ANATOMY OF THE THORAX SKELETON OF THE PERSON IN THE INTERMEDIATE FETAL PERIOD OF ONTOGENESIS

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Abstract

Background: Modern methods of visualization allow to study anatomy of the developing child. Besides prenatal interventions demand new data on anatomy of internal organs of the fetus.

Material and methods: The torsos of 20 fetus 16-22 week gestation of both sexes became material of reseach. This material was divided into two aged groups: 16-17 and 22 week of development (on 10 fetuses in each group). The main method of research was the macromicroscopic preparation, a number of additional data was received by using of the gistotopographical method and the modifying method of cuts according to N. I. Pirogov.

Results: In 90% of cases the pyramidal shape and in 10% cone-shaped of the thorax was observe. The size of the infrasternal angle in group of 16-17 week fetuses changed ranging from 89º to 130º. This parameter for group of 22 week of development was within the limits of 75º-125º. The sternum in cause of 16-22 weeks fetuses consists of three parts: manubrium, body and xiphoid process. Comparing data of width of intercostal spaces and height of ribes, it is possible to note that intercostal spaces are more than ribs height to all projective lines in both age groups. The intercostal spases are 1,5-2 times more than rib height in some places of a thorax.

Conclusions: The thorax skeleton has the following features in the intermeddiate fetal period of person ontogenesis: 1. Wide intercostal spaces; 2. Discrepancy of serial number of the rib with number of a vertebra of this level (to parasternal, midclavicular and midaxillary lines); 3. The obtuse infrasternal angle and costal arches extending in the parties; 4. Asymmetry of a thorax.

Key words: anatomy, thorax skeleton, fetus

Background

Modern methods of visualization such as the three-dimensional (3D), four-dimensional (4D) ultrasonography and MRT of a fetus, allow to study anatomy and topography of internal organs and also to diagnose some anomalies of development [4, 7, 11, 12].

In recent years the new scientific direction such as the fetal anatomy is actively developed. The fetal anatomy studies anatomy and topography of internal organs and structures of the person in the fetal period of ontogenesis.

Besides, there are publications about prenatal correction of congenital defects of the internal organs. The fetal surgery is developed mainly abroad, however there are data on the single operations performed in Russia [1, 8, 9, 10]. These interventions are carried out antenatal when correction of malformations can improve an outcome for health and life of newborns.

According Russian lows newborns since 22 week of a gestation and weight at the birth of 500 grams and more are admitted as viable. There are publications in literature which consecrating questions of modern technologies on nursing of newborn children with extremely low and very low body weight [2, 5]. However, various medical and diagnostic manipulations at deeply prematurely born newborns require the knowledge and understanding of topografoanatomical relationship of the internal organs, including a chest cavity.

We were interested by a question of the person chest skeleton anatomy at the intermediate stage of the development. In the neonatal period and maturity the matter is studied rather in detail whereas these data about the fetal period are practically absent [3, 6]. In this regard the studying of the chest skeleton anatomy of the person in the intermediate fetal period of ontogenesis for more detailed information became a research objective.

Material and methods

This research is based on studying and analysis of the section material of 20 both sexes human fetuses of the 16-22 week of development received as a result of interruption of pregnancy according to

social indications at healthy women served. All material was gathered with observance of all necessary legal norms accepted in the Russian Federation. This material was divided into two aged groups: 16-17 and 22 week of development (10 fetuses in each group).

The main method of research was the macromicroscopic preparation, a number of additional data was received by using of the gistotopographical method and the modifing method of cuts according to N. I. Pirogov. The initial stage of the macropreparations was the preparation a chest with the subsequent careful marking of vertebrae. On the made preparations the measurement of a sternum, ribs, chest vertebrae, intercostal spaces, infrasternal angle and other parameters were studied. All obtained morphometrical data were subjected to variation and statistical processing.

Work is performed within the scientific direction of the Human Anatomy Department (the Orenburg State Medical University) which is devoted to study the fetal anatomy and topography of human internal organs.

