

PRINCIPLES AUTOPSY IN CASES OF PERINATAL DEATH

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Achievements in modern medicine, allowed since 2012, significantly reduce perinatal mortality in the Russian Federation. Despite the impressive rate of decline in perinatal mortality, there are still quite a few deaths that could be prevented. Causes and mechanisms of death in the perinatal period, starting from the 22nd week of intrauterine fetal development, on the 7th day after birth, are significantly different from the tanatogenesis in a patient living more than 7 days. Our work presents perinatal mortality rates in the Russian Federation for the period from 2010 to 2016 and formulates recommendations for the consistent implementation of all stages of an autopsy of the deceased in the perinatal period in full. Issues of approaches to pathoanatomical research, principles of diagnosis formulation and correct registration of medical documentation in stillbirth and in cases of death in the early neonatal period were discussed. The main criteria that allow differential diagnostics between antenatal intrapartum fetal death and the death of a child in the early neonatal period are considered. In addition, we have developed a classification of pathoanatomical diagnosis, taking into account the characteristics of the perinatal period and the interaction in the "mother-placenta-fetus" system. The authors note that in the case of a fatal outcome in the perinatal period, the final pathoanatomical diagnosis, in addition to the generally accepted headings, should take into account the mother's condition (pathology of pregnancy, childbirth), as well as the pathology of the afterbirth.

Keywords: perinatology; pathoanatomical diagnosis; perinatal mortality; stillbirth; neonatal mortality.

ПРИНЦИПЫ ПРОВЕДЕНИЯ ПАТОМОРФОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ В СЛУЧАЯХ ПЕРИНАТАЛЬНОЙ СМЕРТИ

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Достижения в современной медицине позволили начиная с 2012 г. значительно снизить перинатальную смертность в Российской Федерации. Несмотря на внушительный темп снижения перинатальной смертности, остаются достаточно многочисленные случаи летального исхода, которые можно было предотвратить. Причины и механизмы смерти в перинатальном периоде начиная с 22-й недели внутриутробного развития плода по 7-е сутки после рождения в значительной степени отличаются от танатогенеза у пациентов, проживших более 7 суток. В нашей работе представлены показатели перинатальной смертности в Российской Федерации за период с 2010 по 2016 г. и сформулированы рекомендации для последовательного проведения всех этапов аутопсии в перинатальном периоде в полном объеме. Обсуждены вопросы подходов к патологоанатомическому исследованию, принципы формулировки диагноза и верного оформления медицинской документации при мертворождении и в случаях смерти в раннем неонатальном периоде. Рассмотрены основные критерии, позволяющие провести

дифференциальную диагностику между антенатальной, интранатальной гибелью плода и смертью ребенка в раннем неонатальном периоде. Кроме того, нами была разработана рубрификация патологоанатомического диагноза с учетом особенностей перинатального периода и взаимодействия в системе «мать – плацента – плод». Авторы отмечают, что в случае летального исхода в перинатальном периоде заключительный патологоанатомический диагноз, кроме общепринятых рубрик, должен учитывать состояние матери (патологию беременности, родов), а также патологию последа.

Ключевые слова: перинатология; патологоанатомический диагноз; перинатальная смертность; мертворождение; неонатальная смертность.

1. BACKGROUND OF THE PROBLEM

According to the World Health Organization (WHO), more than 5 million cases of perinatal death are registered each year¹ [27, 33], including 2.7 million cases of neonatal death [41, 43] and 2.6 million cases of stillbirth [27, 41]. Most of these cases are preventable [26, 41]; thus, one of the primary objectives of international health research efforts is the elimination of preventable deaths of newborns and stillbirth [29].

In Russia, a three-level model for the provision of perinatal care has been established and is functioning successfully. A program to provide medical care was launched considering the special aspects of the regions, which enabled the drastic reduction of infant mortality rates to the indicators of European countries [22]. Nevertheless, further research and analysis of the causes of infant mortality remain relevant. The latter is necessary to create a model for the prevention of perinatal pathology and consequently reduce infant [21] and child mortality rates.

An important step of programs aiming to reduce perinatal mortality should be to establish mechanisms for careful ubiquitous recording and classification of the causes of such deaths based on a single system that can be applicable worldwide and possibly compare the results². Keeping this in mind, we have prepared recommendations for consistent collection as well as proper documentation of the pathomorphological study findings and analysis of causes of perinatal death. The information obtained provides a basis for drawing conclusions regarding the conditions leading to death and will allow a better understanding of the causes and factors of perinatal mortality, thereby facilitating the development of an appropriate system of therapeutic and preventive measures.

¹ WHO's application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PD). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

² WHO's application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

2. DETERMINATION OF THE PERINATAL PERIOD. GENERAL DEFINITIONS

The perinatal period begins at 22 completed weeks (day 154) of fetal intrauterine life (at this time the fetal body weight is normally 500 g) and ends at 7 completed days after birth [31].

To answer the question of whether a case occurred during the perinatal period, the following criteria should be considered:

- 1) period of pregnancy;
- 2) body weight at birth;
- 3) length of the body from the top of the head (crown) to the feet.

Live birth. Live birth occurs when the fetus separates from the mother via delivery at a gestational age of 22 weeks or more and has signs of life (breathing, heartbeat, umbilical cord pulsation, or voluntary muscular movements), irrespective of whether the umbilical cord is cut and the placenta is detached. The body weight of the newborn may be 500 g or more (or less than 500 g for multiple births). If the body mass of the child at birth is unknown, the body length (25 cm or more) may be considered.

Stillbirth. Stillbirth occurs when the fetus is delivered at a gestational age of 22 weeks or more and has no signs of life³ [31]. The body weight of the newborn may be 500 g or more (or less than 500 g in multiple births). If the body weight at birth is unknown, the body length (25 cm or more) may be used. Morphological signs of death include cadaveric lividity, rigor mortis, maceration of skin, and autolysis of internal organs.

Perinatal mortality. The indicator of perinatal mortality includes the number of fetal deaths, including those deceased in the early neonatal period, during the calendar year per 1000 total births [31]. The birth weight is at least 500 g. If the birth weight is unknown, birth occurs at a gestational period of 22 completed weeks or the body length is at least 25 cm from the crown to the feet.

³ Order of the Ministry of Health and Social Development of Russia dated 27.12.2011 No. 1687n (edited on 02.09.2013) "On the medical criteria of birth, the form of the birth certificate and the procedure for its issuance" (registered in the Ministry of Justice of Russia on 15.03.2012 No. 23490).

Table 1 (Таблица 1)

Perinatal mortality in the Russian Federation in 2010-2016

Перинатальная смертность в Российской Федерации за 2010–2016 гг.

Year / Год	People / Человек			Per 1000 live births and stillbirths / На 1000 родившихся живыми и мертвыми		Per 1000 live births / На 1000 родив- шихся живыми
	All / Всего	Stillbirths / Мертворожденные	Dead at the age before 7 days / Умершие в воз- расте до 7 дней	All / Всего	Stillbirths / Мертворожденные	Dead at the age before 7 days / Умершие в воз- расте до 7 дней
2010	13 248	8300	4948	7.37	4.62	2.75
2011	12 920	8109	4811	7.16	4.49	2.67
2012	19 111	12 142	6969	9.98	6.34	3.64
2013	18 395	12 226	6169	9.64	6.41	3.25
2014	17 228	11 769	5459	8.81	6.02	2.81
2015	16 173	11 453	4720	8.29	5.87	2.43
2016	14 997	10 884	4113	7.89	5.73	2.18

The perinatal period is divided into antenatal, intranatal, and early neonatal, which is indicated in the minimal set of perinatal indicators collected for all births and perinatal deaths⁴.

