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Syndromic approach in assessing the surgical pathology of the cervical spine

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Object of study The existing variety of cervical spine pathologies resulted in a huge number of nosologic classifications and complicates their interpretation. **Purpose** Based on the analysis of patients with various surgical pathologies of the cervical spine, we suggest a syndromic approach to their evaluation to simplify the choice of a therapeutic algorithm. **Study design** Retrospective monocentre multicohort study and literature review **Materials and methods** A retrospective analysis of 336 patients aged 0.9 to 77 years with cervical spine surgical pathology who underwent interventions at the Ilizarov center between 2010 to 2017 was performed. **Results** Based on the analysis of the symptoms that led to the surgical interventions, the following clinical syndromes were identified: compression-ischemic syndrome, instability syndrome, imbalance syndrome. **Conclusion** The proposed concept of assessing syndromes identifies the pathology of the cervical spine regarding its clinical manifestations. The use of the syndromic approach will facilitate intra- and interdisciplinary interaction, as well as allows for tactical decisions.

Keywords: cervical spine, syndrome, compression, instability, imbalance

INTRODUCTION

The existing variety of cervical spine pathologies resulted in a huge number of nosologic classifications and their interpretation is complicated [1, 2]. In addition, the level of intra- and inter-expert discrepancy in interpreting one and the same pathology has been growing, and, as a consequence, there are disagreements in the choice of therapeutic and tactical algorithm [3-6]. Thus, in particular, trauma, as the most common pathology of the cervical spine, raises the greatest confusion among specialists. The unique anatomy of the craniocervical transition junction necessitates the use of separate types of classifications for evaluation of the injuries of the occipital condyles, atlanto-occipital dislocations [1, 7–11], atlant fractures, atlas transverse ligament rupture [12], atlanto-axial rotational dislocation [13, 14], C2 odontoid injury, hangman's fractures, and other C2 fractures[15]. However, most of the classifications do not take into account the most significant component of lesions – the integrity of the ligament complex [16, 17]. Equally difficult is the situation for the sub-axial department, where the "borderline" injuries (according to SLIC – 4 points, according to CSISS – 7 points) [3, 4, 5, 18], bring a doctor to a deadlock, as the choice of treatment implies both conservative and surgical treatment. A separate section is anomalies and malformations, for which a syndromic approach was proposed by A.V. Gubin in 2009 for simplification of systematization [19].

MATERIAL AND METHODS

A retrospective analysis of 336 patients aged 0.9 to 77 years with surgical pathology of the cervical spine and who underwent surgical interventions at the Ilizarov center from 2010 to 2017 was conducted.

RESULTS

Various variants of anterior fixation were performed in 195 of them while posterior fixation was used in the remaining 141. The distribution of patients by nosological groups and clinical manifestations is presented in Table 1 and Table 2.

Based on the analysis of the complexes of symptoms that caused the surgical intervention, the following clinical syndromes were identified:

1. *Compression-ischemic syndrome* At the heart of the syndrome is compression of the spinal cord and/or nerve roots, as well as blood vessels that feed the spinal cord and a part of the brain (vertebrobasilar system), accompanied by irritation, ischemia of neural structures, and disturbance of liquorodynamics. Clinically, it is manifested by vertebrogenic or post-traumatic myelopathy, radiculopathy, bulbar and vestibular disorders.

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Table 1

Pathologies with anterior fixation (n = 195)

Pathology	Syndrome					
	i	c	d	i + c	c + d	i + d
Degeneration dystrophic process		110		1		
Trauma	8	14		56	2	
Inflammation		1				
DISH + trauma				1		
OPLL		1				
DISH + degenerative process		1				

Notes: i – instability, c – compression, d – imbalance; DISH – diffuse idiopathic skeletal hyperostosis; OPLL – ossification of the posterior longitudinal ligament

Table 2

Pathologies with posterior fixation (n = 141)

Pathology	Syndrome						
	i	c	d	i + c	c + d	i + d	i + c + d
Degeneration dystrophic process		8		2			
Trauma	54	1	1	8	1	2	
Malformations and systemic diseases	1	2	20	8	10	2	16
New formations (neoplasms)	3	1		1			
Destructive process due to inflammation or autoimmune process				2	1		1
Iatrogenic factors					1		

Notes: i – instability, c – compression, d – imbalance

Nosologicalpathology:degenerativeanddystrophic changes (disc hernia, stenosis), trauma (dislocation, traumatic hernia, traumatic spondylolisthesis), ossification of the posterior longitudinal ligament (OPLL, Tsukimoto's disease), systemic diseases (achondroplasia, mucopolysaccharidosis types 4 and 6, diastrophic dysplasia), congenital malformations (Arnold-Chiari malformation, basilar invagination), neoplasms of vertebrae, spinal cord and its sheath.