Results and discussion

During research it was revealed that all parts of the thorax skeleton are created: sternum, ribs, thoracic department of a vertebral column. In 90% of cases the pyramidal shape (fig. 1) and in 10% cone-shaped of the thorax was observed (fig. 2).

On this term fetus have three free ribs: the XI rib, the XII rib and also the X rib which isn't connected to a costal arch yet.

The size of the infrasternal angle in group of 16-17 week fetuses changed ranging from 89° to 130°. This parameter for group of 22 week of development was within the limits of 75°-125°. Thus, on this term of development the obtuse angle meets more often.

The sternum in cause of 16-22 weeks fetuses consists of three parts: manubrium, body and xiphoid process. Height and the cross sizes of a body and the handle of the sternum were studied in this research. In group of 16-17 week height of a sternum is equal 21,06 mm (average value), the cross size of the manubrium makes 2,85 mm and sternum body 3,33 mm. In the 22nd week of the development these parameters were made by 33,89 mm (height), 6,35 mm (the cross size of a body) and 7,31 mm (the cross size of the manubrium).

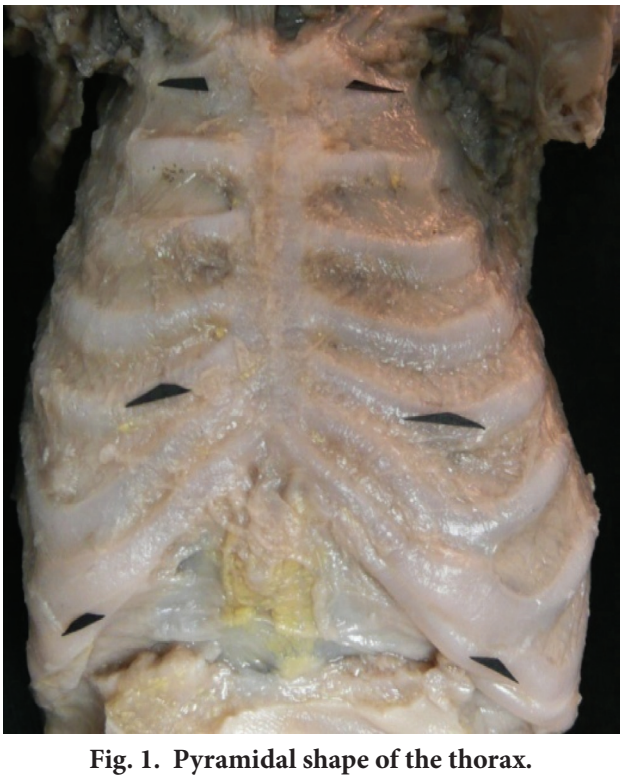

Fig. 1. Pyramidal shape of the thorax. Photo of the fetus torsos preparation, age - 22 weeks of gestation.

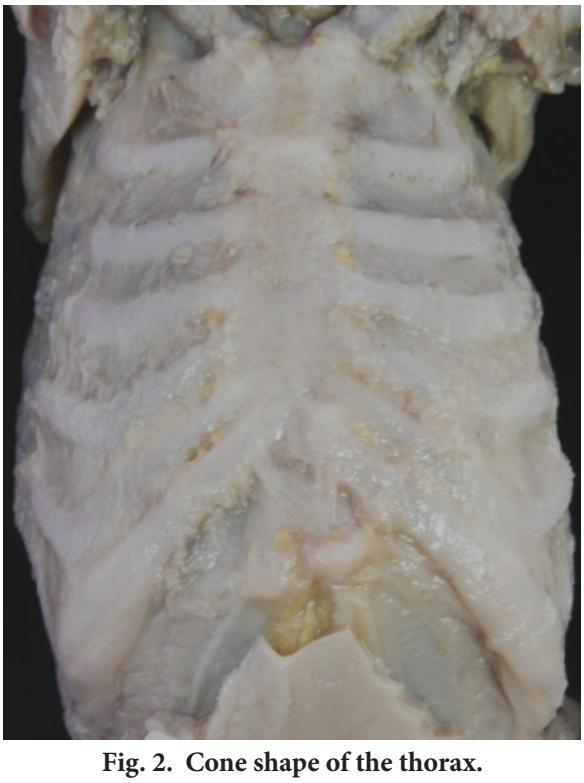

Fig. 2. Cone shape of the thorax. Photo of the fetus torsos preparation, age - 22 weeks of gestation.

