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Адрес для корреспонденции

246046, Республика Беларусь,
г. Гомель, ул. Медицинская, 4,
Учреждение «Гомельский областной клинический кардиологический центр», отделение анестезиологии и реанимации с палатами интенсивной терапии.
Тел./факс: (0232) 43-48-01,43-59-44, 43-47-64
Тел. моб.:+375 29 6146598
e-mail: Osipenko081081@mail.ru
Осипенко Дмитрий Васильевич

Сведения об авторах

Осипенко Д.В., к.м.н, врач-анестезиолог-реаниматолог отделения анестезиологии и реанимации с палатами интенсивной терапии учреждения «Гомельский областной клинический кардиологический центр».

Скороходов А.А., врач-кардиохирург кардиохирургического отделения учреждения «Гомельский областной клинический кардиологический центр».

Силанов А.А., врач-анестезиолог-реаниматолог отделения анестезиологии и реанимации с палатами интенсивной терапии учреждения «Гомельский областной клинический кардиологический центр».

Address for correspondence

246046, Republic of Belarus,
4 Meditsinskaya Street, Gomel,
Gomel Regional Clinical Cardiology Center,
Anesthesiology and Intensive Care Ward.
Tel./fax: (0232) 43-48-01, 43-59-44, 43-47-64
Mob.tel.: +375 29 6146598
e-mail: Osipenko081081@mail.ru
Osipenko Dmitry Vasilievich

Information about the authors

Osipenko D.V., MD, PhD, anesthesiologist of the Anesthesiology and Intensive Care Ward of Gomel Regional Clinical Cardiology Center.

Silanau A.A. MD, anesthesiologist of Anesthesiology and Intensive Care Ward of Gomel Regional Clinical Cardiology Center.

Skorokhodov A.A., MD, Cardiothoracic Surgeon of the Cardiosurgery Department of Gomel Regional Clinical Cardiology Center.

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DIFFERENTIAL DIAGNOSTICS OF AGE-RELATED DYSTROPHIC CHANGES AND CHANGES ARISING FROM FUNCTIONAL OVERLOAD ON THE LUMBO-SACRAL LIGAMENTS

A. M. Yurkovskiy[1], S. L. Achinovich[2]

[1]Gomel State Medical University, Gomel, Republic of Belarus
[2]Gomel Regional Clinical Oncology Center, Gomel, Republic of Belarus

Objective: to develop a method for the differential diagnosis of age-related dystrophic changes and also changes arising from functional overload on the iliolumbar, long dorsal sacroiliac and sacrotuberous ligaments.

Material and methods. The iliolumbar, long dorsal sacroiliac ligaments and sacrotuberous ligaments taken from 101 corpses including 65 men and 36 women aged 24–83.

Results. The data describing the intensity of the dystrophic changes in the iliolumbar, long dorsal sacroiliac and sacrotuberous ligaments for different age periods have been collected.

Conclusion. The comparison of a particular patient's results on Bonar scale with the permissible age-related changes makes it possible to differentiate between the age-related changes and those resulting from the functional overload.

Key words: histopathological changes, iliolumbar ligament, long dorsal sacroiliac ligament, sacrotuberous ligament.

Цель: разработать способ дифференциальной диагностики возраст-зависимых дистрофических изменений, а также изменений, возникших вследствие функциональной перегрузки подвздошно-поясничной, задней длинной крестцово-подвздошной и крестцово-бугорной связок.

Материал исследования. Подвздошно-поясничные, задние длинные крестцово-подвздошные и крестцово-бугорные связки от 101 трупа, в том числе 65 мужчин и 36 женщин (возрастной диапазон 24–83 года).

Результаты. Получены данные, характеризующие выраженность дистрофических изменений в различные возрастные периоды применительно к подвздошно-поясничным, задним длинным крестцово-подвздошным и крестцово-бугорным связкам.

Заключение. Сопоставление оценок по шкале *Bonar* конкретного пациента с долженствующими возрастными значениями позволяет дифференцировать возраст-зависимые изменения от изменений, вызванных функциональной перегрузкой.

Ключевые слова: гистопатологические изменения, подвздошно-поясничная связка, задние длинные крестцово-подвздошные связки, крестцово-бугорные связки.

A. M. Yurkovskiy, S. L. Achinovich

Differential Diagnostics of Age-Related Dystrophic Changes and Changes Arising from Functional Overload on the Lumbo-Sacral Ligaments

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Introduction

Lower back pain syndrome is a pain syndrome limited by the area from the lower edge of the twelfth rib to the gluteal folds, and is one of the most common pathological conditions in the 30-50 year-age group [1].

The occurrence of pain syndrome in the lower back is associated with functional and dystrophic changes in the musculoskeletal system. The structures that are potentially capable (in case of their over-strain and/or damage) of initiating lower back pain syndrome, include the lumbosacral spine and, in particular, the iliolumbar ligaments (ILL), long dorsal sacroiliac ligament (LDSIL), sacrotuberous ligament (STL) [1, 2].

