

# Normal variant computed-tomographic anatomy of the pancreas

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Despite the fact of millions of MRI and CT conducted worldwide the limit of normal studies is still not established [2-5]. This is true for almost all the organs. The choice of control group in clinical research is very difficult since just group normality has not been determined yet [2, 3]. This means that the results of such studies will have to be interpreted cum grano salis.

The doctrine of individual anatomical variability of human is system knowledge, which allows to link the anatomical differences with the justification of the access choice and the volume of surgical intervention. The interest of morphologists and surgeons to intravital method of abdominal organs visualization and, in particular, of pancreas is determined by the desire to avoid surprises during surgery and postoperative complications. The X-ray diagnostic guidelines have the data, designed for "average anatomical norm". Decision of questions of results interpretation outside the established norms of the anatomical structure is not sufficiently developed. Their individualization implies a detailed knowledge of morphometric characteristics of local organ constitution [4, 5, 8]. It is proved that the structure of the organ as part of the local constitution is closely associated with anthropometric measurements of the human body [10-12].

A significant number of publications devoted to vital anatomy of the pancreas specific issues [9, 10-13], and comprehensive work, containing detailed information about the features of the variant, age-related and the individual CT anatomy of the pancreas, are absent.

Purpose of the article is a systemic study of the normal variant CT anatomy of the pancreas at different human somatotypes.

## Material and Methods

CT study (in connection with a suspected abdominal pathology that has not been confirmed) on the spiral tomograph «Activion 16» («Toshiba Medical Systems Corporation», Japan), abdominal organs, particularly the pancreas are made in 60 patients

from 22 to 74 years, who don't abuse alcohol and have no clinical and laboratory signs of pancreatic injury, don't take any regular medications and lead a healthy lifestyle. The distribution of patients by age and sex is demonstrated in Table 1.

**Table 1.**  
*Distribution of the control group by age and sex.*

The age period age (years), sex	The number of patients	
	abs	%
Mature, I period:		
22-35, men	9	15,0
21-35, women	11	18,3
Mature, II period:		
36-60, men	10	16,7
36-55, women	11	18,3
Elderly:		
61-74, men	11	18,3
56-74, women	8	13,3
<i>Total:</i>	60	100,0
<i>men</i>	30	50,0
<i>women</i>	30	50,0

Age periodization is made in accordance with the recommendations [7]. Somatotype was determined using somatotype index (SI) [1] after the formula:  $SI = 100 \times BL / CTD$ ; where BL – body length, CTD – chest transverse dimension measured in centimeters (cm). In accordance with the recommendations [1] the belonging to the definite somatotype was stated (Table 2).

**Table 2.**  
*Identification criteria of somatotype.*

Somatotype	IC	Epigastric angle, degrees	Distance between 10 ribs, sm
Dolihomorphic	> 95	< 80	< 27
Esomorphic	95 – 103	80 – 100	27 – 36
Brachymorphic	< 95	> 100	> 36

Researches were carried out in accordance with rules and principles of bioethics. Patients were fa-

miliarized with procedures and signed the form «Informed consent» as subject patients.

## Results and Discussion

Results of the analysis of diagnostic images based on somatotype presented in Table 3.

When dolichomorphic type is most common S-shaped glands (57.9 %) at the mesomorphic type is U-shaped and straight form (33.3 % of cases), is more rapidly vascularized at dolichomorphic body type: front arterial arc length was  $11,1 \pm 0,3$  cm and gave  $14,2 \pm 0,9$  of arterial branches; back arterial arc length was  $8,68 \pm 0,3$  cm and gave  $12,4 \pm 0,5$  of arterial branches. At brachymorphic type vascularization of the pancreas head is less pronounced than at dolichomorphic type: front arterial arc length is  $6,1 \pm 0,4$  cm and  $6,73 \pm 0,3$  branches; back arterial arc length is  $6,04 \pm 0,3$  cm,  $8,4 \pm 0,3$  arterial branches. Mesomorphic type has a corresponding intermediate index. At dolichomorphic body type the celiac trunk in 10.5 % of case departed above, in 26.3 % of cases at the level and in 63.2 % of cases below the upper

edge of the pancreas. Brachymorphic type characterized by a lower location of the celiac trunk: 60 % - at the level of the pancreas midbody, in 30 % - at the level of the bottom edge and in 10 % - closer to the upper edge. Splenic artery in 100 % of case had more convoluted view at dolichomorphic body type, at brachymorphic body type in 35 % of cases it had strictly straight course.