Besides, thorax height in four standard projective lines was studied. It was measured from the superior edge of the first rib to inferior edge of the last. Results are presented in the table 1.

Table 1

Thorax skeleton height in standard projective lines (to X±Sx, mm)

Lines / Gestational age	16-17 week		22 week	
	Right side	Left side	Right side	Left side
Parasternal	24,59±1,88	25,13±2,19	37,28±1,29	40,93±1,79
Midclavicular	32,78±1,52	33,32±2,27	45,58±2,32	49,17±2,18
Midaxillary	40,22±1,47	40,75±1,75	58,00±0,92	57,61±1,74
Paravertebral	39,38±2,51	38,91±2,87	65,67±2,11	62,61±3,75

It is visible from the table 1 that the thorax of fetus is asymmetric. It was revealed for both studied groups of fetus.

The anteroposterior and transverse sizes of a thorax were studied in the horizontal cuts. Measurements were taken at the following levels: ThIII, ThV-VI, ThVII-VIII, ThIX-X.

The above levels were chosen according to distinctions of the topography of the chest internal organs. Results of the morphometry these parameters are presented in the table 2.

Table 2

Quantitative characteristics of the anteroposterior and transverse sizes of the thorax of fetus of the 16-17 week and 22 week of development (X±Sx, mm)

Level of vertebra/ Gestational age	Th_{III}	Th_{V-VI}	$Th_{VII-VIII}$	Th_{IX-X}
	Anteroposterior size			
16-17 week	24,67±3,5	28,25±1,95	34,22±2,52	39,75±2,13
22 week	35,1±4,18	41,42±3,84	44,62±1,31	46,58±3,14
Rate of increase(%)	42	47	31	18
	Transverse size			
16-17 week	29,5±3,44	33,07±1,8	35,46±3,2	41,39±2,76
22 week	39,77±3,97	46,58±5,15	47,45±4,29	47,27±3,04
Rate of increase (%)	35	41	34	14

The table 2 shows the gradually increasing of values of the anteroposterior and transverse sizes of a thorax in the distal direction to the vertebral column.

Thus this tendency is traced in both age groups. Besides, both at the beginning and at the end of the studied age periods the transverse size of a thorax was more than anteroposterior size.

It was revealed that with increasing of fetus age there is an increase of values of both parameters.

Thus most intensively they increase within ThIII-ThVI: rates of a gain of the anteroposterior size made 42% and 47%, and transverse side made 35% and 41% respectively. The smallest increase in the considered indicators was noted at the level of ThIX-ThX: 18% and 14% respectively.

Besides, ribs and intercostal spases were studied in macropreparations. It is possible to allocate two parts of the rib in developed period of the ontogenesis: cartilaginous and bone.

It was revealed that length of bone part gradually increases both on the right and at the left from the second rib with the greatest value reaches at the seventh rib in the first group of fetus.

Then this parameter decreases in distal direction. The similar tendency is observed regards cartilaginous part of the ribs. It is characteristic for both studied groups.

We studied heights of the ribs at three standard projective lines in details: the parasternal, midclavicular and midaxillary lines were investigated on both sides. Results are presented in the table 3 and 4.

