CASE STUDY

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Surgical treatment of combined thoraco--abdominal injury of liver with the mechanism of the hydrodynamic shock

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ABSTRACT

This article presents a clinical case of successful multilevel treatment the combined gunshot wound of liver with the mechanism of hydrodynamic shock using «damage control» tactic. The patient received a combined thoraco-abdominal injured as a result of warfare on the east of Ukraine. The blind fragmental penetrating trauma of the chest cavity led to the rupture of the right dome of diaphragm and liver (S_3–S_6) by the mechanism of hydrodynamic kick (fragments the wreckage and input/output openings in the abdominal cavity were not found). The «damage control» tactic was implemented as follows. On the second level of medical care the rupture of the liver parenchyma eliminated by repeated firmwares with omentopexy. The post-traumatic period proceeded with the several consecutive complications: cutting the liver sutures, the arrosive bleeding from the right hepatic artery and the irreversible ischemia of the liver S_5-S_6. These complications were liquidated gradually on the IV level of medical care by the transpupillary choledochal stenting, vascular suture and the imposition of a typical anatomical resection of liver S_{5-6}. Successful treatment of patients with the severe fragmental gunshot thoraco-abdominal injuries should be based on a clear understanding of the stages of traumatic disease and expected complications of parallel conduct medical evacuation, using «damage control» tactic on the all levels of medical care.

Keywords: a combined thoraco-abdominal injured, levels of the medical care, warfare on the East of Ukraine.

Introduction

Due to the warfare on the East of Ukraine in recent years, importance of problem in treatment of patients with gunshot wounds is increasing, as a result of mortar attacks and artillery shelling reactive. The most serious injuries include multiple thoraco-abdominal fragmental wounds of gunshot injuries of internal organs [1, 2, 5–7]. The important elements in achieving a successful result of treatment of such injuries are: coordinated work of sorting injured, understanding the stage of traumatic disease process and the possibility of using modern surgical technologies on the all levels of medical care [3, 4, 8]. Patients who achieved serious injuries as a result of warfare on the East of Ukraine provided a multilevel medical care, which includes pre-hospital and hospital stage of treatment. On the pre-hospital stage wounded provided first medical and pre-medical care (basic level) and first medical care (I-level). First medical care is provided on the place of damaged by the self- and mutual aid, when the wounded are being evacuated by the sanitary transport to the nearest place of qualified medical care. If evacuation is

impossible to implement a stage of qualified care for 1 hour (the principle of the «golden hour») the wounded is provided first medical care on the stabilization post where emergency care doctors are available. First aid is provided by nurses during the evacuation [3–5, 8, 9].

Hospital stage of medical care to the wounded in the combat area includes II, III, IV and V levels of medical care. The qualified surgical care (second level) is provided in city and district hospitals, which are groups enhancement of military doctors and deployed military mobile hospitals. These hospitals deployed to the minimum allowable proximity to the contact line, contributing to the implementation of the principle of the «golden hour» in 80% of the wounded. Recently at this level has implemented some elements of specialized surgical care through completing these medical units with laparoscopic racks. In step skilled care injured gets, usually within 60 minutes after the injury.

Specialized surgical care (level III) is provided in one of the three frontline multi-disciplinary hospitals: Military Medical Clinical Center of the North Region (Kharkov), Dnipropetrovsk military hospital (m. Dnipro), Mechnikov Regional Clinical Hospital (m. Dnipro). Term evacuation on the third level of care should not exceed 6–8 hours with injuries of the head and eyes, all other are evacuated after stabilization of the overall situation. The evacuation of this level carried by road (reanimobile), rail (train «InterCity») and air transport (helicopter). The IV level of medical care provides an exhaustive list of the wounded specialized care using high-tech equipment. This level of care is provided in the National (Kyiv) or regional Military Medical Clinic Centers (Vinnytsya, Odesa, Lviv) where wounded evacuated by air.

The V level of care provides a rehabilitation in specialized military and civilian medical facilities.

The course of traumatic disease characterized by a certain phasing course which determines the choice of treatment strategy and forecasting the possible occurrence of vital dangerous complications of traumatic disease and previously performed surgery. An important role in achieving positive outcomes for severe gunshot wounds played availability and accessibility during specialized surgical help of modern high-tech equipment: video endoscopic rack (laparoscopy, thoracoscopy, arthroscopy), systems for VAC therapy, equipment for endoscopic transpapillary surgery etc. [1, 4, 6].

In the present clinical case has demonstrated coordinated stages providing appropriate levels of surgical care and medical evacuation using «damage control» tactic.