Given the severity of the front edge of the pancreas, which in turn depended on the place of attachment of the colon mesentery and severity parapancreatic fiber, in accordance with the recommendations [9] it was identified 5 types of cross section. **Dolichomorphic type.** Triangular type with a primary extension below is more characteristic (68.4 %); triangular type and triangular type with the expansion up are less common (15.8 % and 10.5 %). **Brachymorphic type.** Triangular cross-section type with an extension at the top (55.0 %) is characteristic. Triangular and oval cross-section is less common (25.0 % and 15.0 %). **Mesomorphic type.** The representative of pancreas cross-section types are a triangular and triangular with the primary extension up (38.1 %, 33.3 %, respectively). Results of CT morphometry RV is demonstrated in Table 4.

**Table 3.**  
*The dependence of the pancreas shape from somatotype.*

Shape	Somatotype					
	Dolichomorfic (n = 19)		Mesomorphic(n = 21)		Brachymorphic (n = 20)	
	abs	%	abs	%	abs	%
Pancreas in axial section						
S-shaped (Figure 1)	11	57,9	4	19,1	3	15,0
U-shaped (Figure 2)	2	10,5	7	33,3	4	20,0
Straight (Figure 3)	2	10,5	7	33,3	11	55,0
Hook-shaped (Figure 4)	4	21,1	3	14,3	2	10,0
Pancreas body sectional form						
Triangle (Figure 5)	3	15,8	8	38,1	5	25,0
Triangular with up extension	2	10,5	1	4,8	11	55,0
Triangular with bottom expansion	13	68,4	7	33,3	1	5,0
oval (Figure 6)	1	5,3	4	19,1	3	15,0
Oval with bottom extension	–	–	1	4,8	–	–

**Table 4.**  
*Linear dimensions (cm) of the pancreas*

Index	Somatotype		
	Dolichomorfic (n = 19)	Mesomorphic (n = 21)	Brachymorphic (n = 20)
Pancreas length	101±8	131±11	146±12
Thickness:			
head	19,5±0,9	23,3±1,1	26,5±1,0
cervix	11,3±0,6	13,9±0,8	15,9±1,1
body	16,7±0,8	19,1±1,1	21,6±1,0
tail	11,9±0,5	15,4±0,6	18,3±0,8



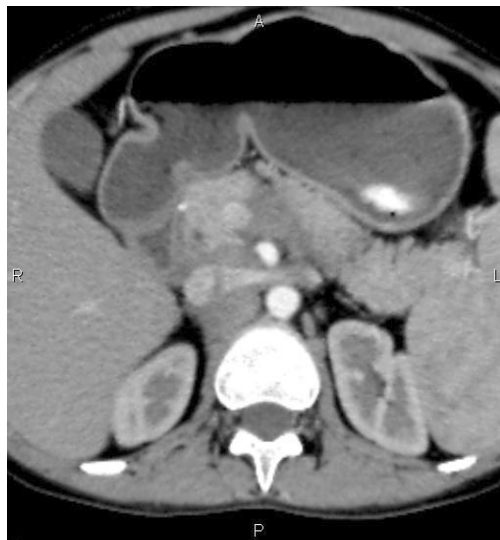
**Fig. 1.** *S-shaped pancreas. Arterial phase.*



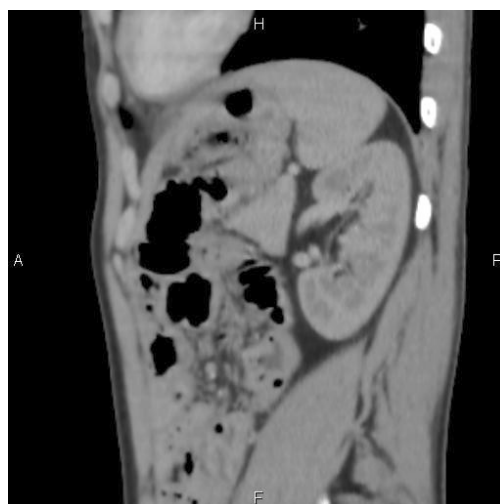
**Fig. 2.** *U-shaped pancreas.*



**Fig. 3.** *Straight-shaped pancreas. Arterial phase.*



**Figure 4.** *Hook-shaped pancreas. Arterial phase.*



**Figure 5.** *The triangular shape of the cross section of the pancreas. Arterial phase.*



**Fig. 6.** *The oval shape of the cross section of the pancreas. Portal phase.*

With age, the prostate size decreases – in the age group 21-35 years the head thickness ( $26,6 \pm 0,8$  mm) was significantly larger than in the group 55-74 years ( $22,0 \pm 1,0$  mm).