The risk of damaging these ligaments depends on the severity of the dystrophic changes found in them at the time of overload [3]. Factors that largely predetermine the severity of these changes in the ILL, LDSIL, STL are: age (> 60 y. o.) [4–6]; high (> 30.0) or, conversely, low (< 18.5) body mass index (BMI) [4–5]; «background» syndrome of undifferentiated connective tissue dysplasia [7]; secondary amyloidosis [8].

At the same time, there are no morphological criteria that would allow us to distinguish such age-dependent and BMI-dependent dystrophic changes from changes due to functional overload in the aforementioned ligaments. Hence occurs the need to develop a method for distinguishing these states, but it is possible only if there are clear representations regarding the expression of «background» dystrophic changes in the ILL, LDSIL, STL at specific age periods.

The purpose of the study was to develop a method for distinguishing age-dependent dystrophic changes and changes resulting from functional overuse of ILL, LDSIL, STL.

Materials and methods

This study was carried out in pathoanatomical department of Gomel Regional Clinical Oncology Dispensary during 2010–2016 years. Age information was obtained from patient record.

Data of morphological study of the ILL, LDSIL, STL was analyzed. For this purpose, autopsy of these ligaments from 101 corpses (aged from 25 to 83 years) was fulfilled. The corpses were obtained from pathoanatomical department of Gomel Regional Clinical Oncology Dispensary.

Histological analysis

Specimens were immediately preserved with 10 % formalin and were subsequently paraffin embedded, and the standard procedure of dehydration and degreasing of tissue fragments and their impregnation with paraffin was followed. Microscopic slides were prepared with 5μm thick tissue sections and were stained with hematoxylin-eosin for cell staining in 101 cases and Romanovsky-Giemsa stains for cell nucleus and cytoplasm staining in 49 cases with expressed dystrophic cases, in addition pigmented toluidine blue and Van Gieson colouring were used for detailed distinguishing collagen and muscle fibers. Stained tissue sections were examined under light microscope at high magnification (× 400).

Histopathological assessment was carried out by two specialists independently of each other and the final histological grading system consisted of a numerical score ranging from 0–12 on Bonar scale [9], as described below:

— evaluation of cells of the fibroblastic differon (0 points — longated shape of the nucleus without distinct visualization of cytoplasm; 1 point — shape of the nucleus acquires ovoid configuration, but no distinct visualization of cytoplasm; 2 points — the core is rounded and slightly increased it is rendered small amount of cytoplasm; 3 points — the core is roundish, large with abundant cytoplasm and the formed recesses);

— interstitial substance score (0 points — no staining of the interstitial substance; 1 point — stained mucin among the fibers; 2 points — the

stained mucin among fibers with impaired differentiation of collagen fibers; 3 points — mucin everywhere, with the collagen fibers imperceptible staining);

— evaluation of collagen fibers (0 points — clear differentiation of fibers; 1 point – the separation of individual fibers from the retaining border definition; 2 points — separation of fibers with loss of border definition, increased interstitial substance; 3 points — the separation of the collagen fibers with complete loss of architectonic ligament);

— vascularization score (0 points — blood vessels disposed among the fibers are not rendered; score 1 — capillaries in an amount up to one in 10 fields of view; 2 points — 1–2 capillary in 10 fields of view; 3 points — more than two capillary on 10 fields of view) [9].

The results from the histological examination were grouped by age and BMI. The grouping was performed according to the World Health Organization (WHO) recommendations [10].

According to these recommendations, the obtained data was divided into the following groups: reduced mass (BMI < 18.5); normal weight (BMI 18.5–24.9); excess weight (BMI 25.0–29.9); first degree of obesity (BMI 30.0–34.9); second degree obesity (BMI 35.0–39.9). The age categories were also based on World Health Organization recommendations.

Statistical analysis

STATISTICA Version 10, StatSoft Inc was used. Data normality was assessed using Shapiro-Wilk test. In the case of the distribution of quantitative indicators different from normal, the data was presented as the median of the 25th and 75th percentiles (Me (Q25 – Q75)). To estimate the strength of the relationship between the morphometric parameters of the ILL, the Spearman rank order correlation analysis was used. Mann-Whitney U test was used to compare the morphometric parameters of the contralateral ligaments. Differences were considered significant at $p < 0.05$.

Results and discussion

Dystrophic changes of varying severities of the three ligaments tested were identified in all the cases. There were no statistically significant differences in the dystrophic changes between contralateral ILL, LDSIL, STL ($p > 0.05$; Mann-Whitney U test). A strong correlation between age and the indicators of characterizing the severity of dystrophic changes according to the Bonar score in the ILL, LDSIL, STL in most cases was found (Spearman R = 0.78, 0.8, 0.82, respectively, $p = 0.00001$).

Me (Q25 – Q75) values of the Bonar scores of the three ligaments were calculated for different age categories, to characterize the severity of dystrophic changes (Table 1).

