Review

Multisystem Abdominal Trauma in Pregnancy: Multidisciplinary Approach to Diagnosis and Treatment

V.V. Aleksandrov✉, N.A. Burova, S.S. Maskin, V.V. Matyukhin

Department of Hospital Surgery
Volgograd State Medical university of the Ministry of Health of the Russian Federation
1, Pavshikh Bortsov Sq., Volgograd, 400131, Russian Federation

✉**Contacts:** Vasiliy V. Aleksandrov, Candidate of Medical Sciences, Associate Professor of the Department of Hospital Surgery, Volgograd State Medical University of the Ministry of Health of the Russian Federation. Email: 79178304989@yandex.ru

INTRODUCTION Due to the increase in injury rate and increased social activity in pregnant women, there is an increase in the number of abdominal injuries as a result of accidents, domestic conflicts, and abuse. The absence of systematic reviews and meta-analyses related to the algorithmization of treatment tactics for multisystem abdominal trauma leads to a large percentage of treatment and diagnostic errors and complications, high maternal and perinatal mortality, which, in turn, dictates the need to develop a standardized interdisciplinary approach to the management of this category of patients.

AIM OF STUDY Standardization of the therapeutic and diagnostic approach to the treatment of pregnant women with multisystem closed abdominal trauma.

MATERIAL AND METHODS This literature review presents data from Russian and foreign publications from January 2015 to December 2020 from the electronic databases of PubMed, Cochrane Library, Scopus, eLibrary using the primary search strategy: trauma of pregnant women, multisystem closed abdominal trauma, damage control surgical treatment, emergency caesarean section, post-mortem caesarean section, treatment and diagnostic algorithm, obstetric bleeding, uterine rupture, placental abruption (total 571 publications), with the following exception from the request for non–full-text articles, publications not in Russian or English, manuscripts, dedicated to open trauma and obstetric complications of non-traumatic origin. The data extraction method was performed by two researchers independently of each other. We analyzed multicenter studies, large series of cases, original articles (11 retrospective studies with the selection of patients from 2001 to 2015; all 988 pregnant women with blunt abdominal trauma) and clinical recommendations; systematic reviews, meta-analyses, and randomized clinical studies for this period on multisystem closed trauma in pregnant women were not found. The levels of evidence and strength of recommendations in the review are derived from Russian and foreign clinical recommendations based on meta-analyses and systematic reviews prior to 2015.

RESULTS The treatment and diagnostic algorithm for multisystem abdominal trauma in pregnant women was standardized based on their hemodynamic status, and indications for minimally invasive and open interventions in this category of patients were clarified.

CONCLUSION Timely diagnosing and multidisciplinary approach contribute to reducing both maternal and perinatal mortality.

Keywords: closed abdominal trauma, multisystem injury, trauma in pregnancy, maternal mortality, perinatal mortality, hysterectomy, obstetric haemorrhage, uterine rupture, placental abruption

Vasily V. Aleksandrov	Candidate of Medical Sciences, Associate Professor of the Department of Hospital Surgery, Volgograd State Medical University; https://orcid.org/0000-0001-8364-8934, 79178304989@yandex.ru; 30%, concept and design of the study, collection and processing of material, writing text
Natalia A. Burova	Doctor of Medical Sciences, Professor of the Department of Obstetrics and Gynecology, Volgograd State Medical University; https://orcid.org/0000-0002-0546-8732, natalia-burova@yandex.ru; 20%, collection and processing of material, writing text, editing
Sergey S. Maskin	Doctor of Medical Sciences, Professor, Head of the Department of Hospital Surgery, Volgograd State Medical University; https://orcid.org/0000-0002-5275-4213, maskins@bk.ru; 30%, research concept and design, editing
Viktor V. Matyukhin	Candidate of Medical Sciences, Associate Professor of the Department of Hospital Surgery, Volgograd State Medical University; https://orcid.org/0000-0002-8195-6172, victor.matyukhin@gmail.com; 20%, collection and processing of material

APTT - activated partial thromboplastin time
BP - blood pressure
BPsyst - systolic blood pressure
AC - abdominal cavity
Br- brain
CAI-closed abdominal injury
DIC - syndrome of disseminated intravascular coagulation
DPL - diagnostic peritoneal lavage
RTA- road traffic accident
GIT - gastrointestinal tract
RH - retroperitoneal hemorrhage
RS - retroperitoneal space
CAI - closed abdominal injury
ALV - artificial lung ventilation
ITT - infusion-transfusion therapy
CS - caesarean section
CTG – cardiotocography
CT - computed tomography
INR - international normalized ratio
MRI - magnetic resonance imaging
MSCT - multislice computed tomography
OAC - organs of the abdominal cavity
ARF - acute respiratory failure
ICU - intensive care unit
VCB - volume of circulating blood
PDNLP - premature detachment of a normally located placenta
UR - uterine rupture
FG - free gas
FL - free liquid
FFP - fresh frozen plasma
CPR - cardiopulmonary resuscitation
USG – ultrasound examination
USDS - ultrasound duplex scanning
RR - respiratory rate
TBI - traumatic brain injury
HR - heart rate
EBOA - endovascular balloon occlusion of the aorta
ECA - extravasation of a contrast agent
EchoES – echoencephaloscopy
EE - endovascular embolization
SpO2 – blood oxygen saturation
URT - upper respiratory tract

INTRODUCTION

Approximately 7–8% of pregnant women are injured annually (mean age 21–30 years [1–3]), most in the III trimester (47.7–54%; in I — 8–15%, in II — 31–40%) [1–7], 0.4% of injured pregnant women require hospitalization [8]. Overall maternal mortality from trauma ranges from 10 to 20% [9]. Closed abdominal injury (CAI), more often combined and multiple, as a result of a traffic accident (TA) (40–74.7%), falls (9–22%) and physical violence (7.4–32.3%) is the leading non-obstetric cause of maternal and fetal death [1, 2, 4, 6–8, 10]. Fetal death occurs in 61–90% of cases of uterine rupture (RM), in 80–85% of cases of shock [8, 11]) and in almost 100% of deaths of a pregnant woman [12] with a combined abdominal injury, most often as result of a traffic accident (82% of perinatal deaths from trauma) [1, 8]. Antenatal death can also be caused by direct trauma to the fetus (less than 1% in CAT) and premature detachment of a normally located placenta (NLP), observed with abdominal trauma in 4.2–66% of cases [2, 8], more often with the location of the placenta in the anterior or lateral walls of the uterus [1] in the third trimester [4–8]. Perinatal mortality in PDNLP Ist degree (up to 25% of the surface) is 30%, IInd degree (25–50% of the surface) - 80%, IIIrd degree (more than 50% of the surface) - 100%, on average, it accounts for 50-70% of all trauma-related potentially preventable fetal losses [6, 8, 9], and timely emergency caesarean section (CS) contributes to survival in 75% of cases [8, 12].

With CAI, if the fetal head is at the entrance to the small pelvis, a skull fracture and intracranial hemorrhage may occur. [6, 8, 9, 11].

At a gestational age of less than 20 weeks, preterm birth after an accident occurs in 0.4% of cases, at later terms - in 3.5% [8], after laparotomy in case of injury in the II trimester, their frequency is 26%, in III - 82% [11]. The risk of preterm birth after CAI and discharge from the hospital in good condition and with a viable fetus is significantly higher, there is a correlation with the severity of the injury and a shorter gestational age [8].

With proper fixation with a three-point seat belt, the outcome of an accident for a pregnant woman is much more favorable: the risk of fetal loss is 2-7.1 times less (level of evidence - C, level of persuasiveness of recommendation - 2; C2) [4, 6, 7, 13, 14] , the deployment of airbags does not worsen it [8, 15]. Uterine rupture in CAI as a result of an accident occurs in 0.6% of cases [4, 5, 9], 10% of all URs [16]; with a previous CS, a late gestational period, a direct blow to the uterus, the frequency of UR increases [9, 12], but it poses a significant danger both to the life of the mother (mortality reaches 30%) and to the fetus [4, 6, 8, 16].