Early neonatal mortality. The early neonatal mortality rate includes the number of dead children among infants aged up to 7 completed days of life during the calendar year per 1000 live births in the same year⁵ (Table 1)^{6, 7}.

All liveborn infants, usually with a birth weight of at least 500 g, are subject to registration.

Body weight at birth. The weight of the child at birth is measured by weighing the newborn during the first hour of life.

Newborns born with a body weight of up to 2500 g are considered to have low birth weight, those weighing up to 1500 g are considered to have

very low birth weight, and those weighing up to 1000 g are considered to have extremely low birth weight⁸.

The gestational age is another important parameter for interpreting the causes of perinatal death, defining clinical and pathoanatomical diagnoses, and preparing a medical certificate of perinatal death.

The gestation period is calculated from the first day of the last normal menstruation. The gestation period is expressed in completed days or weeks. For example, events that occurred between 280 and 286 completed days after the start of the last normal menstruation are considered to have occurred at week 40 of pregnancy. The gestational age, calculated by the date of the last normal menstruation, often serves as a source of statistical errors. To avoid mistakes, it must be remembered that the first day should be regarded as day 0, and not day 1. Accordingly, days 0–6 constitute a “full zero lunar week” and days 7–13 constitute a “full first week.” Furthermore, week 40 of pregnancy is synonymous with “39 completed weeks.” If the date of the last normal

⁴ WHO's application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

⁵ European HFA-database (HFA-DB) WHO ERB, July 2016. [European HFA-database HFA-DB WHO/Europe, July 2016] (<http://data.euro.who.int/hfad/b/shellru.html>).

⁶ Journal of the Federal Service of State Statistics “Public Health in Russia” (official publication). 2015: Stat.sb./Rosstat. M., 2015. 174 p.

⁷ Federal Service of State Statistics. The natural movement of the population of the Russian Federation (statistical bulletin) for 2010-2016. <http://www.gks.ru>.

⁸ Order of the Ministry of Health and Social Development of Russia dated 27.12.2011 No. 1687n (edited on 02.09.2013) “On the medical criteria of birth, the form of the birth certificate and the procedure for its issuance” (registered in the Ministry of Justice of Russia on 15.03.2012 No. 23490).

menstruation is unknown, the gestational age should be determined based on the most reliable clinical data. To avoid misunderstandings, the results of calculations in statistical tables should be indicated in both days and weeks.

Prematurity is delivery at a gestation period of less than 37 completed weeks (less than 259 days) of pregnancy.

Maturity is delivery at a gestation period from 37 to 42 completed weeks (259–293 days) of pregnancy.

Postmaturity is delivery at a gestation period of 42 or more completed weeks (294 days or more) of pregnancy [4, 31].

Preterm delivery is a maternal condition in which, at a period of up to 37 completed weeks of gestation, a woman experiences a spontaneous onset of contractions – with changes in the uterine cervix – in the absence of obvious pathological conditions, such as chorioamnionitis or urinary tract infection.

The connection between preterm delivery and perinatal mortality is of great interest to doctors and scientists. It is necessary to distinguish between preterm delivery of unknown etiology and childbirth accompanied by pathology or caused artificially in a hospital⁹.

3. SPECIAL ASPECTS OF CONDUCTING A POST-MORTEM EXAMINATION OF A FETUS, STILLBORN CHILD OR DEAD NEWBORN

Medical assistance in the Russian Federation is conducted in accordance with Federal Law No. 323-FZ of December 21, 2011 “On fundamental healthcare principles in the Russian Federation”¹⁰. It is organized and provided in accordance with the procedures for the provision of medical care as well as on the basis of medical care standards.

Post-mortem examination (autopsy) consists of a morphological (macro- and microscopic) study of the organs and tissues of a deceased person, a newborn, stillbirths and fetuses in order to diagnose the disease and determine the cause of death¹¹ [11].

In accordance with Article 67 “Conducting post-mortem examinations” of the Federal Law No. 323-FZ of 21.11.2011 and cl. 3 of the Order of the Ministry of Health of Russia of 06.06.2013 No. 354n “On the procedure for post-mortem examinations”¹², an autopsy of stillborn children and children who died before the age of 28 days inclusive is conducted in all cases – regardless of religious motives – as well as on the written application of parents or other relatives or a legal representative. Given the definition of stillbirth in the order of the Ministry of Health and Social Development of Russia dated 27.12.2011 No. 1687n “On the medical criteria of birth, the form of the birth certificate and the procedure for its issuance”¹³, it is mandatory to perform a post-mortem examination of stillborn infants starting from a gestational age of 22 weeks, when the fetal weight is 500 g.

A post-mortem examination is performed within three days after the statement of biological death of a person¹⁴ [13].

The aims, tasks, and methods of performing post-mortem examinations of fetuses, stillborn, and dead children are described in various manuals, methodological recommendations, instructions, and orders¹⁵ [3, 12, 14].

A post-mortem examination is an important tool for quality assurance in clinical medicine. An autopsy can determine the exact cause of death and detect unexpected complications in the course of the development of the disease, including the side effects of treatment and other medical interventions [34].

The results of autopsy are used as quality control of prenatal and perinatal diagnostics [37].

The information obtained from post-mortem examinations of stillborn infants and those who die in the perinatal period provides an explanation of the cause of death, as well as assesses and prevents risks for embryos, fetuses, and newborns in subsequent pregnancies.

¹² Order of the Ministry of Health of Russia of 06.06.2013 No. 354n “On the procedure for post-mortem examinations” (registered in the Ministry of Justice of Russia on 16.12.2013 No. 30612).

¹³ Order of the Ministry of Health and Social Development of Russia dated 27.12.2011 No. 1687n (edited on 02.09.2013) “On the medical criteria of birth, the form of the birth certificate and the procedure for its issuance” (registered in the Ministry of Justice of Russia on 15.03.2012 No. 23490).

¹⁴ Federal Law No. 323-FZ of 21.11.2011 (as amended on 03.07.2016) “On fundamental healthcare principles in the Russian Federation” (with amendments and additions, in effect since 01.01.2017).

¹⁵ Order of the Ministry of Health of the Russian Federation No. 318, Decree of the State Statistics Committee of the Russian Federation No. 190 of 04.12.1992 “On the transition to the criteria recommended by the World Health Organization for live birth and stillbirth” (together with the “Instruction on the definition of criteria for live birth, stillbirth, perinatal period”).

⁹ WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

¹⁰ Federal Law No. 323-FZ of 21.11.2011 (as amended on 03.07.2016) “On fundamental healthcare principles in the Russian Federation” (with amendments and additions, in effect since 01.01.2017).

¹¹ Order of the Ministry of Health of the Russian Federation of 24.03.16 No. 179n “On the rules for conducting post-mortem examinations” (registered in the Ministry of Justice of the Russian Federation on April 14, 2016, the registration number 41799).

Today, there is an increasing number of modern methods that are used in post-mortem imaging all over the world. These include X-ray, ultrasound, computed tomography, and magnetic resonance imaging [28, 35, 38].

Information on admission to the pathoanatomical bureau (office) of the stillborn child or child who died in the neonatal period is entered in the form of the medical records No. 015/y "Registration log of the receipt and issuance of bodies of the deceased."

The post-mortem examination of fetuses, stillborn, or dead newborns has significant differences compared to the autopsy of deceased adults. In particular, one of the important differences is the need to assess the state of the secundines. The results of this should be considered in the analysis of autopsy data and they must be registered in the report of the post-mortem examination.