Case report

Patient

The patient was a 22-years-old soldier (male), who during the fighting in the area of locality Krasnogorivka (Donetsk region) 16.12.2016 around 23:45 received gunshot multifragmental combined thoraco-abdominal injuries as a result of shelling. The nature of the wounds: gunshot blind debris penetrating chest injury case; right-handed haemopneumothorax; firearm fracture 5, 6, 7 ribs on the right; break right dome diaphragm and parenchyma right and left liver fate of the «hydrodynamic shock».

First aid (basic level) was given in place of injured in the order of mutual assistance: had superimposed aseptic dressings, intramuscularly had administered analgesic. From the get injured patient immediately was evacuated sanitary transport to the stage of qualified surgical assistance. Since the evacuation lasted less than 60 minutes (the principle of the «golden hour») wounded were evacuated immediately to the second level of care.

Qualified surgical care (second level) wounded was provided in the 66th Military Medical Hospital, where the wounded with vital indications were implemented immediate measures of surgical intervention: thoracentesis of pleural cavity drainage right on the right haemopneumothorax; primary surgical treatment of gunshot wounds. During laparocentesis of the abdominal cavity revealed hemorrhagic content – laparotomy performed. During the revision of the abdominal organs revealed the rapture of the right dome of the diaphragm and the ruptures of 3, 4, 5 and 6 segments of the liver such as «hydrodynamic shock» (input / output holes and fragments on the CT abdominal organs didn't found). According to the severity of the patient, due to the course of traumatic disease and massive blood loss minimum volume measures of skilled care was made – suturing of gunshot wounds of the liver, abdominal drainage, primary surgical treatment of gunshot wounds of the extremities. During subsequent audit revealed additional strain in the area of liver gallbladder fossa – performed cholecystectomy, closure strain, drainage of the abdominal cavity. Given the questionable viability of liver S_{5-6}, the question arose about the feasibility of resection of liver ischemic segments. Based on the principles of «damage control» due to the critical condition of the wounded (hemodynamics maintained large doses sympathomimetics) decided to limit the minimum amount of surgery – stop bleeding by taking in lots of gaps omentopexy liver, abdominal drainage.

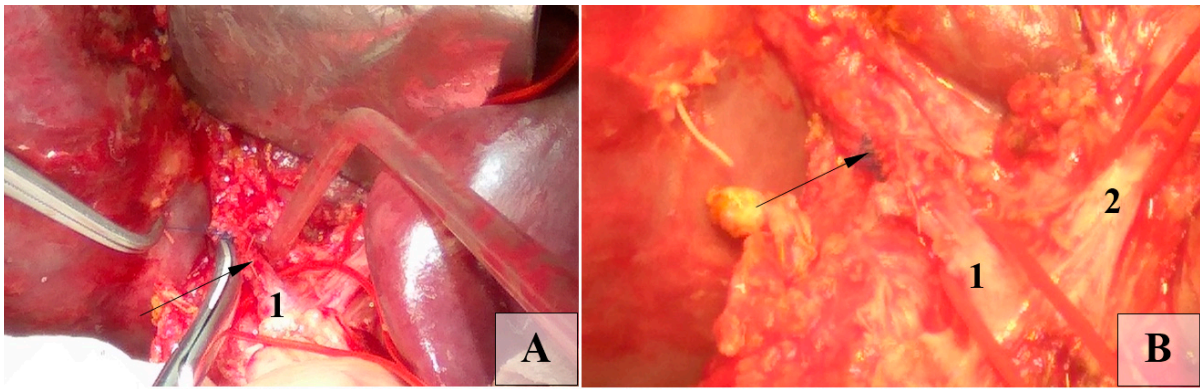

Figure 1. Suturing of arrosive defect of right hepatic artery. A. The area of arrosive defect (pointed by the arrow) of right hepatic artery; the turnstile is placed under the vessel (1). B. The hemostasis has achieved by suturing on the right hepatic artery (suture line pointed by the arrow): 1 – right hepatic artery; 2 – left hepatic artery on the turnstile