In pregnant women with CAI, ruptures of the spleen (in 27.9%), kidneys (18.6%), liver (more often with preeclampsia; 12.8%) and retroperitoneal hemorrhages (RH) (22.1%), intestines most often occur on the contrary, it is damaged less often due to the displacement of the enlarged uterus to the periphery [5, 8, 11]. In traumatic RH, coagulopathy develops (up to 25% of cases) and DIC (disseminated intravascular coagulation syndrome), which worsens the prognosis for the mother and fetus [8]. Pelvic fractures (20.9%) in the II and III trimesters of pregnancy are associated with damage to the urethra (2.3%), bladder (2.3%), RH (maternal mortality 9%), fractures of the fetal limbs and mortality 25– 35% as a result of direct fetal trauma (20%), placental abruption (32%) and maternal shock (36%) [8, 11]. The causes of bladder rupture in women can be blows to the lower abdomen, falling on the buttocks [8]. According to statistics, every fourth woman falls at least once during pregnancy, in these cases the most common injury is fractures of the bones of the lower extremities. In the United States, an analysis was conducted that showed that 79.3% of falls occur in the third trimester of pregnancy due to unsteady walks as a result of a shift in the center of gravity, weight gain, weakening of the ligaments and joints of the pelvis, increased pressure in the pelvic cavity, leading to violations neuromuscular transmission [2, 4, 10]. In the first and second trimesters, falls occur in 9.4% and 11.3% of cases, respectively [2]. Catatrauma leads to pregnancy loss in 90% of cases [1, 12], increases the risk of preterm birth by 4.4 times, PDNLP by 8 times, hypoxia by 2.9 times and fetal distress by 2.1 times [1].

3% of all women seeking trauma care are pregnant, and 11% of them are unaware of their condition [9, 10], so pregnancy should be suspected in every patient of childbearing age (from 15 to 49 years) and tested (determining x - subunits of human chorionic gonadotropin (B2) / USG - ultrasound) [1, 5, 8, 11]. Difficulties in the diagnosis and treatment of trauma can also be caused by complications of the pregnancy itself (amniotic fluid embolism, preeclampsia / eclampsia), which can be provoked or coincide in time with the injury [8, 12].

Changes in the body of a pregnant woman lead to an increase in resistance to blood loss, when the mechanism of centralization of blood circulation is turned on, the body tries to maintain its own homeostasis, primarily at the expense of the fetus, which may be in a state of hypovolemic shock with apparent normovolemia in the mother [8]. A pregnant woman may lose up to 30-35% (1500 ml) of circulating blood volume (CBV) before she develops tachycardia, hypotension, pallor, and weak pulse [5, 6, 8].

Based on the analysis and systematization of literary sources, an algorithm for diagnosing and tactic in case of PDNPP in pregnant women was determined (Fig. 1) [17]. With a gestational age of up to 22 weeks, the patient may be in a general surgical hospital, since serious obstetric complications are rare and the fetus is considered unviable if removed from the uterine cavity. If the period is at least 23 weeks, the pregnant woman should be hospitalized in a multidisciplinary hospital with a maternity hospital and neonatology department (B2) [5, 6, 9].

In accordance with the "golden hour" rule, they are delivered to the operating room for anti-shock measures, where they are examined by a surgeon, an anesthesiologist-resuscitator, an obstetrician-gynecologist, a neurosurgeon and a traumatologist, while measures are taken to ensure the safety of the vital functions of the body and laboratory diagnostics. Each of the specialists solves his own tasks, but the surgeon is in charge [6, 17]. The frequency of diagnostic errors varies from 7 to 25% [8]. In a retrospective study by Smith J.A. et al. 2020 [18] it was proved that an interdisciplinary approach in the examination of pregnant women contributes to a statistically significant reduction in the average time of diagnosis in case of injury (44 minutes vs. 14 minutes, p = 0.001).

Treatment-diagnostic algorithm for combined closed abdominal trauma in pregnant women in antishock operating room
(the first algorithm – abdominal and retroperitoneal trauma is dominated, clinic of hemorrhagic shock): examination of surgeon, anesthesiologist-reanimatologist, gynecologist, neurosurgeon and traumatologist, definitive control of external bleeding, elimination of asphyxia and restoration/support URT patency, oxygen therapy, tracheal intubation and ALV, CPR, if is no effect in 5 min – post-mortem CS starting from week 20, central veins and bladder catheterization, infusion-transfusion anti-shock therapy, warming the patient, anesthesia with BP and respiration control, lower vena cava syndrome profilaxis starting from week 20, nasogastric tube, sanitation bronchoscopy, laboratory diagnostics, test for pregnancy
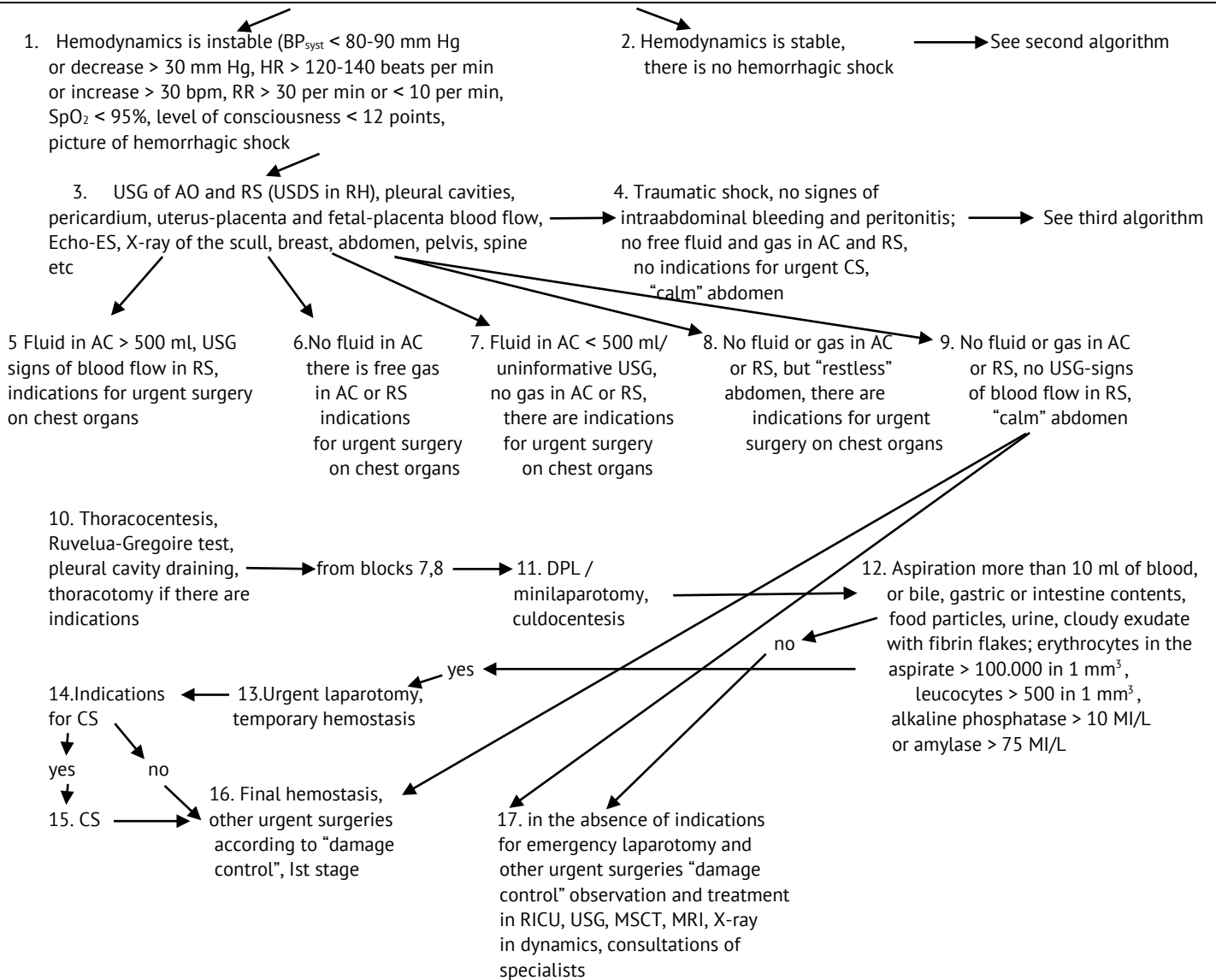
1. Hemodynamics is instable (BP_{syst} < 80-90 mm Hg or decrease > 30 mm Hg, HR > 120-140 beats per min or increase > 30 bpm, RR > 30 per min or < 10 per min, SpO_2 < 95%, level of consciousness < 12 points, picture of hemorrhagic shock