Before the beginning of the post-mortem examination, the pathologist studies the medical documentation submitted for the post-mortem examination and, if necessary, gets an explanation from the doctors who participated in the examination and treatment of the patient¹⁶. Important considerations include: the obstetric and gynecological history, the course of previous and current pregnancies, the nature and course of labor, gestational age, the history of previously born children, and the results of interdisciplinary research.

Macroscopic and histological studies of the placenta are important in diagnostics and must be recorded in the autopsy protocol.

During the post-mortem examination, the body must be photographed while on the back, in the face-down position, and also in profile. At the external examination, the state of maturity, the presence of malformations, dysmorphism, and genetic stigma are assessed. If there are malformations and/or dysmorphic stigmas, genetic and roentgenologic studies are recommended. Attention is paid to details such as skin color, the presence of maceration, meconium, vernix caseosa, hemorrhage, and injuries.

When examining the head of the fetus/infant, attention is paid to the presence, size, and location of "labor tumor," which indicates the presenting part of the fetus.

Labor tumor is edema of the soft tissues in the presenting part of the fetus: the occipital, parietal, frontal, and facial regions with the head presentation,

buttocks, lower extremities, perineum, and genital organs in pelvic presentation. In the next 23 days after birth, the labor tumor disappears as the swelling resorbs.

Labor tumor should be distinguished from cephalohematoma, hemorrhage under aponeurosis, and cerebral hernia (protrusion of the meninges through the fontanel).

Cephalohematoma is hemorrhage under the periosteum of the skull bones with the accumulation of coagulated blood in the formed subperiosteal space. The boundaries of the external cephalohematoma are limited by the boundaries of bones of the skull, which are often the parietal bones and less often the occipital bones. Cephalohematoma refers to birth trauma.

Three degrees of cephalohematoma are distinguished according to the size of the subperiosteal hemorrhage:

- degree 1 – hemorrhage diameter of 4 cm or less;
- degree 2 – hemorrhage diameter of 4.1–8 cm;
- degree 3 – hemorrhage diameter is more than 8 cm (in the case of multiple cephalohematomas, the total hemorrhage area is estimated).

Assessment of the state of maturity. The maturity of the fetus is understood as the optimal functional and morphological development of the systems, organs, and tissues of the newborn adapted to extrauterine life.

Criteria for maturity of a full-term fetus:

- the skin is elastic, with a well-developed subcutaneous fat layer;
- the presence of prenatal hairs in the area of the shoulder blades and shoulder girdle;
- hair on the head reach a length of 2 cm;
- dilated pupils without a membrane, transparent corneas;
- elastic, resilient cartilage of the nose and ear conches;
- the nails are dense and protrude beyond the fingertips;
- the umbilical ring is located in the middle between the bosom and the metasternum;
- testicles in the scrotum in boys;
- the labia minora in girls are covered with labia majora and the interlabial space is closed.

Measurement and weighing. When a fetus or child is measured and weighed, the results are registered in the protocol of post-mortem examination.

The following is determined:

- body weight;
- the distance from the crown to the tailbone and from the crown to the feet;
- length of the shoulder, forearm, hand, hip, shin, foot (both sides);

¹⁶ Order of the Ministry of Health of Russia of 06.06.2013 No. 354n "On the procedure for post-mortem examinations" (registered in the Ministry of Justice of Russia on 16.12.2013 No. 30612).

- the maximum width of the hand and foot (on both sides);
- head circumference;
- bilateral head size;
- frontal-occipital head size;
- circumference of the chest;
- circumference of the abdomen at the navel level [36].

Damage to the bones of the skull, brain, and spinal cord is possible with birth or obstetrical trauma. Also, with birth injury of the skull, the brain can be displaced into the spinal canal leading to the development of paravertebral edema in the neck, chest, and even abdomen. This can simulate the tumor. It must be differentiated from Arnold–Chiari syndrome.

Dislocation or fracture of the clavicle with an obstetric aid may manifest as an asymmetry of the thorax.

A complete defect in the abdominal wall (peritoneum, muscle, skin) with the abdominal organs protruding through a rupture of the umbilical ring, or any part of the abdominal wall, is not possible with pathological births and birth trauma. This is usually associated with a hernia of the umbilical cord (omphalocele).

In mild cases, the hernial sac of an omphalocele may contain single loops of the intestine, while in severe cases it may contain almost all the organs of the abdominal cavity.

Maceration is autolysis of tissues under the action of fetal and amniotic fluid. It develops immediately after embryofetal death. Evaluation of the degree of maceration enables an estimation of the time of onset of fetal death and allows for the assessment of the adequacy of preventive and medical measures.

The sequence of macerative changes is well described in the literature. A few hours after death, changes occur in the epidermal and dermal junction. This includes the separation of the epidermis from the dermis. Shortly after that, liquid and bubbles (bullae) start to accumulate under the epidermis. They can be torn apart spontaneously or in the process of birth, under the influence of the compressive forces of the birth canal.

In addition to skin manifestations, other changes, such as generalized hypermobility of joints and autolysis of internal organs occur later.

As follows from the literature, maceration can be divided into three stages [30, 40]:

Stage 1 (from 6 to 24 h):

- 6 h – the skin of the fetus is gray-white, the vernix caseosa is impregnated with meconium, and it is

greenish. The umbilical cord remnant is purple-red. A slight exfoliation of the epidermis is determined;

- 12 h – reddish skin of the fetus, exfoliation of the epidermis from the dermis in the face and back (or abdomen);
- 18 h – exfoliation of the epidermis from the dermis on 25% of the body surface area or two or more anatomical areas;
- 24 h – the skin of the fetus is dark red or purple, exfoliation of the epidermis from the dermis on more than 25% of the body surface area.

Stage 2 (from 1 to 3 days):

- 36 h – skin is dull, purple, of dirty appearance, exfoliation of the epidermis from the dermis on less than 50% of the body surface area;
- 48 h – exfoliation of the epidermis from the dermis on more than 50% of the body surface area;
- 72 h – exfoliation of the epidermis from the dermis on more than 75% of the body surface area.

Stage 3 (4 days and more):

- 96 h – the skin is gray-purple-red, of dirty appearance due to impregnation with blood and hemolysis in the places of exfoliation of the epidermis from the dermis. The skull bones in the sutures area overlap;
- Week 1 – wide open mouth;
- Week 2 – mummification – the fetus is dehydrated, compressed, purple, and grayish.

Autopsy and examination of the cavities of the body and skull. Extraction of organocomplex.

The study of organs and tissues. This section is compiled based on data and is rather widely represented in the Russian literature¹⁷ [3, 12, 14, 25].

After external examination of the body, the second stage of the post-mortem examination is performed: autopsy of the body cavities and examining the organs.

Both sides of the abdomen, to the left and right of the middle umbilical ligament are examined, to identify possible aplasia of the umbilical arteries, as well as to assess the integrity of the umbilical vein and the place of its entry into the liver [36].

As in adults, the volume of serous fluid and blood in the body cavities is determined.

After autopsy of the body cavities, a step by step location of organs and vessel complexes is conducted. Additionally, the integrity and height of the diaphragm elevation is studied. This enables the examiner to rule out any malformations.

¹⁷ Order of the Ministry of Health of the Russian Federation No. 318, Decree of the State Statistics Committee of the Russian Federation No. 190 of 04.12.1992 “On the transition to the criteria recommended by the World Health Organization for live birth and stillbirth” (together with the “Instruction on the definition of criteria for live birth, stillbirth, perinatal period”).

In accordance with the gestational age, the state of blood circulation and blood flow is assessed by studying the open oval window, the Botallo's foramen, and the umbilical vein.

Extraction of the organocomplex is recommended to be performed using Shore's method of complete evisceration.

Attention is paid to organs such as the parotid salivary gland, pharyngeal ring with tonsils, pituitary gland, and spinal cord. These organs must be extracted and studied. The remains of the umbilical cord with the surrounding peri-umbilical region are excised and registered.