Table 3

Height of ribs of the 16-17 week development fetus measured in a projection of the parasternal, midclavicular and midaxillary lines (X±Sx, mm)

Lines	Parasternal		Midclavicular		Midaxillary	
Number of rib	Right side*	Left side**	Right side*	Left side**	Right side*	Left side**
I	1,77±0,01	2,12±0,09	3,32±0,01	3,35±0,01	1,19±0,12	1,17±0,23
II	2,06±0,12	2,11±0,07	1,74±0,12	2,03±0,06	1,37±0,17	1,40±0,16
III	2,20±004	2,16±0,10	2,25±0,06	2,10±0,15	1,68±0,17	1,77±0,17
IV	2,15±0,08	2,31±0,09	2,27±009	2,29±0,07	1,81±0,09	1,86±0,15
V	1,79±0,07	1,82±0,11	2,07±0,18	1,80±0,13	1,76±0,15	1,96±0,16
VI	1,70±0,06	1,64±0,14	2,05±0,08	2,34±0,08	1,76±0,11	1,99±0,24
VII	2,03±0,25	1,96±0,23	2,24±0,04	2,02±0,21	1,67±0,13	1,83±0,29
VIII	1,59±0,01	1,70±0,01	0,94±0,25	1,33±0,01	1,84±0,17	2,06±0,11

Note: in the groups marked * and ** reliable distinctions aren't revealed (p>0,05).

Table 4

Height of ribs of the 22 week development fetus measured in a projection of the parasternal, midclavicular and midaxillary lines (X±Sx, mm)

Lines	Parasternal		Midclavicular		Midaxillary	
Number of rib	Right side*	Left side**	Right side*	Left side**	Right side*	Left side**
I	2,97±0,08	3,18±0,16	2,20±0,11	2,90±0,13	1,96±0,14	2,19±0,28
II	2,64±0,15	2,76±0,18	2,62±0,12	3,26±0,17	2,16±0,27	2,45±0,19
III	3,24±0,18	3,01±0,12	3,45±0,10	3,59±0,09	2,43±0,13	2,67±0,25
IV	2,80±0,11	3,03±0,10	3,06±0,11	3,36±0,06	2,61±0,07	2,89±0,13
V	2,71±0,09	2,50±0,20	2,91±0,15	3,48±0,22	2,52±0,15	2,58±0,18
VI	2,92±0,12	2,22±0,16	3,30±0,17	3,15±0,22	2,78±0,15	2,75±0,34
VII	3,26±0,25	3,41±0,19	3,00±0,21	3,27±0,21	2,93±0,18	3,38±0,55
VIII			1,70±0,21	1,81±0,01	3,55±0,39	3,40±0,49

Note: in the groups marked * and ** reliable distinctions aren't revealed (p>0,05).

Data of tables show the increasing of value of the ribs height at all lines with increase of the fetus age.

Thus height of forward parts (cartilaginous) ribs increases more intensively.

However, the great values of this parameter received to parasternal and midclavicular lines in comparison with the midaxillary attract attention.

This tendency is noted as at the beginning, so and at the end of the studied age period.

In the same way we studied heights of intercostal spases. Results of measurements are presented in tables 5 and 6.

Results of these tables show that the widest intercostal spaces are noted in a projection of the parasternal and midclavicular lines, the smallest indicators are noted on the midaxillary line.

With increase of fetus age this indicator also increases, thus most intensively at the level of the superior three ribs to parasternal, midclavicular and midaxillary lines.

Table 5

Heights of fetus intercostal spase, measured in a projection of the parasternal, midclavicular and midaxillary lines in group of 16-17 week of development (X±Sx, mm)