Gender differences of pancreas tomographic slices were identified as well – in men pancreas body is thicker than in women ( $22,0 \pm 0,8$  mm and  $18,5 \pm 0,7$  mm, respectively).

The considerable individual variation in the topographic pattern on slices of the same level, as well as distinct age-related changes of the pancreas are marked.

Note that there is definite relationship of the pancreas pathogenesis, pathogenesis of its diseases. For example, for the development of chronic pancreatitis: in classification of etiological factors [12, 13] U-shaped pancreas takes the 6th place after alcohol, hypertriglyceridemia, hypercalcemia, congenital pancreatitis and gemohromatosis. According to data [6] tumors are localized in the head in 70 % of cases, in areas of body and tail – in 24% of cases, and in hook-shaped appendix – only in 6% of the cases.

## Conclusion

The dependence of the pancreas cross section from body type was stated. It should be considered during surgery on this organ.

The dependence of pancreas shape in axial section and a cross-sectional form of pancreas body from the body somatotype that must be considered at organ visualization and identification of organ disease was found.

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## NORMAL VARIANT COMPUTED-TOMOGRAPHIC ANATOMY OF THE PANCREAS

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The doctrine of individual anatomical variability of human is the system knowledge, which allows to link the anatomical differences with the rationale for the choice of access and volume surgical intervention. Interest of surgeons to intravital method of imaging of abdominal organs and, in particular, of pancreas is associated with the characteristics of the local constitution individualization of morphotopometric bodies: the structure body is closely related to anthropometric measurements of the human body.

**Purpose** – the systemic study of the normal variant CT anatomy of the pancreas at different human body somatotype.

**Material and methods.** CT study (in connection with a suspected abdominal pathology that has not been confirmed) on the spiral tomograph «Activion 16» of the abdominal cavity, and in particular the pancreas, performed at the age of 60 patients from 22 to 74 years.

**Results.** When dolichomorphic type is most common S-shaped glands (57.9 %) at the mesomorphic type – U-shaped and straight form (33.3 % of cases), with brachymorphic type – straight-shaped (55.0 % of cases). The head of the pancreas more rapidly vascularized when dolichomorphic body type: Front arterial arc length was  $11,1 \pm 0,3$  cm and  $14,2 \pm 0,9$  gave arterial branches; Back arterial arc length was  $8,68 \pm 0,3$  cm and  $12,4 \pm 0,5$  gave arterial branches. When brachymorphic type vascularization of pancreas head less pronounced than in dolichomorphic type length front arterial arc  $6,1 \pm 0,4$  cm and  $6,73 \pm 0,3$  branches; Back arterial arc  $6,04 \pm 0,3$  cm,  $8,4 \pm 0,3$  веточек. Mesomorphic type has a corresponding intermediate indicators.

**Conclusion.** The dependence of the cross section of the pancreas from the body type was stated. It must be considered at surgery. The dependence of pancreas form in axial cross-section and cross-sectional shape of pancreas body from the body somatotype was found.

**Keywords:** pancreas, normal anatomy, body somatotype, computed tomography.

### НОРМАЛЬНА ВАРИАНТНА КОМП'ЮТЕРНО-ТОМОГРАФІЧНА АНАТОМІЯ ПІДШЛУНКОВОЇ ЗАЛОЗИ

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Вчення про індивідуальної анатомічної мінливості людини – системне знання, що дозволяє зв'язати анатомічні відмінності з обґрунтуванням вибору доступу і обсягу хірургічного втручання. Інтерес хірургів до прижиттєвих методів візуалізації органів черевної порожнини і, зокрема, підшлункової залози (ПЗ) пов'язаний з індивідуалізацією морфотопометричних характеристик локальної конституції органів: будова органу тісно пов'язана з антропометричними показниками тіла людини.