All organs are weighed and measured. Paired organs are measured and weighed separately.

It should be noted that the weight and size of the body and organs of stillborn children are less than the weight and size of dead newborns of the same gestational age.

Sampling biological material for histological and other additional studies. Laboratory processing of biological material. Microscopic study of biological material. In a post-mortem examination, histological, biochemical, microbiological, immunohistochemical, and other methods of research of individual fetal (stillborn) tissues – or parts thereof – are obligatory parts of the diagnostic process in order to establish the initial and immediate causes of human death. In addition, in the conclusion of the autopsy protocol, a pathoanatomical diagnosis is formulated, including the necessary categories.

Sampling of biological material for histological examination (in the presence of medical indications – histochemical, immunohistochemical, genetic, molecular, and biological research) includes excision of pieces of organs and tissues, as well as placing them in fixing solutions¹⁸.

For histological examination, it is recommended to take material from the following organs [3, 19]:

- brain – at least 7–10 pieces (cortex, central gyri, subcortical area, including the optic thalamus with lateral ventricular wall, rachidian bulb, and pons varolii);
- lungs-4 pieces (upper and lower lobes of the left and right lung, with parahilar and peripheral divisions);
- heart-2 pieces (the wall of the left and right ventricles), 5–7 in some cases;
- small intestine-2 pieces (ileum and jejunum with follicles);

- large intestine-2 pieces (rectum and sigmoid colon);
- liver with umbilical vein-2–3 pieces;
- umbilical vessels at different levels from the skin graft of the umbilical fossa region-2–3 pieces;
- umbilical fossa with skin-2 pieces;
- pancreas-3 pieces (head, body, tail);
- salivary glands-2 pieces (parotid, submandibular);
- spleen-2 pieces;
- kidneys-2 pieces;
- adrenal glands-2 pieces;
- thymus gland-2 pieces (left and right lobes);
- lymph nodes-3 pieces (cervical, bronchopulmonary and mesenteric).

Depending on the tasks, the number of pieces of individual organs can be increased.

All organs are examined with the gestational age considered [33]. In addition to staining with hematoxylin and eosin, separate organs require additional histological staining.

In case of suspected genetic disease, a skin sample must be taken from the least contaminated areas (axillary cavity, inguinal fold). The material must be placed in a container with medium and sent for study on the day of autopsy. It is possible to store the material overnight at a temperature of +4 °C.

If more than 24 h have passed from the moment of death (for example, stillbirth), a sample of the Achilles tendon tissue is taken for examination.

In the absence of a storage medium, the material is placed in a sterile vessel [36].

For virological and bacteriological studies for the detection of the herpes simplex virus, cytomegalovirus, toxoplasmosis, chlamydia, mycoplasmas, and other pathogens, the following material is sampled:

- 1) blood (serum) for virological and bacteriological research;
- 2) pieces of tissue from the liver, spleen, brain, and heart for virological research.

For immunohistochemical studies, impression smears from the lungs and pial membrane are used.

4. WHO'S APPLICATION OF THE INTERNATIONAL CLASSIFICATION OF DISEASES (ICD-10) TO DEATHS IN THE PERINATAL PERIOD (ICD-PM)

In August 2016, the guidance “WHO's application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period: ICD-Perinatal Mortality (ICD-PM)” was published¹⁹.

¹⁸ Order of the Ministry of Health of Russia dated 06.06.2013 No. 354n “On the procedure of postmortem examination” (registered in the Ministry of Justice of Russia on 16.12.2013 No. 30612).

¹⁹ WHO's application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

The guidance is prepared by the WHO working group and deals with the classification of cases of perinatal death. The ICD-PM tool is based on the international statistical classification of diseases and health-related problems, the tenth revision (ICD-10), and its encoding rules. It should be emphasized that ICD-PM is not a new classification of diseases and causes of death, but an “instrument” for ensuring the consistent collection, analysis, and interpretation of data on perinatal mortality. The use of the ICD-PM is aimed at decreasing the number of coding errors, improving the procedure for determining the causes of perinatal death, and improving the ease of use and comparison of statistics on perinatal mortality based on the ICD.

It should be noted that the structure of the ICD-PM is intended to facilitate the collection of standardized data on the causes of perinatal deaths and on the maternal conditions that affect the outcome. The WHO working group draws attention to three important functions of the ICD-PM:

- 1) records the time of onset of perinatal death and relates it to a certain period: antenatal, intranatal, and early neonatal;

- 2) offers a multi-level system for classification of the causes of death, taking into account the depth of available information and local norms. Based on the ICD-PM, mutually exclusive clinical conditions can be identified and properly coded, collectively indicating one cause of perinatal death;

- 3) links possible maternal diseases and perinatal mortality, taking into account the fact that the mother’s diseases are often identified in the context of perinatal death.

Mandatory recording of the mother’s condition for each case of perinatal death (even if the code is chosen of “no complications in the mother”) will enable the recording of the inextricable relationship between the health indicators in these two groups of patients.

Within the framework of the ICD-PM, the basic condition of the fetus or child is classified according to the causes of death, divided into three periods: A – antenatal death, I – intranatal, and N – neonatal death. The data of the condition are given in Table 2.

There are six categories of antenatal causes of death (A1–A6), seven categories of intranatal causes of death (I1–I7), and 11 categories of neonatal causes

Table 2 (Таблица 2)

ICD-PM: the causes of perinatal death and the corresponding ICD-10 codes broken down by periods of death, and the pathological conditions of the mother for cases of perinatal death*

МКБ-ПС: причины перинатальной смерти и соответствующие коды МКБ-10 с разбивкой по периодам наступления смерти и патологические состояния матери для случаев перинатальной смерти*

Headings of ICD-PM with the main causes of perinatal death / Рубрики МКБ-ПС с основными причинами перинатальной смерти	Antenatal death (A) / Антенатальная смерть (А)	ICD-10 codes / Коды МКБ-10
A1	Congenital malformations, deformations and chromosomal abnormalities / Врожденные аномалии (пороки развития), деформации и хромосомные нарушения	Q00-Q99
A2	Infectious Diseases / Инфекционные болезни	P35, P37, P39, A50
A3	Intrauterine hypoxia / Внутриутробная гипоксия	P20
A4	Other disorders that occur in the antenatal period (including codes for the antenatal period from the hemorrhagic and hematological disorders in the fetus and newborn, etc.) / Другие нарушения, возникающие в антенатальном периоде (включая коды для антенатального периода из рубрики «Геморрагические и гематологические нарушения у плода и новорожденного» и т. д.)	P50, P52, P55, P56, P60, P61, P70, P75, P77, P83, P96.4, Разл.
A5	Fetal growth disorders / Расстройства, связанные с ростом плода	P05, P08
A6	Fetal death for unspecified cause / Смерть плода по неуточненной причине	P95