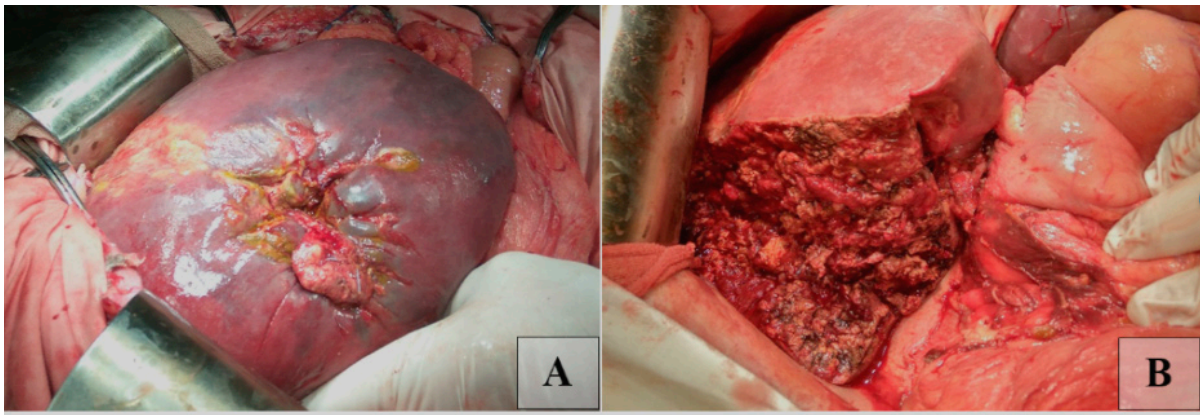

Figure 2. Patient's liver on 16th day after gunshot wound. A. The condition after suturing of liver's gunshot wounds (17.12.2016) and repeated suturing of liver's injury with omentopexy because of failure of the stitches (12.18.2016). B. Liver's diaphragmatic surface after the 5th and 6th segments' resection within healthy tissues (01.01.2017 p.)

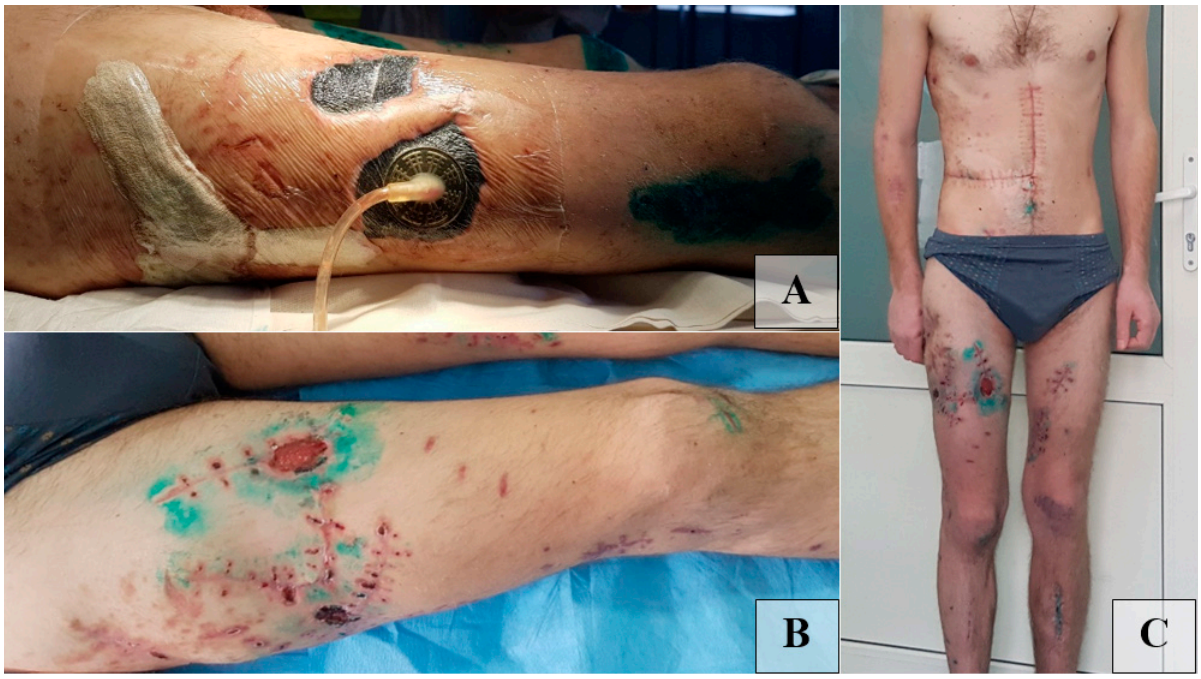

Figure 3. The dynamics of wounds' healing of the soft tissues of the right extremity. A. The view of the shrapnel wounds of the right thigh with installing VAC-system on the 21th day after the injury. B. The view of patient's right thigh on the 49th day after the injury. C. Patient Zh., 1995 year of birth, before discharge from the hospital on the 49th day after wounded

Specialized surgical care (level III). 18.12.2016 for further treatment the wounded was transferred to the Mechnikov Regional Clinical Hospital (Dnipro) by sanitary transport, where he received the infusion, antibacterial (aurotaz, dorybaks, amitsyl), symptomatic therapy, was conducted prevention of thrombo-embolic complications daily dressings.