2. Hemodynamics is stable, there is no hemorrhagic shock → See second algorithm

3. USG of AO and RS (USDS in RH), pleural cavities, pericardium, uterus-placenta and fetal-placenta blood flow, Echo-ES, X-ray of the scull, breast, abdomen, pelvis, spine etc

4. Traumatic shock, no signes of intraabdominal bleeding and peritonitis; no free fluid and gas in AC and RS, no indications for urgent CS, "calm" abdomen → See third algorithm

5 Fluid in AC > 500 ml, USG signs of blood flow in RS, indications for urgent surgery on chest organs

6. No fluid in AC there is free gas in AC or RS indications for urgent surgery on chest organs

7. Fluid in AC < 500 ml/ uninformative USG, no gas in AC or RS, there are indications for urgent surgery on chest organs

8. No fluid or gas in AC or RS, but "restless" abdomen, there are indications for urgent surgery on chest organs

9. No fluid or gas in AC or RS, no USG-signs of blood flow in RS, "calm" abdomen

10. Thoracocentesis, Ruvelua-Gregoire test, pleural cavity draining, thoracotomy if there are indications → from blocks 7,8 → 11. DPL / minilaparotomy, culdocentesis

12. Aspiration more than 10 ml of blood, or bile, gastric or intestine contents, food particles, urine, cloudy exudate with fibrin flakes; erythrocytes in the aspirate > 100.000 in 1 mm^3, leucocytes > 500 in 1 mm^3, alkaline phosphatase > 10 MI/L or amylase > 75 MI/L

no

yes

14. Indications for CS ← 13. Urgent laparotomy, temporary hemostasis

yes

no

15. CS

16. Final hemostasis, other urgent surgeries according to "damage control", Ist stage

17. in the absence of indications for emergency laparotomy and other urgent surgeries "damage control" observation and treatment in RICU, USG, MSCT, MRI, X-ray in dynamics, consultations of specialists

Fig. 1. I treatment and diagnostic algorithm for combined blunt abdominal trauma in pregnant women, hemorrhagic shock clinic
Notes: BP — blood pressure; BPsist — systolic blood pressure; URT — upper respiratory tract; DPL — diagnostic peritoneal lavage; RH — retroperitoneal hemorrhage; RS — retroperitoneal space; MVL — mechanical ventilation of lungs; CS — cesarean section; MRI — magnetic resonance imaging; MSCT — multislice computed tomography; AO — abdominal organs; RICU —Resuscitation and Intensive Care Unit; CPR — cardiopulmonary resuscitation; US — ultrasonic scanning; USDS — ultrasonic duplex scanning; RR — respiratory rate; HR — heart rate; EchoES— echoencephaloscopy

In case of sudden circulatory arrest in a pregnant woman and the ineffectiveness of resuscitation measures within 4 minutes at a gestational age of 20–22 weeks, resuscitation hysterotomy (A1) is indicated [5, 8, 9, 19, 20] to save the life of the mother, but not the fetus. At a gestational age of at least 23 weeks, emergency CS and delivery in 5 minutes is indicated to save the life of the mother and fetus. If the pregnancy is less than 20 weeks, CS is not performed. Cases of extraction of a live fetus 10-22 minutes after the circulatory arrest in the mother are described [4, 21]. When the fetus is removed within 5 minutes from the moment of circulatory arrest in the mother, the survival rate reaches 70%. If the woman has a circulatory arrest, cardiopulmonary resuscitation is continued until the fetus is removed (A1) [19, 21, 22]. If the time of death is unknown, then delivery is performed only with a live fetus (from the 23rd week of gestation and in the presence of heartbeats in the fetus [4, 6, 9]). If cardiopulmonary resuscitation is effective, postpone CS and prevent intrauterine hypoxia [12].

A complete initial examination and stabilization of the mother's condition should precede any assessment of the fetal condition (B2) [9]. If possible, they take a history and conduct a thorough physical examination. Clinical manifestations of abdominal trauma are less pronounced, especially in the third trimester of pregnancy. Peritoneal symptoms are indistinct. Due to the displacement of organs by an enlarged uterus, pain can be localized in atypical places [8]. When examining the uterus, it is necessary to assess the height of the fundus, tone, soreness, it is also necessary to auscultate the fetal heart sounds, assess its size and position, determine the presentation of the fetus (C2) [19]. A vaginal examination is performed in the presence of bloody discharge from the genital tract, as well as to determine the condition of the cervix and the integrity of the fetal bladder (from the 23rd week - after ultrasound exclusion of placenta previa (C2) [6, 9]).

An assessment of the condition of the fetus should be carried out during a secondary examination. At a period of at least 23 weeks of pregnancy, continuous cardiotocography (CTG) (B2) is indicated [5, 6, 8, 9], it is important for assessing the condition of both the fetus and the mother, because the first manifestation of hypovolemic shock in a pregnant woman is often intrauterine hypoxia [12, 13].

1. In case of hemodynamic instability of the patient (BPsyst less than 80–90 mm Hg (or decrease by more than 30 mm Hg compared to the period before injury [23, 24]), heart rate more than 120–140 (or increase more than 30 bpm [23, 24]) or less than 50 bpm), RR more than 30 or less than 10 per minute, SpO2 less than 95%, obvious clinic of hemorrhagic shock, level of consciousness not more than 12 points on a scale Glasgow coma, regardless of the gestational age, the algorithm is carried out according to the following plan (see Fig. 1, block 1) [3, 6, 17].

In the first 15 minutes from the moment of arrival of the victim, in parallel with resuscitation, ultrasound of the abdominal organs (AO) and retroperitoneal space (RS) is performed (A1) [1, 6, 17, 24, 25, 26] (when RH is detected, an ultrasound assessment of the presence of blood flow is performed as a sign of ongoing bleeding), pleural and pericardial cavities (E-FAST-протокол) to search for free fluid (FF) and pneumothorax [11]; fetal ultrasound and Doppler ultrasound examination of uteroplacental and fetal-placental blood flow, echoencephaloscopy (EchoES), radiography of the skull, chest, abdomen, pelvis with capture of the hip joints, spine, and other segments - according to indications (Fig. 1, block 3) [1, 9, 17, 25, 27]. Differences in sensitivity (83%) and specificity (96%) in the detection of SF and intra-abdominal lesions using the FAST protocol in pregnant and non-pregnant women were not found in most studies [4-6, 9, 28], only in one study of 328 pregnant women FAST sensitivity was 61%, specificity - 94.4%, accuracy - 92.1% [4]. "Obstetric" ultrasound can help in assessing the number of fetuses and their (its) location, gestational age, location of the placenta, length of the cervix, heart rate and heart rate of the fetus, its possible damage, amniotic fluid volume or confirmation of fetal death [5, 6, 9, 13, 15, 22].

Ultrasound in the case of PONPP reveals an echo-negative area (hematoma) between the uterine wall and the placenta [7]. The sensitivity of the method in this case is 24-80%, specificity - 92-96%, positive and negative predictive value - 88% and 53%, respectively [9]. 25-50% of hematomas, mostly retroplacental, go unnoticed [7, 9]. With RM, you can see the presence of the fetus and placenta in the BP outside the uterus, SF in the BP, and the rupture itself in the form of a hypoechoic area [13, 22]. In general, the sensitivity and positive predictive value of "obstetric" ultrasound is 85.7%, specificity and negative predictive value - 99.7% [12, 28].

Plain radiography is performed in order to detect free gas (FL) in the AC / RS or a possible rupture of the diaphragm with the movement of the abdominal organs into the pleural cavity. According to the American College of Obstetricians and Gynecologists (ACOG) guidelines for exposure during pregnancy, doses less than

5 rad (50 mGy) are not associated with an increase in miscarriage or fetal abnormalities, regardless of gestational age (C2) [4, 11, 26]. The method of radiography can help to identify FF in the AC in the form of parietal ribbon-like shadows in the lateral canals and expansion of the interloop spaces [8]. The implementation of radiopaque examination methods during pregnancy should be strictly justified by the lack of information content of less stressful research methods and, if necessary, to obtain additional diagnostic information.