Table 2 (continued) / Продолжение табл. 2

Headings of ICD-PM with the main causes of perinatal death / Рубрики МКБ-ПС с основными причинами перинатальной смерти	Antenatal death (A) / Антенатальная смерть (A)	ICD-10 codes / Коды МКБ-10
Intratal death (I) / Интранатальная смерть (I)		
I1	Congenital malformations, deformations and chromosomal abnormalities / Врожденные аномалии (пороки развития), деформации и хромосомные нарушения	Q00-Q99
I2	Birth injury / Родовая травма	P10-P15
I3	Acute intrapartum complication / Острое интранатальное осложнение	P20
I4	Infectious Diseases / Инфекционные болезни	P35, P37, P39, A50
I5	Other disorders that occur in the intrapartum period (including codes for the intrapartum period from the hemorrhagic and hematological disorders in the fetus and newborn) / Другие нарушения, возникающие в интранатальном периоде (включая коды для интранатального периода из рубрики «Геморрагические и гематологические нарушения у плода и новорожденного»)	P50, P52, P55, P56, P60, P61, P70, P96,
I6	Fetal growth disorders / Расстройства, связанные с ростом плода	P05, P07, P08
I7	Fetal death for unspecified cause / Смерть плода по неуточненной причине	P95
Neonatal death (N) / Неонатальная смерть (N)		
N1	Congenital malformations, deformations and chromosomal abnormalities / Врожденные аномалии (пороки развития), деформации и хромосомные нарушения	Q00-Q99
N2	Fetal growth disorders / Расстройства, связанные с ростом плода	P05, P08
N3	Birth injury / Родовая травма	P10-P15
N4	Neonatal complications / Неонатальные осложнения	P20, P21
N5	Cramps and disorders of cerebral status / Судороги и нарушения церебрального статуса	P90, P91
N6	Infectious Diseases / Инфекционные болезни	P23, P35-P39
N7	Respiratory and cardiovascular disorders / Дыхательные и сердечно-сосудистые нарушения	P22, P24-P29
N8	Other disorders that occur in the neonatal period (including codes for the neonatal period from the hemorrhagic and hematological disorders in the fetus and newborn, transient endocrine and metabolic disorders specific for the fetus and newborn, digestive system disorders in the fetus and newborn, conditions involving external integument and thermoregulation in the fetus and newborn, other conditions occurring in the perinatal period) / Другие нарушения, возникающие в неонатальном периоде (включая коды для неонатального периода из рубрик «Геморрагические и гематологические нарушения у плода и новорожденного», «Преходящие эндокринные нарушения и нарушения обмена веществ, специфичные для плода и новорожденного», «Расстройства системы пищеварения у плода и новорожденного», «Состояния, вовлекающие наружные покровы и терморегуляцию у плода и новорожденного», «Другие состояния, возникающие в перинатальном периоде»)	P50-P61, P70-P78, P80-P83, P92-P94

Table 2 (continued) / Окончание табл. 2

Headings of ICD-PM with the main causes of perinatal death / Рубрики МКБ-ПС с основными причинами перинатальной смерти	Antenatal death (A) / Антенатальная смерть (А)		ICD-10 codes / Коды МКБ-10
	N9	Disorders related to short gestation and low birth weigh / Малая масса тела и недоношенность	P07
	N10	Termination of pregnancy, affecting fetus and newborn / Различные	P96.4**
	N11	Other conditions originating in the perinatal period / Неонатальная смерть по неуточненной причине	P96
Pathological conditions of the mother / Патологические состояния матери	Pathological conditions of the mother (M) / Патологические состояния матери (М)		ICD-10 codes / Коды МКБ-10
	M1	Fetus and newborn affected by maternal infectious and parasitic diseases / Осложнения со стороны плаценты, пуповины и плодных оболочек	P02
	M2	Fetus and newborn affected by maternal complications of pregnancy / Осложнения беременности у матери	P01
	M3	Fetus and newborn affected by other complications of labour and delivery / Другие осложнения родов и родоразрешения	P03
	M4	Fetus and newborn affected by maternal conditions that may be unrelated to present pregnancy/ Медицинские и хирургические осложнения у матери	P00
	M5	Without complications from the mother / Без осложнений со стороны матери	
<p><i>Notes.</i> * Perinatal death is usually encoded by codes P05–P96 or Q-code, but there are cases when it is necessary to use the codes of other sections of ICD-10. For a complete list, see ICD-10 [4] and ICD-10, Volume II: a collection of instructions.</p> <p>** For information on perinatal deaths and their inclusion in summary tables, the user needs information on the time period of perinatal death (antenatal/intranatal/neonatal) and ICD-10 codes for causes of death. Information on the cause of death and mother conditions should be coded in accordance with the rules of ICD-10 code assignment before it can be tabulated. The table presented above contains indicative parameters necessary for obtaining summary statistics; ICD-10 [32] and ICD-10 Volume II should be used to encode the causes of death [42].</p> <p><i>Примечание.</i> * Перинатальная смерть обычно кодируется кодами P05–P96 или Q-кодом, однако бывают случаи, когда необходимо использовать коды других разделов МКБ-10. Полный список см. в МКБ-10 [4] и МКБ-10, том II: сборник инструкций. ** Для рубрикации случаев перинатальной смерти и их включения в сводные таблицы пользователю необходима информация о временном периоде перинатальной смерти (антенатальный/интранатальный/неонатальный) и коды МКБ-10 для причин смерти. Информация о причине смерти и состояниях матери должна быть закодирована в соответствии с правилами МКБ-10 по присваиванию кодов, прежде чем можно будет производить табулирование. Таблица, представленная выше, содержит индикативные параметры, необходимые для получения сводной статистики; для кодирования причин смерти следует использовать МКБ-10 [32] и МКБ-10, том II [42]</p>			

of death (N1–N11). These groups present all the ICD-10 codes that are indicated in the death certificate for cases of perinatal deaths. The order of the arrangement of the ICD-10 codes has been changed and clarified in order to indicate better pathological conditions in different periods of perinatal death. In our opinion, these nosologies and conditions cannot

limit the further expansion of the list of causes of perinatal death. Five categories of ICD-10, describing the pathological conditions of the mother in cases of perinatal death, were transformed into four sections of *ICD-PM* (M1–M4):

- M1 – complications associated with abnormalities of the placenta, umbilical cord, and fetal membranes;

- M2 – complications of pregnancy in the mother;
- M3 – complications of labor and delivery;
- M4 – medical and surgical complications that may be associated with or are associated with the current pregnancy²⁰.

There is a fifth category: in the event that at the moment of perinatal death there are no registered conditions or complications in the mother, which could lead to perinatal death, you should select the M5 category

“no complications in the mother.” The list of the primary diseases and conditions of the mother, according to the ICD-10 and the corresponding codes of maternal conditions included in the coding categories within the framework of the ICD-PM, are presented in Tables 2 and 3.

This manual, “WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM),” should only be used in conjunction with ICD-10 (volumes I–III) [13]. The proposed code should be checked. Additional information should be coded in accordance with ICD-10, volumes I and III. The requirements for the selection of coding for the initial cause of death and the cer-

²⁰ WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

Table 3 (Таблица 3)

The state of the mother according to the ICD-PM and the main condition of the mother (according to ICD-10) with the distribution according to the headings*

Состояния у матери по МКБ-ПС и основные состояния у матери (по МКБ-10) с распределением по рубрикам*

Maternal states by / Рубрики материнских состояний по МКБ-ПС ICD-PM	Main maternal conditions by topics / Основные материнские состояния по рубрикам	ICD-10 codes / Коды МКБ-10
M1: Complications from the placenta, umbilical cord and membranes / M1: Осложнения со стороны плаценты, пуповины и плодных оболочек	Fetus and newborn affected by placenta praevia / Предлежание плаценты	P02.0
	Fetus and newborn affected by other forms of placental separation and haemorrhage / Другие осложнения, связанные с отделением плаценты и кровотечением	P02.1
	Fetus and newborn affected by other and unspecified morphological and functional abnormalities of placenta / Дисфункция, инфаркт, недостаточность плаценты	P02.2
	Fetus and newborn affected by placental transfusion syndromes / Синдромы плацентарной трансфузии	P02.3
	Umbilical cord prolapse, other types of umbilical cord compression / Выпадение пуповины, другие виды сдавления пуповины	P02.4, P02.5
	Fetus and newborn affected by chorioamnionitis / Хориоамнионит	P02.7
	Fetus and newborn affected by other abnormalities of membranes / Другие осложнения со стороны плодных оболочек	P02.8
M2: Complications of pregnancy in mothers / M2: Осложнения беременности у матери	Fetus and newborn affected by incompetent cervix / Цервикальная недостаточность	P01.0
	Fetus and newborn affected by premature rupture of membranes / Преждевременный разрыв плодных оболочек	P01.1
	Oligohydramnios/polyhydramnios / Олигогидрамнион/полигидрамнион	P01.2, P01.3
	Fetus and newborn affected by ectopic pregnancy / Внематочная беременность	P01.4
	Fetus and newborn affected by multiple pregnancy / Многплодная беременность	P01.5
	Fetus and newborn affected by maternal death / Смерть матери	P01.6
	Fetus and newborn affected by malpresentation before labour / Неправильное предлежание плода перед родами	P01.7
	Fetus and newborn affected by other maternal complications of pregnancy / Другие осложнения беременности	P01.8