Lines	Parasternal		Midclavicular		Midaxillary	
Number of rib	Right side*	Left side**	Right side*	Left side**	Right side*	Left side**
I	2,28±0,31	2,34±0,39	2,70±0,20	2,71±0,33	1,99±0,16	2,10±0,17
II	2,41±0,29	2,61±0,36	2,89±0,29	2,60±0,47	2,28±0,34	2,53±0,24
III	2,40±0,21	2,12±0,16	2,57±0,21	2,67±0,24	1,75±0,07	2,20±0,16
IV	1,97±0,23	2,04±0,19	2,48±0,10	2,37±0,21	1,78±0,12	2,42±0,33
V	1,62±0,33	1,68±0,26	1,86±0,21	2,19±0,23	1,84±0,04	2,13±0,32
VI	0,82±0,14	1,07±0,20	1,38±0,27	1,46±0,45	1,70±0,10	2,71±0,39
VII	0,83±0,10	0,88±0,10	1,06±0,27	0,96±0,20	1,90±0,15	2,76±0,58
VIII					2,27±0,31	2,41±0,20

Note: in the groups marked * and ** reliable distinctions aren't revealed (p>0,05).

Table 6

Heights of fetus intercostal spase, measured in a projection of the parasternal, midclavicular and midaxillary lines in group of 22 week of development (X±Sx, mm)

Lines	Parasternal		Midclavicular		Midaxillary	
Number of rib	Right side*	Left side**	Right side*	Left side**	Right side*	Left side**
I	3,53±0,82	2,34±0,39	4,12±0,47	4,45±0,26	2,95±0,36	3,09±0,37
II	3,54±0,18	2,61±0,36	3,68±0,19	4,18±0,25	3,35±0,42	3,51±0,51
III	2,64±0,26	2,12±0,16	3,34±0,08	3,49±0,04	2,59±0,18	2,98±0,41
IV	2,39±0,28	2,04±0,19	3,45±0,13	3,21±0,07	2,26±0,24	2,61±0,14
V	1,52±0,12	1,68±0,26	2,89±0,17	3,91±0,28	1,94±0,13	1,70±0,12
VI	1,51±0,13	1,07±0,20	1,14±0,31	1,43±0,24	2,01±0,20	2,37±0,63
VII	0,83±0,10	0,88±0,10	0,61±0,08	0,51±0,01	3,68±0,34	3,92±0,72

Note: in the groups marked * and ** reliable distinctions aren't revealed (p>0,05).

Comparing data of tables of width of intercostal spaces and height of ribes, it is possible to note that intercostal spaces are more than ribs height to all projective lines in both age groups. The intercostal spases are 1,5-2 times more than rib height in some places of a thorax.

Also the thoracic part of the vertebral column was investigated. During studying horizontal cuts of thoracic region the vertebral column the body, the arch, the transverse process of a vertebra and the vertebral opening are defined (fig. 3).

For more detailed studying of morphometric characteristics of thoracic part of the vertebral column the following parameters were examined: anteroposterior and transverse sizes of vertebral bodies and vertebral canal size.

Analyzing the results given in tab. 7 it is possible to note that the anteroposterior size of vertebral body decreases in the distal direction in both group of fetus.

Whereas, the transverse size of the vertebral body decreases from the Th1-3 level to Th4-7 and then this indicator increases again. This tendency remains with growth of fetus.