In the case of a concomitant injury, after stopping external bleeding and ensuring the patency of the upper respiratory tract, while there are indications for emergency interventions on the organs of the chest and BP, first of all, interventions on the chest (thoracocentesis / drainage of the pleural cavity / thoracotomy) are performed as a resuscitation measure and to prevent ventilation disorders during mechanical ventilation (Fig. 1, blocks 5–8;10;13) [17].

In patients with unstable hemodynamics and signs of ongoing intra-abdominal (with SF more than 500 ml) / retroperitoneal bleeding, the presence of FF in the AC / PC on the x-ray, the clinic of peritonitis, an urgent median laparotomy (A1) / revision of the FF is performed (Fig. 1, blocks 5, 6; 13), hemostasis, removal of the source of peritonitis, debridement and drainage of AC/RS [3, 4, 25–27]. Continued massive intra-abdominal bleeding prevents recovery operations and makes it difficult to revise the damage, and during laparotomy the bleeding increases due to a decrease in intra-abdominal pressure. If there is uncontrolled subdiaphragmatic bleeding from parenchymal organs, vessels of the AC/RS, as well as unstable pelvic fractures (C2) [4, 8, 24, 25, 29], severe arterial hypotension (BPsyst not more than 70 mm Hg), in the absence of severe traumatic brain injury (TBI) and chest trauma, pre- or intraoperatively, endovascular balloon occlusion of the aorta (EVBOA) is performed [30], this stops bleeding and allows time for intensive care (C1) [4, 24], emergency CS, blood aspiration (B2) [24] and achieving final hemostasis. If EVBOA is not possible, temporary stop of bleeding is performed by pressing the aorta to the spine immediately below the diaphragm proximal to the mouth of the celiac trunk with aortic clamp for up to 20–30 minutes, by applying tourniquets on the vascular pedicles of the parenchymal organs/internal iliac arteries (B2) [24] and evacuating the blood with a device for reinfusion [24, 29]. In 2.4–7.2% of pregnant women with trauma, there are indications for emergency CS [19]. They are:

A. Placenta previa with ongoing bleeding (C2) [29];

B. Progressive PDNPP (C2) II–III gr. (more than 25–30%) [5, 8, 24, 31]. Continuous monitoring of fetal heart rate and uterine contractions for at least 4–6 hours (B2) [4–6, 8, 9]. In severe trauma (collision of motorcycles, pedestrians with high-speed vehicles, ejection from a car), if the mother's heart rate is more than 110, the fetal heart rate is more than 160 or less than 110, the gestational age is at least 23 weeks, uterine contractions more than once within 15 minutes, maintaining tension of the abdominal wall, the appearance of bloody discharge from the genital tract, continuous CTG is indicated, careful monitoring with determination of the level of fibrinogen (B2) [9] within 48 hours [5, 8, 22, 23, 26]. It must be remembered that PDNLP can occur within 5 days after injury. [8, 12]. Extremely rarely, with the hemodynamic stability of the mother and the absence of fetal distress, when placental abruption is accompanied by expansion and shortening of the cervix, induction of labor in a natural way is possible; the same tactic is possible in case of fetal death and no other indications for emergency CS (B2) [9];

C. Threatening/beginning/completed UR (C2) [5, 6, 8, 9, 15]: with incomplete UR, maintaining uterine tone and no signs of infection, it is possible to suture the defect [16], with complete UR and/or damage to large vessels uterus - hysterectomy [4, 6, 15, 24];

D. Fetal distress syndrome with signs of progressive metabolic acidosis as measured by CTG or lactate (C1 [23]) in an "immature" cervix [1, 27];

E. Prolapse of the loops of the umbilical cord or handle of the fetus with head presentation (C2) [8, 9];

F. Agony or sudden death of a woman (C2) with at least 15 minutes interval between maternal death and delivery, maternal refractory shock [8, 9];

G. Premature rupture of amniotic fluid with an incorrect position of the fetus (C2) / multiple pregnancy, as well as in combination with chorioamnionitis, preeclampsia / eclampsia; DIC, amniotic fluid embolism with eclampsia [29].

In most pregnant women with fractures of the pelvis after their fixation, vaginal delivery is possible only in the case of fractures of the pubic bones, when there is a risk of damage to the urethra and bladder, severe fractures of the pelvic or lumbosacral spine, it is possible to perform CS [12].

In the presence of a live fetus, CS is performed after the rapid achievement of temporary hemostasis in the AC/RS (Fig. 1, blocks 13, 14, 15) [24, 27, 29]. After the extraction of the fetus and placenta, measures are taken for the final hemostasis and the elimination of other injuries (Fig. 1, blocks 15;16), and in the case of hemorrhagic shock (with BPsyst less than 70 mm Hg lasting more than 1 hour, requiring inotropic support), combined (C1) and multi-organ damage, ongoing bleeding (the need for transfusion of more than 10 doses of red blood cells), leading to metabolic acidosis (pH less than 7.2; serum lactate more than 5 mmol/l (B1); base deficiency less than -10-15 mmol/l), hypothermia (less than 34°C) and coagulopathy (activated partial thromboplastin time - APTT more than 60 s, thrombocytopenia less than 90x109l) (B1), the use of surgical tactics "damage control" is indicated (B1) [24, 29].

With uncontrolled hypotonic uterine bleeding against the background of hemorrhagic shock and the ineffectiveness of compression sutures (according to B-Lynch — longitudinal /Pereira – transverse) (C2) [29], controlled balloon tamponade of the uterus, ligation of the uterine/internal iliac arteries (efficiency 92%) (C2) [29]; RM in the lower segment with the transition to the cervix or fornix of the vagina, separation of the uterus from the fornix, the presence of signs of infection, the development of DIC, for Kuveler's uterus hysterectomy is indicated [8, 29, 32].

In the presence of a live fetus, the absence of the above indications for emergency CS, non-progressive placental abruption up to 30%, measures are taken to prolong pregnancy [8, 29]. In case of fetal death before laparotomy and a gestation period of up to 17 weeks, in the absence of indications for an emergency CS, the uterus is emptied, with a gestation period of more than 17 weeks - induction of labor activity - after laparotomy and relative stabilization of the patient's condition [8].

If the amount of fluid in the AC is less than 500 ml or ultrasound is uninformative, there is no FG in the AC/RS (Fig. 1, block 7) or there are no FF/FG in the AC/RS, but there is a clinically "restless" abdomen, hemopneumothorax (Fig. 1, block 8), then after the measures described in block 10, they urgently perform diagnostic peritoneal lavage (DPL) [17] / mini-laparotomy (A1) (with multiple postoperative scars on the anterior abdominal wall, intestinal paresis) supraumbilically (with palpable uterus above the symphysis) by an open technique (sensitivity is similar to that in non-pregnant women – 96–100% [9]) [15], or culdocentesis (in early pregnancy) and, with aspiration of at least 10 ml of blood, bile, gastric, intestinal contents or food particles, urine, cloudy exudate with fibrin flakes; the content of more than 100 thousand erythrocytes / 500 leukocytes in 1 mm3/ml in the aspirated fluid, the level of alkaline phosphatase is more than 10 IU/l or amylase is more than 75 IU/l, laparotomy is to be performed (A1) (Fig. 1, blocks 11x12x13) [4, 15, 17].

In the absence of FF/FG in the AC/RS, hemopneumothorax, US signs of blood flow in the RS, "calm" abdomen (see Fig. 1, block 9) and the presence of appropriate indications, other urgent surgical interventions are performed according to the "damage control" tactics (Fig. 1, block 16), in the absence – observation and treatment in the ICU, ultrasound / MRI / MSCT (abdomen and pelvis – at a gestational age of at least 18 weeks) / X-ray in dynamics [11], examination by narrow specialists (Fig. 1 , block 17) [17].

Ultrasound and laparocentesis largely determine the treatment tactics in "unstable" patients [8, 17, 25].