Table 3 (continued) / Продолжение табл. 3

Maternal states by / Рубрики материнских состояний по МКБ-ПС ICD-PM	Main maternal conditions by topics / Основные материнские состояния по рубрикам	ICD-10 codes / Коды МКБ-10
M3: Other complications of childbirth and delivery / M3: Другие осложнения родов и родоразрешения	Fetus and newborn affected by breech delivery and extraction / Родоразрешение в тазовом предлежании и с экстракцией плода	P03.0
	Fetus and newborn affected by other malpresentation, malposition and disproportion during labour and delivery / Другой вид неправильного предлежания, положения и диспропорции во время родов и родоразрешения	P03.1
	Fetus and newborn affected by forceps delivery/vacuum extractor / Родоразрешение с наложением щипцов/применением вакуум-экстрактора	P03.2, P03.3
	Fetus and newborn affected by caesarean delivery / Родоразрешение с помощью кесарева сечения	P03.4
	Fetus and newborn affected by precipitate delivery / Стремительные роды	P03.5
	Preterm labour and delivery / Преждевременные роды и родоразрешение	O60
	Fetus and newborn affected by other specified complications of labour and delivery / Другие осложнения родов и родоразрешения, включая аборт	P03.8
M4: Medical and surgical complications / M4: Медицинские и хирургические осложнения	Gestational, eclampsia / Преэклампсия, эклампсия	O14, O15
	Fetus and newborn affected by maternal hypertensive disorders / Вызванная беременностью гипертензия	P00.0
	Unspecified maternal hypertension / Другие гипертензивные нарушения	O16
	Fetus and newborn affected by maternal renal and urinary tract diseases / Болезни почек и мочеполовой системы	P00.1
	Fetus and newborn affected by maternal infectious and parasitic diseases / Инфекционные и паразитарные болезни	P00.2
	Fetus and newborn affected by other maternal circulatory and respiratory diseases / Болезни системы кровообращения и органов дыхания	P00.3
	Fetus and newborn affected by maternal nutritional disorders / Расстройства питания	P00.4
	Fetus and newborn affected by maternal injury / Травма	P00.5
	Fetus and newborn affected by surgical procedure on mother / Хирургическая процедура	P00.6
	Fetus and newborn affected by other medical procedures on mother, not elsewhere classified / Другие медицинские процедуры	P00.7
	Diabetes mellitus arising in pregnancy / Сахарный диабет у матери, включая гестационный сахарный диабет	O24.4
	Fetus and newborn affected by maternal anaesthesia and analgesia in pregnancy, labour and delivery / Применение анестезии и анальгезирующих средств у матери	P04.0
	Fetus and newborn affected by other maternal medication / Терапевтические воздействия на мать	P04.1
	Consumption of tobacco, alcohol, drugs / Потребление табака, алкоголя, наркотических средств	P04.2, P04.3, P04.4
	Fetus and newborn affected by maternal use of nutritional chemical substances / Использование пищевых химических веществ	P04.5
Fetus and newborn affected by maternal exposure to environmental chemical substances / Воздействие химических веществ, содержащихся в окружающей среде	P04.6	
Fetus and newborn affected by maternal noxious influence, unspecified / Неуточненное вредное воздействие на мать	P04.9	

Table 3 (continued) / Окончание табл. 3

Maternal states by / Рубрики материнских состояний по МКБ-ПС ICD-PM	Main maternal conditions by topics / Основные материнские состояния по рубрикам	ICD-10 codes / Коды МКБ-10
M5: No complications from the mother M5: / Без осложнений со стороны матери	There were no complications (the mother is healthy) / Не выявлено осложнений (мать здорова)	
<p><i>Note.</i> * A complete list of states and their definitions, incl. other and unspecified states included in each heading, see the current version of ICD-10 [42] and ICD-10 Volume II: a collection of instructions [31]</p> <p><i>Примечание.</i> * Полный список состояний и их определений, в том числе других и неуточненных состояний, включенных в каждую рубрику, см. в текущей версии МКБ-10 [42] и МКБ-10, том II: сборник инструкций [31].</p>		

tification of the fact of death are set out in ICD-10, Volume II.1²¹.

5. PATHOANATOMICAL DIAGNOSIS IN THE CASES OF DEATH IN THE PERINATAL PERIOD

One of the most succinct and up-to-date definitions is “Diagnosis is one of the most important objects of standardization in healthcare, the basis of clinical expert work and quality management of medical services, documentary evidence of the professional qualification of a doctor” [23]. In this regard, the responsibility placed on forensic surgeons and forensic investigators is particularly high.

Diagnosis is a medical conclusion about the health condition of the existing disease. It is expressed in terms of the diseases envisaged by accepted classifications and nomenclature, denoting the names of diseases, their forms, and variants of the course. It is based on a comprehensive systematic examination of the patient [16, 17, 23]. It includes information about the primary disease or condition, complications of the primary disease, and concomitant diseases or conditions²².

The diagnosis should meet the following requirements:

- nosological (each category should start with a nosological form (nosological unit), or a syndrome if this is not possible);

²¹ WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

²² Federal Law No. 323-FZ of 21.11.2011 (as amended on 03.07.2016) “On fundamental healthcare principles in the Russian Federation” (with amendments and additions, in effect since 01.01.2017).

- comprehensive, containing additional (intranosological) characteristics of pathological processes (clinical and anatomical form of suffering, type of course, degree of severity, stage, functional disorders), including all known morphological, clinical, laboratory, and other data in this particular case;
- etiological and pathogenetic (if this does not contradict the medical and social requirements that have priority);
- structured and classified (divided into standardized categories);
- actually and logically justified (reliable) [10, 15, 23, 24];
- corresponding to international nomenclature and classifications of diseases²³ [31, 32].

In the Russian public health care system, the general structure of the diagnosis is traditionally accepted. This includes the following categories:

- 1) the primary disease is a disease that, in itself or in connection with complications, causes the primary need for medical care in connection with the greatest threat to working capacity, life and health, or leads to disability, or causes death;
- 2) complications of the primary disease are nosological units, traumas, syndromes and symptoms, and pathological processes that are pathogenetically (directly or indirectly) associated with the primary disease, but at the same time they are not its manifestations. Complication of the primary disease is also defined as a pathological process, pathogenetically and/or

²³ Letter of the Ministry of Health of Russia of 05.12.2014 No. 13-2/1664 (on the direction of the list of added and deleted sections of ICD-10).

etiologically associated with the primary disease, aggravating its course, and often being the immediate cause of death. The complications are expedient to list in pathogenetic or time sequence;

- 3) comorbidity is a disease that does not have a causal relationship with the primary disease, is inferior to it in the degree of need for medical care, influence on working capacity, hazard to life and health, and is not the cause of death. Comorbidity can be represented by one or several nosological units (less often by syndromes). Concerning these diseases, certain therapeutic and diagnostic measures may be performed. Comorbidity cannot have fatal complications [10, 15, 23, 24].