2. *Instability syndrome* At the heart of the syndrome are lesions of bone structures and disco-ligamentary complex, leading to disruption in the relationship and inability of spinal motor segments to perform their functions under physiological loads (stability determination by White & Panjabi). The main clinical manifestation of this syndrome is pain (most often axial, as well as radicular); combination with transient neurological and vascular disorders (dynamic character) is possible.

Nosological pathology: trauma (especially ligaments), degenerative and dystrophic lesions (degenerative spondylolisthesis), autoimmune conditions (rheumatoid arthritis) and infectious process (nonspecific and specific) – most common for the atlanto-axial complex, some neoplasms (mainly lytic).

3. *Imbalance syndrome* At the heart of the syndrome are disorders in the relationship of cervical lordosis and the slope of the T1 vertebra, sagittal vertical axis (SVA – a plumb line dropped from the centroid of C2 and the posterior superior corner of C7). These disorders lead to improper redistribution of the gravitational load and to a loss of horizontal gaze in more severe cases. In turn, this syndrome includes sub-syndromes: sagittal imbalance and frontal imbalance (which is of the great significance in children up to pubertal age).

Nosological pathology of sagittal imbalance: atlanto-axial dislocations (mainly posttraumatic, as well as developmental and inflammatory), degenerative and dystrophic lesions accompanied by a decrease in the range of movements and loss of physiological cervical lordosis, autoimmune lesions (ankylosing spondylitis) with a drop-head syndrome. Frontal imbalance: atlanto-axial rotational blocking and/or dislocation (upper torticollis), developmental abnormalities presented by segmentation disorders, anomalies of vertebral formation (lower torticollis) which leads to disturbance of the horizontal gaze in the frontal plane and, as a consequence, asymmetry in child's face during the growth of the axial skeleton.

It should be noted that in most cases, nosological pathology is manifested by a combination of several syndromes. Moreover, each syndrome might be leading and should be considered in the tactics of observations and surgical treatment. This kind of situation explains the severity of the pathology and great cautiousness in terms of surgical correction. Thus, the proposed syndromic approach to assessing the pathology of the cervical spine can unify the terminology used by physicians in its interpreting, and also assist to choose a more specific approach to the treatment algorithm (conservative or surgical).

DISCUSSION

The greatest problem in the interpretation of nosological pathology in any classification is the inter-expert agreement, which is most clearly seen in trauma cases [3]. The most difficult, from the position of interpretation, are injuries to C2. Thus, "deep" type III odontoid fractures with an atypical line are interpreted by some authors as an atypical hangman's fracture of type I or as "other" fractures of C2 [17, 20]. Modern classifications of sub-axial injuries are also not devoid of shortcomings. In the SLIC (subaxial injury classification) and CSISS (cervical spine injury severity score) systems the greatest disagreement refers to "borderline" lesions. In addition, when using SLIC, the greatest difficulty is assessing the integrity of the disco-ligamentary complex. The inter-expert disagreement exceeds 20 % when it is estimated. The CSISS and AOSpine Subaxial Classification System do not take into account the state of the nerve structures while a large number of their criteria make them difficult for the doctor to reproduce [21].

Absolutely uncertain, from the point of view of systematization, is the situation with assessing degenerative and dystrophic lesions [12, 20, 22-27]. Currently, there is no any classification. This kind of problem is noted in an infectious and autoimmune process with damage to the structures of the cervical vertebrae.

Evaluation of neoplasms in the cervical spine involves the use of oncological principles in terms of the morphological characteristics of the substrate, as well as localization of the process [28, 29]. In this case, as a rule, neuro-orthopedic aspects are not taken into account.

The variety of anomalies and malformations, disorders due to systemic diseases are difficult to systematize as an individual approach in each specific case is required. The developed syndromic classification (ischemic, compressive, destabilizing, or mixed) made it possible to significantly facilitate the interpretation of pathological changes, including from the point of view of choosing treatment tactics [19].

The syndromic systematization proposed in the current study enables to unite diverse and heterogeneous groups of patients with the pathologies of the cervical spine from the position of a tactical approach (conservative or surgical). The presence of one of the syndromes and/or their combination indicates the need for surgical treatment. In turn, the choice of a specific method of treatment is based, on the one hand, on the paradigm prevailing in the vertebrology, and on the other hand on the preferences and manual skills of the doctor.

This study is the first attempt of comprehensive systematization of the entire pathology of the cervical spine from the position of the syndromic approach. It enables to get rid of the inter-expert disagreement and make a choice of the therapeutic algorithm. The limitation of this concept is the following: it is impossible to choose a specific surgical method on the basis of the syndrome revealed. The method will require taking into account the specific changes characteristic for each nosology.

CONCLUSION

The proposed syndromic concept unites various pathologies of the cervical spine regarding their clinical manifestations. The use of the syndromic approach will facilitate intra- and interdisciplinary interaction, as well as assists in tactical solution making.

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