**Мета статті** – системне вивчення нормальної варіантної КТ анатомії ПЗ при різних соматотипах статури людини.

**Матеріал і методи дослідження.** КТ дослідження (у зв'язку з підозрою на патологію

органів черевної порожнини, яка не підтвердилася) на спіральному томографі «Activion 16», органів черевної порожнини і, зокрема ПЗ, виконані у 60 пацієнтів у віці від 22 до 74 років.

**Результати.** При доліхоморфного типі найбільш часто зустрічається S-подібна форма залози (57,9 %), при мезоморфному типі – U-подібна і пряма форми (по 33,3 % спостережень), при брахіморфному типі – пряма форма (55,0 % спостережень). Головка ПЗ більш інтенсивно васкуляризується при доліхоморфному типі статури: передня артеріальна дуга мала довжину  $11,1 \pm 0,3$  см і віддавала  $14,2 \pm 0,9$  артеріальних гілочок; задня артеріальна дуга мала довжину  $8,68 \pm 0,3$  см і віддавала  $12,4 \pm 0,5$  артеріальних гілочок. При брахіморфному типі васкуляризація головки ПЗ менш виражена, ніж при доліхоморфному: довжина передньої артеріальної дуги  $6,1 \pm 0,4$  см і  $6,73 \pm 0,3$  гілочок; задня артеріальна дуга  $6,04 \pm 0,3$  см,  $8,4 \pm 0,3$  гілочок. Мезоморфний тип має проміжні відповідні показники.

**Висновки.** Виявлена залежність поперечного перерізу ПЗ від типу статури, що необхідно враховувати при операціях на цьому органі. Встановлено залежність форми ПЗ в аксіальному перерізі і форми поперечного перерізу тіла ПЗ від соматотипу статури.

**Ключові слова:** підшлункова залоза, нормальна анатомія, соматотип статури, комп'ютерна томографія.

### НОРМАЛЬНАЯ ВАРИАНТНАЯ КОМПЬЮТЕРНО-ТОМОГРАФИЧЕСКАЯ АНАТОМИЯ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ

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Учение об индивидуальной анатомической изменчивости человека – системное знание, позволяющее связать анатомические различия с обоснованием выбора доступа и объема хирургического вмешательства. Интерес хирургов к прижизненным методам визуализации органов брюшной полости и, в частности, поджелудочной железы (ПЖ) связан с индивидуализацией морфотопометрических характеристик локальной конституции органов: строение органа тесно связано с антропометрическими показателями тела человека.

**Цель статьи** – системное изучение нормальной вариантной КТ анатомии ПЖ при различных соматотипах телосложения человека.

**Материал и методы исследования.** КТ исследования (в связи с подозрением на патологию органов брюшной полости, которое не подтвердилось) на спиральном томографе «Activion 16», органов брюшной полости и, в частности ПЖ, выполнены у 60 пациентов в возрасте от 22 до 74 лет.

**Результаты.** При долихоморфном типе наиболее часто встречается S-образная форма железы (57,9 %) при мезоморфном типе – U-образная и прямая формы (по 33,3% наблюдений), при брахиморфном типе – прямая форма (55,0 % наблюдений). Головка ПЖ более интенсивно васкуляризируется при долихоморфном типе телосложения: передняя артериальная дуга имела длину  $11,1 \pm 0,3$  см и от-

давала  $14,2 \pm 0,9$  артериальных веточек; задняя артериальная дуга имела длину  $8,68 \pm 0,3$  см и отдавала  $12,4 \pm 0,5$  артериальных веточек. При брахиморфном типе васкуляризация головки ПЖ менее выраженная, чем при долихоморфном типе: длина передней артериальной дуги  $6,1 \pm 0,4$  см и  $6,73 \pm 0,3$  веточек; задняя артериальная дуга  $6,04 \pm 0,3$  см,  $8,4 \pm 0,3$  веточек. Мезоморфный тип имеет промежуточные соответствующие показатели.

**Выводы.** Обнаружена зависимость поперечного сечения ПЖ от типа телосложения, что необходимо учитывать при операциях на этом органе. Установлена зависимость формы ПЖ в аксиальном сечении и формы поперечного сечения тела ПЖ от соматотипа телосложения.

**Ключевые слова:** поджелудочная железа, нормальная анатомия, соматотип телосложения, компьютерная томография.