In 1971 G.G. Avtandilov, with the purpose of the account and the analysis of mortality for multiple reasons, proposed the notion of the combined primary disease on the basis of emphasizing the mono-, bi-, and multi-causal types of diagnoses [1, 2, 9].

The structure of the combined primary disease, represented by concurrent diseases or polypathia or primary and underlying medical condition, became widely used in pathoanatomical practice. Rules were developed for the isolation of a nosological unit taken to the fore in a combined primary disease as the main unit of account in a statistical analysis of morbidity and the initial cause of death in a lethal outcome. The concurrent disease is defined as the nosological unit of the disease (disease or trauma), from which the deceased suffered simultaneously with the primary disease. Each disease, individually, could definitely lead to death. A polypathia is defined as a nosological unit of the disease (disease or trauma), from which the deceased suffered simultaneously with the primary disease, and all these diseases, being in various pathogenetic relationships and aggravating each other, led to death. Each disease, separately, would not cause a lethal outcome. An underlying medical condition is defined as a nosological unit of the disease (disease or trauma), which was one of the causes of the development of another independent disease (condition), aggravating its course and contributing to the occurrence of common fatal complications that led to death. In the case of iatrogenic primary disease, the underlying medical condition is that for which medical intervention was performed [1, 2, 10, 15, 24].

The WHO rules specify that limiting the analysis to a single condition for each episode entails

the loss of some of the information available [42]. Therefore, it is recommended, if possible, to perform coding and analysis of morbidity and mortality by multiple reasons. The plurality of causes of death is defined as comorbidity [42]. In the ICD-10, comorbid diseases (conditions) are defined as other important diseases (conditions) that contributed to death [18, 32]. In the structure of the diagnosis, it is advisable to specify such comorbid diseases (conditions) as concurrent diseases, polypathia, and/or underlying medical conditions in an additional category after the category of "Primary disease." They should have common complications with the primary disease, since they jointly cause a chain of disease processes that directly led to death [8].

The basic principles of diagnosis in adults and children older than 7 days are the same. The exception is "Separate conditions arising in the perinatal period" – ICD-10, class XVI, categories P00–P96. The issue of interpretation of morphological changes and the establishment of a pathoanatomical diagnosis in the perinatal period remains complicated. In this period, the pathology and cause of death of a child are largely due to a complex of factors related to the "mother – placenta–fetus" interaction. Pathoanatomical diagnosis in cases of death in the perinatal period should include information about the diseases and conditions in all components of the mother-placenta-fetus system and contain several parts. The first part is the pathology of the child, such as the initial and immediate cause of death, underlying medical condition, concurrent diseases, polypathia, and concomitant nosological units. The second part of the information in the perinatal pathoanatomical diagnosis is associated with clinical data on the diseases of the mother, including pathology of the secundines, which had an adverse effect on the fetus. It is important to draw a parallel between the mother's condition and the death of the child. The third part in the structure of the perinatal pathoanatomical diagnosis concerns conditions that adversely affected the fetus or the newborn (medical and criminal causes). All these data should be recorded in the pathoanatomical diagnosis, clinical and pathoanatomical epicrisis, and in the certificate of perinatal death (strictly in unified terminology) [3]. Diseases of the mother, the pathology of the secundines, as well as all information about external causes are included in the diagnosis in order of their importance in the initial cause of death of the child. According to modern requirements, this diagnosis must comprise the moment of death of the child and refer it to

a certain period: antenatal (before the onset of labor), intranatal (during labor), and early neonatal (168 h of life of the newborn).

Expressing the pathological sequence of the child and the mother, which led to perinatal death, provides valuable information for the subsequent development of therapeutic and preventive measures aimed at reducing perinatal mortality [41].

Based on the above provisions, we render the structure of the pathoanatomical diagnosis for cases of perinatal death.

I. Pathology of the child (fetus).

1. Primary disease.
2. Concurrent diseases, polypathia, underlying medical conditions (comorbid diseases, if available).
3. Complications of the primary disease (and those of comorbid disease, if available).
4. Comorbidity.

II. Pathology of secundines.

III. Pathology of the mother, pregnancy, and childbirth.

An example of a pathoanatomical diagnosis.

Primary disease. Intraventricular nontraumatic hemorrhage with damage to brain tissue of the 3rd degree; hemorrhagic tamponade of the lateral ventricles III and IV (blood volume 10 ml) (P52.2).

Polypathia. Syndrome of respiratory distress in a newborn: hyaline membranes of the lungs (P22.0).

Complications. Aspiration of amniotic fluid. Disseminated intravascular blood coagulation syndrome: uneven plethora of internal organs, multiple hemorrhages, fibrinous thrombi, erythrocytosis. Cerebral edema.

Comorbidities. Extremely low birth weight (550 g, body length of 31 cm), gestational age of 23–24 weeks.

Pathology of secundines. Ascending amniotic infection: purulent membranite, subchorial intervillitis, umbilical phlebitis.

Pathology of the mother, pregnancy, and childbirth. Chronic pyelonephritis. Myopia of the 3rd degree, primary chorioretinal degeneration of the retina. Primary sterility for 10 years. Abnormal development of the reproductive system, namely the rudimentary right uterine horn (removal of the rudimentary horn and the fallopian tube on 07.2016). The present pregnancy II IVF (I - medical abortion). First labor, emergency cesarean section at the term of week 23/24. Extraction of infant from uterus at the pelvic end.

6. APPROACHES TO INTERPRETATION OF CERTAIN CONDITIONS REPRESENTING THE INITIAL CAUSE OF DEATH IN THE PERINATAL PERIOD

The manual “WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period: ICD-Perinatal Mortality (ICD-PM)” identifies the main groups of causes of perinatal death that should be attributed to a specific period: antenatal (before labor), intranatal (during labor), and early neonatal period (168 hours of life of the newborn)²⁴.

There are certain difficulties in the choice of the initial cause of death and the interpretation of individual conditions that arise in the perinatal period.

Congenital abnormalities (malformations), deformities, and chromosomal abnormalities (Q00–Q99).

Congenital malformations hold a specific place in perinatal pathology in the frequency and severity of the lesion.

When establishing a diagnosis in cases of congenital malformations, the following points should be considered:

- 1) The diagnosis must not be limited to “congenital malformation” or “multiple malformations.” This generic term should be followed by a detailed description of the forms.
- 2) In cases of multiple malformations, it is necessary to establish whether the set of detected defects corresponds to a specific syndrome (genetic, chromosomal, or environmental), which is of great importance in the prevention of congenital malformations.

Congenital malformations with complications that are incompatible with life or that lead to fatal complications, remain the primary pathology and are established as a major disease in the pathoanatomical diagnosing.

In cases where congenital malformations are combined with infectious diseases, these two nosological forms, depending on the severity and nature of the lesion, may appear in the diagnosis as concurrent diseases or polypathia. Also, congenital malformations can be classified as underlying medical conditions or comorbidities, depending on their role in thanatogenesis [3].

Prematurity (P05). In accordance with the instructions of Volume II of the ICD-10, prematurity should not be indicated as a primary disease or condition

²⁴ WHO’s application of the International Classification of Diseases (ICD-10) to deaths in the perinatal period (ICD-PM). Geneva: World Health Organization, 2016. License CC BY-NC-SA 3.0 IGO.

of the fetus or a newborn, unless this was the only known condition of the fetus or newborn.