2. With relative hemodynamic stability of the patient (BPsyst more than 90 mm Hg, heart rate less than 120 per minute), respiratory rate less than 30 per minute, level of consciousness above 12 points on the Glasgow coma scale and gestational age of at least 18 weeks, SpO2 of at least 95% , in the absence of obvious signs of hemorrhagic shock, MSCT of the skull and brain, chest, abdomen (A1) [6, 8, 15, 17, 25], fetus, pelvis with capture of the hip joints, spine, and other segments are performed – according to indications – always after temporary immobilization of fractures (Fig. 2, block 2x18); if there is a suspicion of damage to large vessels (including placental) and parenchymal organs of AC/RS and/or FF in AC and there is no FG in AC/RS/indications for emergency CS (Fig. 2, block 19), the examination is supplemented with angiocontrast to detect a source of possible bleeding [17, 26, 31] (Fig. 2, block 2x18x19), given that after 18 weeks of pregnancy, exposure carries a negligible risk for the fetus, especially if the cumulative doses are less than 10 rad (100 mGy/mSv) [6, 9, 11].

Treating-diagnostic algorithm for combined abdominal trauma in pregnant women in antishock operating room (second algorithm – abdominal trauma and trauma of retroperitoneal space are dominating, there is no hemorrhagic shock): examination by a surgeon, an anesthesiologist-resuscitator, an obstetrician-gynecologist, a neurosurgeon and a respiration, prevention of inferior vena cava syndrome from traumatologist, final control of external bleeding, elimination of asphyxia and restoration/maintenance of the patency of the upper respiratory tract, oxygen therapy, if indicated, tracheal intubation and mechanical ventilation, with ineffectiveness within 5 minutes - post-mortem CS from 20 weeks , catheterization of the main veins, bladder, infusion-transfusion therapy, warming the patient, anesthesia under the control of blood pressure and external 20 weeks, nasogastric tube, sanitation bronchoscopy, laboratory diagnostics, test for pregnancy

19. There is damage to the parenchymal organ and / or fluid in the abdominal cavity, RS, no free gas in the abdominal cavity and RS, no indications for emergency CS, - CT angiography.. ... .

2. Hemodynamically stable (BP syst>90 mm Hg. 50<HR<120 per min, level of consciousness >12 points, gestational age>18 weeks, no hemorrhagic shock

34. There is damage of hollow organs, free gas in AC or RS, clinical picture of peritonitis, indications for CS

20. There is extravasation of contrast in a free AC/RS RS or parenchyma of an organ (unstable hematoma)

21. No extravasation of contrast in a free AC/RS, parenchyma of an organ (stable hematoma)

18. MSCT of the skull, chest, abdomen, fetus, HP, pelvis (when gestational age ≥18 weeks / unknown fact / gestational age – Ultrasound of the BP/ZP/fetus instead of CT, X-ray of AO and pelvis), spine and other segments according to indications after immobilization of bone fractures, MRI for suspected PDNLP / ... threatening uterine rupture ......

36. Aspiration of bile, gastric, intestinal content or particles of food, urine, cloudy exudate with flakes of fibrin, content in aspirate 500 and more leukocytes in 1 mm3, alkaline phosphatase >10 IU/L or amylase >75 IU/l

22. endovascular embolization of vessels of parenchymal organ / RS

23. ineffective endovascular embolization, increase in RB/ appearance of indications for CS

24. effective endovascular embolization

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29. Urgent laparotomy, pelvic tamponade, temporary hemostasis, CS, then final hemostasis, other urgent surgeries according "damage control" tactics , 1-st stage, surgeries on the breast before laparotomy according indications

yes

26. There is no fluid in AC, hematoma of AO/RS

25.There is fluid in AC, <500 ml in volume

35. Results of MSCT of the abdomen and RS doubtful/negative

27.There is fluid in AC, >500 ml in volume

30. Laparoscopy, thoracocentesis, Ruvelua-Gregoire test, draining of pleural cavity, thoracoscopy, thoracotomy according indications before laparoscopy

31"restless" abdomen

32. "quiet" abdomen

33.DPL/ minilaparotomy / culdocentesis

28.In "quiet"abdomen, no indication for emergency laparotomy, CS and other urgent surgeries according to "damage control" tactics observation and treatment in RICU, USG/MRI/X-ray in dynamics, consultations of specialists.
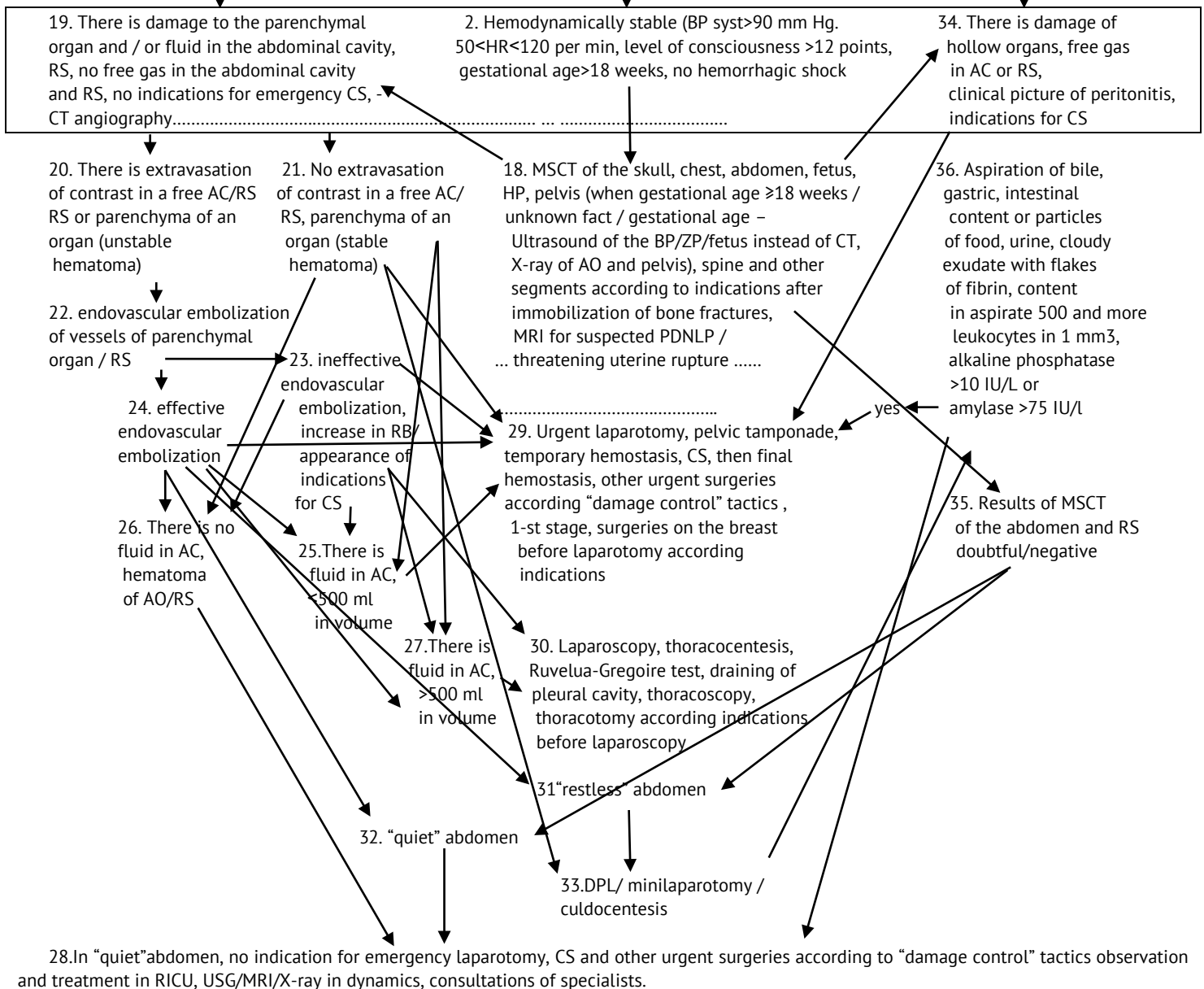
Fig. 2. II treatment and diagnostic algorithm for multisystem closed abdominal trauma in pregnant women, the absence of obvious signs of hemorrhagic shock
Notes: BP — blood pressure; AC — abdominal cavity; URT — upper respiratory tract; DPL — diagnostic peritoneal lavage; RH — retroperitoneal hemorrhage; RS — retroperitoneal space; MV — mechanical ventilation; ITT — infusion-transfusion therapy; CS — cesarean section; CT — computed tomography; CT- angiography — computed tomography with angiography; MRI — magnetic resonance imaging; MSCT — multislice computed tomography; AO — abdominal organs; PDNPP — premature detachment of a normally positioned placenta; FG — free gas; CPR — cardiopulmonary resuscitation; USDS — ultrasonic duplex scanning; RR — respiratory rate; HR — heart rate.