Specialized surgical care (IV level). 21.12.2016 the patient had been brought by the air to the National Military Medical Clinical Center of Ukraine (Kyiv), where he was placed in the department of reanimation and intensive care because his serious condition. The general condition of the patient remained difficult due to course the third period of traumatic disease. For drainage of subhepatic space recorded daily flow rate of bile in volume to 300 ml. It was decided that one of the reasons the continuation of bile from the place of suturing a gunshot wound of the liver may be the intrahepatic biliary hypertension as a result of post-traumatic edema of liver parenchyma. In order to decompress biliary hypertension 12.22.2016 (6th day after the injury) the transpapillar intervention had been performed: endoscopic papillosphincterotomy, endoscopic retrograde cholecystopancreatography, stenting of the common bile duct; for enteral nutrition the probe had been set behind Treitz ligament. Implementation of endoscopic decompression of the bile duct had a positive effect in the form of a gradual reduction of bile from subhepatic space from 300 ml to 50 ml per day.

Given the earlier signs of liver ischemia injured areas of patient test performed CT scans of the liver, which resulted in the patient showed a trend to increase in areas of ischemic lesions of the liver parenchyma. According to «damage control» tactic the patient was preparing for liver resection of the affected segment, to prevent necrosis and abscess formation. However, on 16th days (01.01.2017) after the injury the patient had occurred an intra-abdominal bleeding. In an emergency laparotomy revealed arrosive wall defect right hepatic artery (**Figure 1A**), due to the vessel wall arrosive bile and chronic inflammation. Imposed on vascular suture site arrosive defect – achieved stable hemostasis (**Figure 1B**). With further revision including early sutured the liver gunshot wounds, surgical wounds were found covered with layers of fibrin, has been a partial failure of previously imposed joints, signs of bile, the liver tissue S_{5-6} had expressed ischemic changes with a corresponding change in the consistency of focal liver parenchyma softening type (**Figure 2A**). In order to prevent further secretion of bile and failure formed vascular suture decided to perform anatomic resection of segments 5 and 6 of the liver (**Figure 2B**). Due to the critical condition of the patient and guided by «damage control» tactic the surgery had stopped for 2 hours, then held blood transfusion, stabilized hemodynamic, operating crew completed by surgeon-hepathologist (surgery was performing at New Year's Eve). Due to the irreversible changes in liver sections after repeated suturing of gunshot wounds, reaching hemodynamic stabilization, the patient had been performed anatomical resection of liver S_{5-6} within the viable tissue. In general, due to intraperitoneal bleeding episode 11 doses of one-group packed red blood cells had been transfused to the patient. The postoperative period was uneventful, on the 9th day after the last operation patient was transferred to the specialized department.

Along with the performance of thoracic and abdominal surgery patient was held repeated surgical treatments of multiple fragmental injuries of soft tissues of the head, chest, abdominal, upper and lower extremities. The most traumatic injury suffered soft tissue arrays right lower limb, so for their treatment used VAC-treatment system rewiring them every 3–4 days (**Figure 3A, 3B**).

Further post-traumatic and postoperative periods proceeded smoothly, postoperative wounds had healed without complications, sutures had been removed. The patient was discharged in satisfactory condition from the hospital on 49th day after receiving a gunshot multifragmental wound (**Figure 3C**). Decision military medical commission wounded granted 45 days for rehabilitation (V level) before continuing performance of military duties.

Conclusions

1. Treatment of patients with serious gunshot penetrating wounds should be based on a clear understanding of the stages of traumatic disease course and expected complications with parallel conduct medical evacuation, using «damage control» tactic at all levels of care and attachment of all possibilities of modern surgical technology.
2. In terms of the use of high-energy rocket launchers gunshot liver damage can occur not only by clastic injured, but the mechanism of hydrodynamic impact.
3. The third period of traumatic disease with severe gunshot wounds the linked liver may be accompanied by a number of life-deferred dangerous complications that are caused by the partial failure of seams after a gunshot wound suturing the liver, bile seepage and hepatic bile arrosive vessels.

4. Bile from wounds after a gunshot injury of the liver can be effectively eliminated by endoscopic transpapillary decompression biliary tract.
5. An effective method of finally stopping arrosive delayed bleeding from the hepatic artery after gunshot injury can be suturing arrosive defect of vessel with resectional removal source of arrosion (liver resection).

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Conflict of interest statement
The authors declare no conflict of interest.

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