According to the current rules of the ICD-10, low body weight and prematurity are recorded within a single code (in the presence of data on body weight and gestational age, the priority in coding is the body weight), but if prematurity is the cause of low body weight, then the inverse proposition is not necessarily correct. Prognosis for premature children with low weight, corresponding to gestation, differs from the prognosis for children with the same weight, which is considered small for this gestation period [39].

It is recommended that prematurity be indicated as a primary disease or a pathological condition of the newborn only if there is other evidence of this assumption – for example, if the gestational age is less than 28 weeks.

In addition, according to the instructions of Volume II of the ICD-10, the diagnosis of prematurity can be indicated as the main cause of the disease or pathological condition of the newborn only if respiratory failure is indicated as the only other cause of perinatal death [39].

Birth trauma (P10–P15). Birth trauma can be regarded as the primary disease only in the case of detection of the morphological substrate of mechanical damage to the tissues of the child or fetus. This includes sprain, breakage, bursting, fractures, and dislocations. In this case, the diagnosis should begin with indications of localization and the nature of mechanical damage to the tissues of the child (fetus) obtained in the process of delivery²⁵ [20]. A variety of hemorrhages, including intracranial ones (subdural, intraventricular), as well as cerebral leukomalacia (P91.2), without indicating mechanical injuries cannot be considered as birth trauma and should be treated as complications. These pathological conditions are not only detected with birth trauma, but also with asphyxia, congenital infections, pneumopathy, hereditary and acquired hemorrhagic diathesis, and infusion hyperosmolar therapy [20].

Asphyxia of the fetus and the newborn (P20, P21). In most cases, asphyxia of the fetus (intrauterine asphyxia) is the result of the following: 1) acute termination of uteroplacental or placental-fetal circulation or 2) manifestations of various fetopathies of infectious and noninfectious genesis [7]. Asphyxia of the fetus can only be considered as a major dis-

ease in cases of stillbirth. It is necessary to indicate the period of its onset: antenatal (P20.0) or intranatal (P20.1).

Asphyxia of a newborn is a pathological condition caused by the failure of the child's independent breathing. A disorder of the act of independent breathing can be observed at the birth of a child in a state of hypoxia or who otherwise become increasingly hypoxic in the first hours and days of extrauterine life [7]. In newborns, regardless of body weight and gestational age, it is necessary to avoid assessing the detected asphyxia as a primary disease and to continue searching for its substrate, which is most often represented by pneumopathies, residual intrauterine asphyxia, congenital abnormalities of the lungs or heart, and infections. These types of pathologies should be regarded as primary diseases of a newborn. Asphyxia should be registered as a fatal complication and coded with P21 [2, 3].

In cases of fetal asphyxia with an artificial termination of pregnancy for medical reasons, the mother's primary disease is indicated as antenatal asphyxia (P20.0), and the mother's pathology is coded in accordance with her existing disease, which caused the pregnancy termination.

In the case of artificial termination of pregnancy, as indicated in the fetus, the fetal disease as the cause for termination of pregnancy should be indicated as the primary disease, and the provoked asphyxia considered a complication and an immediate cause of death [20].

Respiratory disorders characteristic of the perinatal period (pneumopathy). Respiratory distress syndrome (RDS) of a newborn is a respiratory disorder in children in the first days of life due to the immaturity of the lungs and the primary deficit of surfactant. The occurrence of RDS is higher in children born at lower gestational ages and with low birth weights. Pathoanatomically, pneumopathies are defined, which are included in the categories of "Hyaline membrane disease" (P22.0), "Primary atelectasis of a newborn" (P28.0), and "Pulmonary hemorrhage" (P26). These conditions are more common in premature infants with congenital infections. In these cases, the infection should be considered as the primary disease, and pneumopathy should be considered as a complication. According to P.A. Samokhin, T.A. Del [20], only "noninfectious" or unspecified pneumopathy can claim the role of the equivalent of a nosological unit and be the initial cause of death (the primary disease). All forms of pneumopathy are usually complicat-

²⁵ Information-methodical letter "Proposals for the pathoanatomical interpretation and coding of the ICD-10 of some forms of perinatal pathology", approved by the Directorate General of Health Services of the Administration office of the Chelyabinsk region, 1999.

ed by asphyxia of the newborn, which should already be considered as the cause of immediate death [2, 3].

Infectious diseases specific for the perinatal period (P35–P39). This block of three-digit categories includes infections acquired in utero or during labor.

Intrauterine infectious diseases in the perinatal period should be considered as the primary diseases in cases when the fetus (newborn) has a generalized nature of alterative changes, exudative or proliferative inflammation in the lungs, brain, liver, and other organs.

The final pathoanatomical diagnosis of intrauterine infection in the fetus (newborn) should be based on the data of the morphological study when comparing them with the results of laboratory studies. For verification, it is necessary to perform virological, bacteriological, and immunohistochemical studies. In children with congenital infections, low body weight, icterus of the skin, and hyperplasia of the liver and spleen are noted. As a rule, there is an accidental transformation of the thymus. The inflammatory changes in the secundines (in the membranes and chorion frondosum) must be revealed.

In cases of detection of the infectious process in the perinatal period, we recommend using blocks of categories “Congenital viral infections” (P35), “Other infectious diseases specific for the perinatal period” (P39), more precisely, the codes of four-digit sub-categories “Intra-amniotic fetal infection, not classified in other categories” (P39.2), “Other specified infection specific for the perinatal period” (P39.8), “Congenital syphilis” (A50), “Bacterial sepsis of a newborn” (P36), “Other congenital infectious and parasitic diseases” (P37), and “Omphalitis of a newborn with minor or no bleeding” (P38).

Neonatal aspiration of meconium (P24.0), amniotic fluid and mucus (P24.1). The different degrees of aspiration of meconium and/or amniotic fluid is a consequence of intrauterine hypoxia and is almost always observed with antenatal or intranatal asphyxia; therefore, aspiration syndrome can be included in the intranatomical characteristics of asphyxia [7, 20].

In the event that aspiration syndrome is revealed in the study of the deceased newborn child, in the absence of other causes of death, it should be considered as the initial cause of death (the primary disease), and the wording of the diagnosis should start with it.

Intracranial nontraumatic hemorrhage in fetus and newborn (P52). Intraventricular hemor-

rhage (IVH) (P52.0–P52.2) is the most severe and the most frequent (60%–90% of cases) brain damage in premature newborns. It is noted that lower the gestational age and body weight is at birth, more often and severe is the IVH. Among antenatal factors, intrauterine viral infection plays a major role [6]. IVH, as a rule, is combined with fetal and newborn asphyxia, pneumopathy, infections, and other conditions accompanied by circulatory disorders in the central nervous system. Therefore, in each case, one should approach the problem of the primary disease individually i. e., it is necessary to decide which process predominates in severity (hemorrhage or, for example, pneumopathy) and serves as the initial cause of death [2, 3, 7]. It is recommended that IVH be considered as a primary disease in cases of perinatal death when a number of signs are established. These include if the mass of clots and liquid blood takes up more than 50% of the lumen of the ventricle and if there is IVH in combination with parenchymal hemorrhage (periventricular hemorrhage). These changes correspond to the 3rd degree of IVH in the ICD-10. A more severe lesion is hemorrhagic periventricular infarction, which is conditionally designated as IVH-4 [6].

HIV infection. HIV infection in the mother may increase the risk of perinatal death [32], the cause-effect relationship is usually difficult to establish, so it is necessary to distinguish cases of perinatal death that occur due to other maternal conditions in the context of which HIV infection in the mother was a minor problem.

It is recommended to classify the death cases of children in the context of the mother's HIV status. This will enable a clarification of the role of HIV in the mother in the structure of perinatal mortality [32].

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