Concerns about the absorbed dose of fetal radiological exposure should not preclude radiodiagnosis, the risk of missed or untimely diagnosed maternal and fetal injury is much greater than the risk of exposure (B2) [4, 6, 8, 9, 11]. The greatest teratogenic potential of ionizing radiation is observed during the first 5–10 weeks during the period of organogenesis, and between 10 and 18 weeks damage to the central nervous system and fetal growth retardation are possible [7, 11].

With a decrease in placental perfusion on computed tomography (CT) by 25–50%, a correlation with PDNLP is observed, and an emergency CS is needed [31]. The sensitivity of contrast-enhanced CT is 100%, and the specificity is 54–56% [7, 12, 22, 26]. With CT, you can see the FF in the AC and the defect itself, it is also possible to detect the fetus in the AC outside the uterine cavity [16, 31].

At a gestational age of up to 18 weeks / unknown fact / gestational age, CT of the abdomen and pelvis is replaced by ultrasound of the AO / RS of the fetus and plain radiography (Fig. 2, block 2-18) [3, 33], but in the presence of FF in the AC / blood flow in retroperitoneal hematoma and the absence of FG in AC/RS/indications for emergency CS, it is preferable to supplement the CT examination with contrast enhancement and angioembolization (Fig. 2, block 18-19) [6, 11, 26]. Iodine-containing contrast agents can cross the placenta and accumulate in the fetal thyroid, but studies have not reported cases of goiter or thyroid dysfunction, which expands the use of CT during pregnancy [6]. CT of the skull and brain, cervical spine, or extremities (except for the pelvic bones) is considered safe in any trimester of pregnancy. The dose of ionizing radiation to the fetus can be reduced by using lead shielding [6, 11], limiting the study area and the number of sections [5, 33].

With a gestational age of up to 18 weeks / unknown fact / gestational age and uninformative ultrasound, stable hemodynamics, MRI can be performed [3, 26, 33], the sensitivity and diagnostic accuracy of which is 94-100% and 87-94%, respectively [9, 14, 16].

In the presence of extravasation of a contrast agent (ECA) into the AC/RS/parenchyma of organs (unstable hematoma), endovascular embolization (EE) is performed (Fig. 2, blocks 20;22; if necessary, embolization of the internal iliac/uterine arteries – after removal of the fetus; efficiency 58 –98%, in 15% of cases there are indications for hysterectomy (C2) [23, 24, 32]) [8, 17, 29]. Athiel Y. et al. in 2020 [34] performed a successful embolization of the splenic artery in a hemodynamically stable pregnant woman at week 33 with subcapsular hematoma of the spleen and small hemoperitoneum, no intra-abdominal bleeding was detected during CS at week 35, and the hematoma decreased in size on repeated CT. The fetus was protected by lead shielding [34].

In case of ineffective EE and the amount of FF in the AC more than 500 ml, the growth of RS, the appearance of indications for an emergency CS, a laparotomy is performed, a temporary stop of the ongoing intra-abdominal / retroperitoneal bleeding, CS, then final hemostasis and elimination of other injuries (Fig. 2, blocks 23;25;29) [4, 17]. Only when damage to the chest organs, hemopneumothorax is detected, first of all, interventions on the chest (thoracocentesis / drainage of the pleural cavity / thoracoscopy / thoracotomy) are performed, then laparotomy or other urgent surgical interventions [5, 17].

In case of ineffective EE, if the amount of FF in the AC is less than 500 ml, there are no indications for emergency CS, laparoscopy is performed according to the Hasson method (Fig. 2, blocks 23;27;30) to stop bleeding and debridement, drainage of the AC. Contraindications to laparoscopy: severe abdominal distension, multiple scars on the anterior abdominal wall, extremely serious condition of the pregnant woman due to shock, damage to the chest, brain, since the volume of pneumoperitoneum significantly affects the function of external respiration and hemodynamic parameters [8]. In the II and III trimesters of pregnancy, the trocar is inserted into the AC above the navel, above the fundus of the uterus. This is technically feasible up to 32 weeks of gestation, later laparotomy is performed. The imposition of a large pneumoperitoneum is contraindicated if a diaphragm rupture is suspected, since a tension pneumothorax will occur [8], in this situation, against the background of a pneumoperitoneum with a volume of up to 600 ml, the diaphragm is initially examined. If it is impossible to find the source of ongoing bleeding or if hemostasis is ineffective, conversion of the access is performed [8, 17].

In the absence of FF in the AC, FG in the AC/RS, the presence of ECA in the parenchyma of the organs (unstable hematoma) and the ineffectiveness of EE, a laparotomy is performed (with the exception of the spleen, where laparoscopic intervention is possible) (Fig. 2, blocks 26;29) [6, 17].

With effective EE and the absence of hemoperitoneum ("stabilization" of an unstable hematoma, including retroperitoneal), no indications for emergency CS, stable hemodynamics, the patient is dynamically monitored in the ICU (Fig. 2, blocks 24;26;28) [17]. With effective EE and the amount of FF in the AC more

than 500 ml (stopped intra-abdominal bleeding with stable hemodynamics), stabilization of the RH, and no indications for emergency CS, laparoscopy is performed (Fig. 2, blocks 24; 25; 30) for sanitation and drainage of the AC [3, 8, 17].

With effective EE and the amount of FF in the AC less than 500 ml (stopped minor intra-abdominal bleeding with stable hemodynamics), the absence of FG in the AC / RS and a "calm" abdomen (no signs of peritonitis, intestinal obstruction, tension of the anterior abdominal wall, indications for emergency CS) perform dynamic monitoring of the patient in the ICU (Fig. 2, blocks 24;27;32;28) [8, 17]. With a "restless" abdomen, DPL [17]/culdocentesis (in the early stages of pregnancy) is performed, and if appropriate indications are identified (in addition to damage to the parenchymal organ, there is a rupture of the hollow organ without the release of FG into the AC/RS), they switch to laparotomy (Fig. 2, blocks 31;33;36;29) [4, 8, 17].

In the absence of ECA in the AC/RS/parenchyma of organs, the absence of FG in the AC/RS, the absence of hemoperitoneum (stable hematoma), indications for emergency CS, dynamic monitoring in the ICU (Fig. 2, blocks 21;26;28) [8, 17].

In the absence of ECA in the AC/RS/parenchyma of organs, the absence of FG in the AC/RS, the presence of FF up to 500 ml, DPL is performed urgently to clarify its nature (CT sensitivity for intestinal ruptures reaches 90%; in hemodynamically stable patients, CT and DPL are complementary diagnostic methods (A1) [21]) and, if appropriate indications are identified (rupture of a hollow organ without FH exit into the AC/RS), they switch to laparotomy (Fig. 2, blocks 21;27;33;36;29) [4, 5, 17].

In the absence of ECA in the AC/RS/parenchyma of organs, the absence of FH in the AC/RS, the amount of FF in the AC is more than 500 ml, laparoscopy is urgently performed (Fig. 2, blocks 21;25;30) to search for a possible rupture of the hollow organ (without release of FF into the AC / RS), adequate sanitation and drainage of the AC, if the latter is detected – conversion [5, 17].

If there are clear signs on CT of damage to a hollow organ (FF in AC/RS), a clear clinic of peritonitis, indications for emergency CS, a laparotomy is performed (Fig. 2, blocks 34;29). In case of questionable or negative CT results and a "calm" abdomen (no signs of peritonitis, intestinal obstruction, tension of the anterior abdominal wall, indications for an emergency CS), dynamic observation is performed in the ICU (Fig. 2, blocks 35;32;28) (A1). In case of a "restless" abdomen, DPL/culdocentesis is performed on an emergency basis, and if appropriate indications are identified, they switch to laparotomy (Fig. 2, blocks 31;33;36;29) [3, 4, 17].