Table 1 — Severity of dystrophic changes (Bonar scale) of ILL, LDSIL and SLL in different age categories. Me (Q25 – Q75): median and the inter-quartile range

Age categories (Years)	**Bonar score** Me (Q25 – Q75)		
	ILL	**LDSIL**	**SLL**
25–35	5.0 (4.0–5.0)	5.0 (4.0–5.0)	5.0 (4.0–5.0)
36–44	5.0 (5.0–6.0)	5.0 (5.0–6.0)	5.0 (5.0–6.0)
45–59	6.0 (6.0–7.0)	6.0 (6.0–7.0)	6.0 (6.0–7.0)
60–74	7.5 (7.0–8.0)	7.0 (6.0–7.0)	7.0 (6.0–7.0)
75–90	8.0 (8.0–9.0)	8.0 (7.0–8.0)	8.0 (8.0–9.0)

Assuming that overweight can also have an effect on the health of the iliolumbar ligaments, long dorsal sacroiliac ligaments, sacrotuberous ligaments, the strength of the relationship between the final values of the Bonar scale and BMI was evaluated (Table 2).

Table 2 — Strength of the relationship of estimates reflecting the severity of dystrophic changes (on the Bonar scale) of the ILL, LDSIL, SLL at different BMI values

BMI	**Spearman Rank Order Correlations**		
	ILL	**LDSIL**	**SLL**
18.5–24.9	R = 0.02 (p = 0,9)	R = 0.2 (p = 0.6)	R = 0.04 (p = 0.9)
25.0–29.9	R = 0.05 (p = 0,9)	R = 0.1 (p = 0.8)	R = 0.2 (p = 0.7)
30.0–40.0	R = 0.4 (p = 0,05)	R = 0.5 (p = 0.05)	R = 0.27 (p = 0.2)

Based on the data given in Table 2, it can be concluded that there is no statistically significant relationship between the severity of dystrophic changes in the iliolumbar ligaments, long dorsal sacroiliac ligaments, sacrotuberous ligaments and BMI in the range of 18.5–30.0. As for the range of BMI values above 30.0, only a moderate correlation between BMI and the severity of dystrophic

changes in the above ligaments was observed. And this means that the obesity factor will affect the final Bonar score in a small part of the patients only (in the case of this sample, 18 %).

Conclusions:

There is a strong correlation between age and severity of dystrophic changes of the iliolumbar ligaments, long dorsal sacroiliac ligaments, sacrotuberous ligaments, with each age category corresponding to its range of values of the Bonar scale, and therefore any excess of the limits of this range should be regarded as a consequence of functional overload; BMI may affect the value of the final Bonar score of the iliolumbar ligaments, long dorsal sacroiliac ligaments, sacrotuberous ligaments only at values above 30.0, hence the proposed scale of values on the Bonar scale can be used in most cases.

Conformity with ethical standards. Conflict of interest.

The authors declare that there are no conflicts of interest of any kind. All specimens were handled in accordance to the laws and regulations of the country in which the study was performed.

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2. Yurkovskiy AM, Achinovich SL, Kushnerov AI. Podvzdoshno-pojasnichnye, zadnie dlinnye krestcovo-podvzdoshnye i krestcovo-bugornye, svjazki v razlichnye vozrastnye periody: sonograficheskie i gistologicheskie sopostavlenija. *Med Jhurn*. 2015;3:137-40. (in Russ.)

3. Yurkovskij AM. Est' li patologicheskij continuum pri povrezhdenij ahpodvzdoshno-pojasnichnoj svjazki? *Problemy Zdorov'ya i Jekologii*. 2012;4:27-32. (in Russ.)

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5. Mihajlov AN, Jurkovskij AM, Achinovich SL. Vozmozhnosti sonografii v ocenke vyrazhennosti distroficheskih izmenenij zadnej dlinnoj krestcovo-podvzdoshnoj svjazki: sonograficheskie i gistologicheskie sopostavlenija (in vitro). *Izv NAN Belarusi. Ser Med Nauk*. 2014;4:9-13. (in Russ.)

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Адрес для корреспонденции

246012, Республика Беларусь,
г. Гомель, ул. Медицинская, д. 2,
УО «Гомельский государственный медицинский университет»,
кафедра внутренних болезней №3, курс лучевой диагностики и лучевой терапии,
Тел. моб.: +375 44 7892095,
e-mail: yurkovsky@mail.ru
Юрковский Алексей Михайлович

Сведения об авторах

Юрковский А.М., к.м.н., доцент кафедры внутренних болезней №3 УО «Гомельский государственный медицинский университет».

Ачинович С.Л., к.м.н., заведующий патологоанатомическим отделением У «Гомельский областной клинический онкологический диспансер».

Address for correspondence

246012, The Republic of Belarus,
Gomel, Medicinskaya, 2,
Gomel State Medical University,
Department of Radiology,
Tel. mob.: +375 44 7892095,
e-mail: yurkovsky@mail.ru
Aliaxei M. Yurkovskiy

Information about of the authors

Yurkovskiy A.V. PhD, Ass. Professor of the Department of Internal Diseases No.3, Gomel State Medical University.

Achinovich S.L. PhD, Head of the Pathoanatomical Department of Gomel Regional Clinical Oncology Center.

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