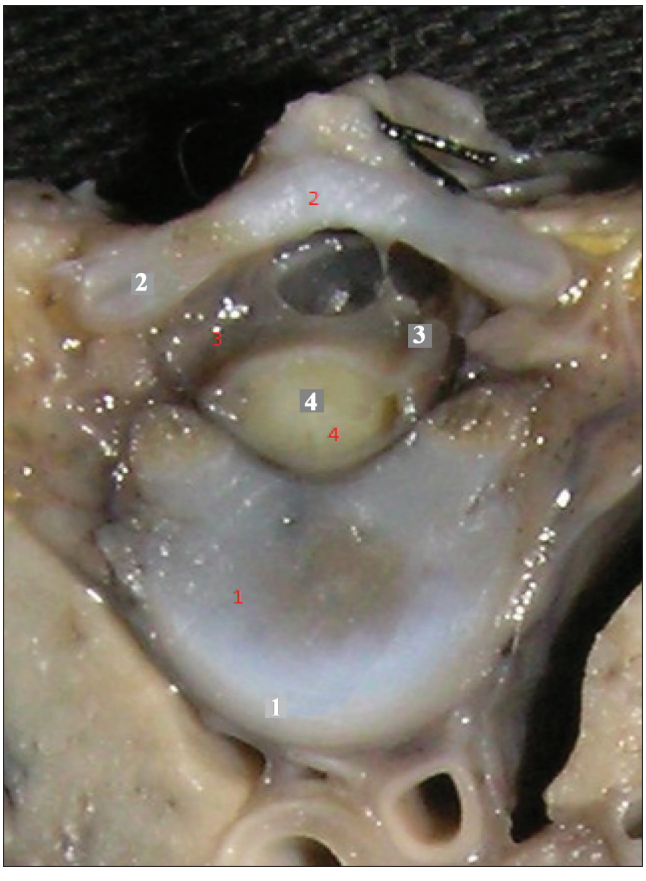

Fig. 3. A thoracic vertebra on the fetus preparation. The horizontal cut according to N. I. Pirogov, the level of cut is Th 4-5, development term is 22 week. 1 – vertebral disks, 2 – vertebral arch, 3 – vertebral opening, 4 – spinal cord.

Table 7

Anteroposterior and transverse sizes of the thoracic vertebra bodies and the vertebral canal at fetus of 16-17 week and 22 week of development (X±Sx, mm)

Gestational age / Level	16-17 week			22 week		
	Th1-3	Th4-7	Th8-12	Th1-3	Th4-7	Th8-12
Anteroposterior size of vertebral body	4,19±0,2	3,69±0,2	3,76±0,2	5,88±0,5	5,75±0,2	5,66±0,2
Transverse size of vertebral body	6,87±0,4	5,21±0,5	6,13±0,2	9,80±0,7	7,63±0,1	8,91±0,5
Anteroposterior size of vertebral canal	4,22±0,4	4,03±0,3	4,13±0,3	7,25±0,4	5,99±0,2	5,83±0,2
Transverse size of vertebral canal	5,21±0,4	4,83±0,3	4,66±0,4	8,34±1,02	6,74±0,4	6,54±0,4

The anteroposterior size of the vertebral canal decreases in the distal direction in both age groups. The cross size of the vertebral canal firstly decreases to the middle of the thoracic part of the vertebral column, then increases to the caudal direction in both age groups again.

Conclusions

Thus, results of this research showed that the thorax skeleton has the following features in the intermeddiate fetal period of person ontogenesis:

1. Wide intercostal spaces,

2. Discrepancy of serial number of the rib with number of a vertebra of this level (to parasternal, midclavicular and midaxillary lines),

3. The obtuse infrasternal angle and costal arches extending in the parties.

4. Asymmetry of a thorax.

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CARACTERISTICA IMUNOHISTOCHIMICĂ A CELULELOR STEM MEZENCHIMALE DIN COMPLEXUL OMBILICOPLACENTAR

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Abstract

THE IMMUNOHYSTOCHEMICAL CHARACTERISTICS OF MESENCHYMAL STEM CELLS OF THE UMBELLICO-PLACENTAR COMPLEX

The actual research presents the results obtained by studying the receptors characteristic for the mesenchymal stem cells of the umbilical cord and placenta using the immunohistochemical methods as follows CD 34, CD 105, AC (CD) 133 and VEGFR 2 (CD 309). The studied structures are rich in mesenchymal stem cells, which could be used for the collection, preserving, cultivation and following cellular transplantation in different diseases.

Key words: mesenchymal stem cells, cellular transplantation, immunohistochemical methods, umbilical cord.

Actualitatea lucrării

Progresele făcute în ultimii ani in ceea ce priveşte izolarea, caracterizarea şi diferenţierea celulelor stem, au adus noi speranţe în dezvoltarea de terapii celulare ce pot fi utilizate în tratamentul unor boli considerate azi incurabile [1, 6, 12, 15].