In case of traumatic shock, absence of signs of intra-abdominal and retroperitoneal bleeding and/or peritonitis, FF/FG in AC/RS, indications for emergency CS, "calm" abdomen (Fig. 3, block 4 - concomitant abdominal trauma is not dominant) after exclusion of data complications with the help of ultrasound of the AO and RS, pleural and pericardial cavities (E-FAST-протокол), Ultrasound of the fetus and ultrasound Doppler study of uteroplacental and fetal-placental blood flow, EchoES, radiography of the skull, chest, abdomen, pelvis with the capture of the hip joints, spine, and other segments — according to indications (Fig. 3, block 3)), if there are appropriate indications, urgent surgical interventions are performed according to the tactics "damage control" (Fig. 3, blocks 37, 38), in the absence of such - observation and treatment in the ICU, ultrasound / MRI / MSCT / X-ray in dynamics, examination by narrow specialists (see Fig. 3, block 39) [3, 5, 17].

Treatment and diagnostic algorithm for multisystem closed abdominal trauma in pregnant women in antishock operating room (the third algorithm – trauma of abdomen and RS are not dominant, clinical signs of traumatic shock): examination by a surgeon, an anesthesiologist-resuscitator, an obstetrician-gynecologist, a neurosurgeon and a traumatologist, final control of external bleeding, elimination of asphyxia and restoration/maintenance of the patency of the upper respiratory tract, oxygen therapy, tracheal intubation and mechanical ventilation if indicated, CPR, with ineffectiveness within 5 minutes - post-mortem CS from 20th week, catheterization of the main veins, bladder, infusion-transfusion therapy, warming the patient, anesthesia under the control of blood pressure and external respiration, prophylaxis of vena cava inferior syndrome from 20th week, nasogastric tube, sanitation bronchoscopy, laboratory diagnostics, test for pregnancy

↓

3.USG of AC and RS (USDS in RS), pleural cavities and pericardium, USG of fetus, uterine and placental blood flow, EchoES, X-ray of the scull, chest, abdomen, pelvis, spine and other segments if there are indications

↓

4.Traumatic shock, there are no signs of intraabdominal and retroperitoneal bleeding, peritonitis: there are no free fluid and free gas in the AC and RS, no indications for urgent CS, "quiet" abdomen ⟶ **37. In hemopneumothorax** thoracocentesis, Ruvelua-Gregoire test, pleural drainage, thoracotomy according to indications

↓ ↓

39. In "quiet" abdomen, no indications for urgent laparotomy, CS and other urgent surgical operations according to "damage control" tactics – observation in ICU, USG, MSCT, MRI in dynamics, consultations of specialists.   **38.Other urgent surgeries according to "damage control" tactics, 1st stage**
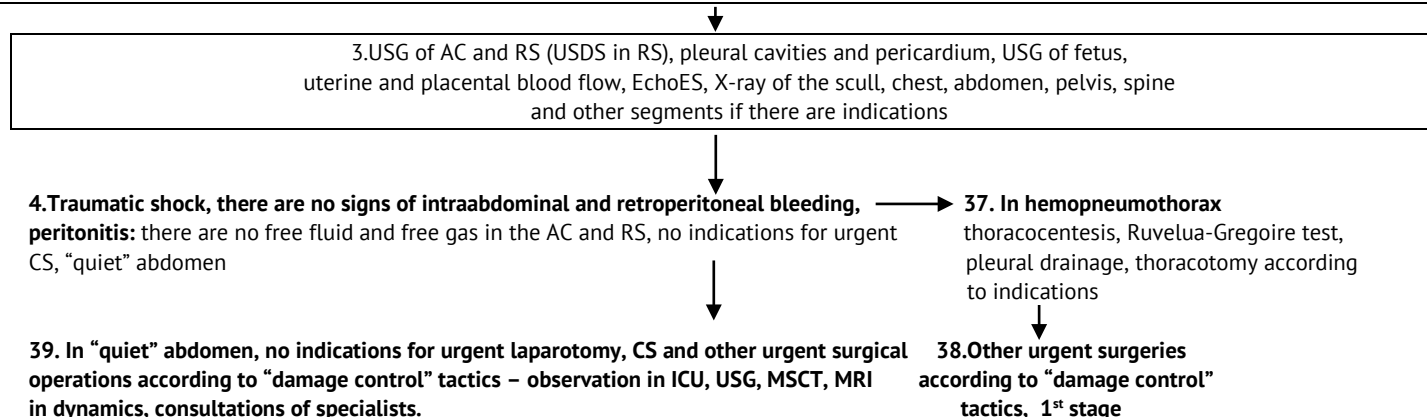
Fig. 3. III treatment and diagnostic algorithm for multisystem closed abdominal trauma in pregnant women, abdominal trauma is not dominant.
Notes: BP — blood pressure; URT — upper respiratory tract; RH — retroperitoneal hemorrhage; MV — mechanical ventilation; CS — cesarean section; MRI — magnetic resonance imaging; MSCT — multislice computed tomography; AO — abdominal organs; RICU — Resuscitation and Intensive Care Unit; CPR — cardiopulmonary resuscitation; FF — free liquid; FG — free gas; USG — ultrasonic scanning; USDG — ultrasonic duplex scanning; EchoES — echoencephaloscopy.

Treatment. The goal of treating pregnant women with injuries is to save the life and health of the mother and fetus. The "key" to saving and surviving the fetus is effective treatment of the mother [8, 9].

The complex of resuscitation and conservative measures for concomitant CAI includes:

1) Maintaining blood circulation, stopping external bleeding. CPR indications and technique are the same as for non-pregnant women, but after 20 weeks of gestation, they are carried out in the position of the left lateral tilt and left lateral displacement of the uterus [4, 6, 20, 21, 35];

2) Elimination of asphyxia and restoration/maintenance of patency of the upper respiratory tract [8, 10], prevention of hypoxemia (A1) [6, 25]. For unspecified conditions of the cervical spine, impaired airway patency and apnea, loss of consciousness, and significant chest injuries, cervical spine immobilization, direct laryngoscopy, early fiberoptic tracheal intubation with a smaller tube (no more than 6.5 mm; risk of unsuccessful intubation in pregnant women is 8 times higher) are necessary [4, 6, 7, 9, 10]) and mechanical ventilation with 100% oxygen 15 l/min [15, 21]. Pregnant women tolerate apnea worse due to an increase in the level of the diaphragm up to 4 cm (it must also be borne in mind when setting up pleural drainage - 1–2 intercostal spaces higher (C2) [9] (III–IV intercostal space along the midaxillary line) [5, 6]), a decrease in the functional residual capacity of the lungs [5, 35]. It is recommended to maintain a minimum level of saturation - 95% (A1) [9, 24] (optimally – 98-100%), PaCO2 is about 30 mm Hg. Art. (from the 20th week of pregnancy) [4–6, 10];

3) Replacement of blood loss (A1) [24, 29] (two venous accesses with large-gauge needles (A1) (14–18 G) [7, 9, 24] on the upper limbs [4–6, 10], preferably limited in volume (up to 3500 ml [36]) ITT (high risk of pulmonary edema and increased intra-abdominal bleeding), balanced and polyelectrolyte crystalloids up to 2000 ml (A1) [6, 23, 24]/colloids (HES/modified gelatin/albumin for initial resuscitation in shock, up to 1500 ml) (B2) [24, 29, 32]). The optimal concentrations of Ht or Hb to maintain hemostasis in polytrauma have not been established [25, 35]. Many researchers consider hemoglobin levels less than 90 g/l (C1) [6, 25] and heart rate more than 100 beats/min as indications for blood transfusion; with massive blood loss, the ratio of effective doses of erythrocytes (3-4 doses), plasma (15-20 ml / kg), platelets (platelet mass 1 dose per 10 kg / thromboconcentrate 1-2 doses) and cryoprecipitate (1 dose per 10 kg) should be 1:1:1:1 (A2) [4, 23, 24, 32]. ITT is carried out against the background of glucocorticoid therapy (prednisone at least 10 mg/h per kg of body weight). Electrolyte disturbances are corrected with potassium-magnesium asparaginate solutions. To regulate metabolic processes, ATP is introduced (neoton (phosphocreatine) 6 g / day). Mandatory correction of hypocalcemia (ionized Ca2+ should be more than 1.1–1.3 mmol/l) (A1) [24];

