora in wound discharge, massive growth of Acinetobacter baumannii in sputum in association with massive growth of Klebsiella pneumoniae, sensitive to imipenem. The previously prescribed antibiotics were changed to imipenem 500 mg 4 times a day and amikacin 3 g 4 times a day.

21 and 23.07.23 - repeated surgical treatment of the wound, application of a vacuum system.

On 23.07.23, the patient's body temperature rose sharply to 38.4 °C, and on 24.07.23 - to 40.2 °C. At the same time, the nature of the discharge from the vacuum system drains did not change, there was no perifocal inflammation, no signs of wound suppuration. Laboratory tests: haemoglobin 117 g/l, erythrocytes $3.55 \times 10^{12}$/l, leukocytes $5.8 \times 10^9$/l, platelets $97 \times 10^9$/l, total protein 52 g/l, procalcitonin 3.7 ng/ml. The dose of imipenem was increased to 1 g 4 times a day. On 25.07.23, the body temperature dropped to 37.5 °C.

On 27 and 31.07.23, the patient was operated on, with repeated surgical treatment of the wound and application of a vacuum system (Fig. 2).

Microbiological examination on 01.08.23: massive growth of Proteus mirabilis, susceptible to imipenem, in wound discharge.

On 03.08.23, plastic surgery of the defect on the right lateral surface of the torso was performed with a skin-muscle flap of the rectus femoris muscle combined with an anterolateral flap of the thigh with the inclusion of the descending branch of the femoral circumflex artery. The course of the postoperative period was unremarkable.

In our observation, the defect measured 25 25 cm and was up to 15 cm deep, with pelvic bone fragments entering the wound. Given the peculiarities of the blood supply to the rectus femoris muscle [8-11], the volume and location of the defect, it was decided to use a skin-muscle flap of the rectus femoris muscle to fill the defect cavity with the inclusion of the descending branch of the lateral femoral circumflex artery in the flap to increase the area of the skin part of the flap and improve blood circulation in it. The anterior
abdominal wall tissue was not used to prevent scarring of the abdomen and to avoid placing polypropylene mesh to strengthen the anterior abdominal wall after flap harvesting.

The surgical intervention aimed at closing the defect began with the marking of the flap on the anterior surface of the right thigh (Fig. 3). The axis of the flap was along the line connecting the upper anterior iliac crest and the middle of the apex of the patella. The flap was 20 cm long and 17 cm wide. An island-shaped incision was made through the skin, subcutaneous tissue and fascia in the lower third of the anterior and anterolateral thigh surfaces. The rectus femoris muscle was identified through the lower edge of the incision, and the lateral incision identified the lateral thigh muscle group and the descending branch of the lateral femoral circumflex artery. The distal part of the rectus femoris muscle was transected 6 cm above the knee to maintain stability in the knee joint. The next step was to isolate an ischial skin and muscle flap with the inclusion of the descending branch of the lateral femoral circumflex artery in the cranial direction to the point of origin of the vessel from the deep femoral artery. In our observation, it was at a distance of 8 cm from the inguinal ligament, and this was the point of flap rotation. After isolating the flap, a tunnel was made between the point of flap rotation and the defect on the trunk under the tailor's muscle, the broad fascia tensioner muscle, and the lateral thigh muscle group. The flap was placed in a tunnel over the defect. The medial and lateral muscle groups, the intermediate muscle and the tendon of the rectus femoris were aligned and sutured together on the donor site to preserve the extensor apparatus of the knee joint. The wound was sutured in layers, and negative pressure drainage was installed. Taking into account the massive growth of Proteus mirabilis in the wound, flushing tubular drains were placed on the trunk under the flap and the flap was sutured to the defect walls in layers (Fig. 4).

In the postoperative period, antibiotic therapy was continued for 14 days until the sutures were completely removed; the drainage on the thigh was removed on the 3rd day. On the trunk, the drains were washed three times a day with antiseptic solutions for 5 days, after which they were removed.

The patient was discharged on the 48th day in a satisfactory condition with fully restored skin.

Follow-up examination of the patient 2 and 4 months after discharge. The condition is satisfactory. The wounds on the trunk and thigh are completely epithelialised. The contours of the displaced flap and the affected area are approaching the normal contours of the lateral surface of the trunk, and there is a change in the contours (thinning) of the thigh area from which the flap was taken. She was verticalised and her gait was not affected (Fig. 5).

Thus, the treatment of blast injuries of the lateral surface of the torso with pelvic fractures poses a serious challenge for surgeons, as they are accompanied by severe shock in the early stages of injury, difficulties in preparing the wound for plasty and a limited number of suitable tissues for it, given the volume of the defect. The use of staged vacuum therapy accelerates wound preparation for plastic surgery, reduces the number of dressings and pain, which does not occur when applying wet, drying dressings. The proposed method of plastic surgery using a skin-muscle flap of the rectus femoris muscle with improved vascularisation due to the inclusion of the descending branch of the lateral femoral circumflex artery allows for effective closure of large defects in the lateral trunk and pelvis.

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