4) Early correction/prevention of coagulopathy (A1) [29, 36] — by transfusion:

a) FFP 15-20 ml/kg of body weight (if fibrinogen is less than 2 g/l; prothrombin time and APTT are 1.5 times or more higher than normal, INR (international normalized ratio) is more than 1.5; platelet count is less than 80x109/l) (B2), at least 1000 ml [6, 23, 32, 36] until normalization of INR (no more than 1.3) and APTT [23, 29, 32];

b) fibrinogen (initial dose 3–4 g) (C1) [29, 35];

c) cryoprecipitate with fibrinogen less than 1.5 g/l; starting dose 50 mg/kg (C1) [25, 29, 32, 36];

d) platelet mass / thromboconcentrate to maintain platelet levels above 50x109/l (C1) [23, 25, 29, 32, 36]; in patients with ongoing bleeding, severe polytrauma, impaired platelet function, TBI, it is recommended to maintain a platelet level of more than 100x109/l (C1) [25];

5) Administration of hemostatic agents 5–12 days – tranexamic acid 1 g administered within 10 minutes within the first hour of injury is recommended (2.5% reduction in risk of bleeding death) (A1) [24, 35, 37], followed by an intravenous infusion of 1 g over 8 hours (up to a maximum of 40 mg/kg [24, 45]) (A1) [4, 6, 23, 36]. The introduction of tranexamic acid as part of complex therapy for massive blood loss reduces its magnitude and the risk of hysterectomy (B1) [24, 37]. With the ineffectiveness of the above drugs, it is possible to use a recombinant activated coagulation factor VII (rFVIIa) (C1) [23, 25, 36], which significantly reduces the amount of blood transfusion in patients with blunt trauma [29];

6) Creation of rest, the appointment of analgesics (short-acting, opioids are possible, nonsteroidal anti-inflammatory drugs are contraindicated) and therapy aimed at preventing and treating organ failure, maintaining and prolonging pregnancy [8, 35]. In case of emergency CS in the period of 23–34 weeks, in order to accelerate the maturation of pulmonary surfactant, antenatal prophylaxis of fetal RDS with corticosteroids should be performed. [8, 9];

7) Prevention of tetanus (B2) [9] and antibiotic therapy in the presence of damage to the skin and mucous membranes, burns, abortions and childbirth outside the hospital, damage to the hollow organs of the gastrointestinal tract (GIT)). Cephalosporins and penicillins are category A or B drugs and are generally considered safe for use in pregnancy. Tetracyclines and aminoglycosides are category D drugs and should generally be avoided. [5];

8) The introduction of inotropic drugs (dobutamine) for myocardial dysfunction (B2) [9, 23]. Vasopressors and inotropes can lead to fetal ischemia, they are administered only in case of resistant hypotension, when volume replacement does not increase blood pressure above 90 mm Hg within 1 hour (B1) [4, 6, 10, 15, 24]. In decompensated hemorrhagic shock and indications for emergency surgery under general anesthesia and mechanical ventilation, vasopressors are prescribed immediately [24, 35];

9) Prevention of stress bleeding from the upper gastrointestinal tract - the introduction of proton pump blockers (A1) [25]. Absolute indications - mechanical ventilation, hypoxia (acute respiratory failure - ARF - increases the risk of gastrointestinal bleeding by 15.6 times), hypotension (3.7 times), coagulopathy (4.3 times), sepsis (2 times) [5];

10) Permanent catheterization of the bladder (A1) [23] for hourly control of diuresis [6, 15]; its decrease to less than 0.5 ml/kg/h is a reliable indicator of inadequate infusion therapy [15];

11) Warming up the patient (A1) ideally up to 36.5°C [6, 22, 24, 25]. More than 50% of patients with hemoperitoneum suffer from hypothermia, which forms a fatal triad with coagulopathy and acidosis. A decrease in body temperature when measured in the esophagus to 34°C is accompanied by 4 times greater mortality than at a temperature of 35°C [25]. It is necessary to remove cold damp clothes, increase the ambient temperature (29°C), provide air heating, use warming blankets and mattresses, warm oxygen, 35–39°C crystalloid solutions (A2) [24], in extreme cases, devices for artificial warming of patients [24];

12) Elimination of acidosis (A1) [24, 29]: there are currently no clear recommendations for the use of medicines [25]. Sodium bicarbonate is contraindicated in ARF, too aggressive correction of acid-base balance can suppress compensatory hyperventilation - an important mechanism in acute blood loss [9, 10, 35]. Tris(hydroxyethyl)-aminomethane is not well studied, it is not administered for oliguria. Avoid hypoventilation and large infusions of 0.9% sodium chloride solution [5];

13) Prevention/treatment of gastrointestinal paresis: intravenous administration of solutions containing potassium, nasojejunal intubation, prokinetics (metoclopramide (in the II and III trimesters), erythromycin (A1)), hypertonic enemas, enteral nutrition [5];

14) Prevention of venous thromboembolic complications - intermittent pneumatic compression (A2) [24] and pharmacological prophylaxis with low molecular weight fractionated heparins (A1) — after achieving final hemostasis (A2) no later than 12-24 hours [23–25, 36];

15) Prevention of inferior vena cava syndrome [6, 7, 15]. Approximately 10% of women from the 20th week of pregnancy experience hypotension in the supine position due to compression of the inferior vena cava by the uterus: venous return decreases, cardiac output decreases and manifestations of hemorrhagic shock increase, therefore, transportation and examination of a pregnant woman with a gestational age of more than 20 weeks should be carried out in the position on the left side (30–45 °) (A1) [9, 19, 24], in the case of surgical treatment, it is necessary to tilt the operating table to the left [6] after stabilization of the cervical spine (A1) [4, 9, 15, 19]. If lateral tilt is not possible, manual displacement of the uterus to the left is necessary (B2) [6, 9]. With unstable hemodynamics, it is possible to raise the foot end of the operating table [6];

16) Nasogastric tube (especially in violation of consciousness (C2) [9, 15]) after intubation, since in pregnant women the risk of aspiration of gastric contents increases many times [4, 6, 10, 35]. There is no evidence base for the use of certain drugs for the prevention of aspiration syndrome, but the American Society of Anesthesiologists (2016) recommends the use of antacids, H2-histamine blockers and metoclopramide [13, 19]. Blood flow through a nasogastric tube may indicate an injury to the upper gastrointestinal tract and is an indication for fibrogastroduodenoscopy and, possibly, diagnostic laparoscopy to exclude damage to the stomach / duodenal ulcer [8, 17];

17) Prevention/treatment of feto-maternal transfusion [4, 6, 9, 35], since in 2.6–30% of cases of CAI, after the 12th week, chorionic villi are damaged, and fetal blood enters the mother's bloodstream from the intervillous space. Feto-maternal transfusion develops, which leads to anemia, cardiac arrhythmias (bradycardia), heart failure, intrauterine hypoxia and possible death of the fetus / newborn, as well as isosensitization of the mother by fetal erythrocytic antigens. This diagnosis is confirmed by the detection of

fetal erythrocytes in a maternal blood smear stained by Kleihauer-Betke (shown in all pregnant women after the 12th week (B2) as a predictor of preterm birth regardless of Rh factor [9]) [4, 5, 8, 9, 22]. All Rh-negative pregnant women with abdominal trauma should receive a single dose of human immunoglobulin anti-Rho [D] 300 micrograms intramuscularly within 72 hours of receiving it (A1) [5, 6, 8, 13, 22]. One fetal cell per 1,000 maternal cells counted corresponds to a mother-to-fetus bleed of 5 ml. If bleeding is more than 30 ml of fetal blood, an additional dose of immunoglobulin is administered [4, 5, 22].

CONCLUSION

Combined closed abdominal trauma in pregnant women is an urgent problem in polytrauma surgery due to the high risk of adverse outcomes for both mother and fetus, and the solution to this problem requires an interdisciplinary approach using a standardized diagnostic and treatment algorithm. A clear understanding of the possible complications and consequences of an injury, as well as the possibility and expediency of using certain diagnostic and treatment methods from the point of view of safety and maximum information content, can reduce the time for making a correct diagnosis and improve the results of treatment in this category of patients.

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