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Overlooked threat: Orthostatic hypotension after degenerative cervical spondylosis surgery

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Abstract: *Patients with Degenerative cervical spondylosis (DCS) who fail to respond to conservative treatment are mostly treated with cervical decompression surgery. In addition to the common complications such as nerve root injury, trachea, esophagus and neck vascular injury, Orthostatic hypotension (OH) can also occur after surgery. OH is a clinical manifestation of abnormal blood pressure fluctuations during postural changes. At present, there have been in-depth studies in the fields of spinal cord injury, Parkinson's disease and cardiovascular and cerebrovascular diseases. However, it has not received enough attention in patients after DCS. Therefore, this article is committed to explore the mechanism and risk factors of OH when DCS patients get out of bed for the first time after surgery, and summarize the diagnostic methods and preventive measures, in order to improve the understanding of medical staff on OH in DCS patients after surgery and improve the prognosis and quality of life of patients.*

Keywords: *Degenerative cervical spondylosis; Orthostatic hypotension; Pathogenesis; Risk factors; preventive measure*

1. Introduction

Degenerative cervical spondylosis (DCS) is an aging-related disease, which is usually caused by long-term strain of the cervical spine, hyperostosis or intervertebral disc herniation, leading to compression of the cervical spinal cord or nerve root [1]. When the clinical symptoms are serious and conservative treatment is ineffective, surgical treatment is often required [2]. The latest research shows that about 27.7% of DCS patients will have adverse reactions or complications after surgery [3]. Common complications include dysphagia, nerve root injury, axial pain, neck vascular injury, infection, etc. [4]. Among them, Orthostatic hypotension (OH), which is easily overlooked, is a disease in which the blood pressure drops significantly when the supine position changes to the upright position [5]. The presence of OH often indicates complications such as dizziness, falls, fractures and even death, which seriously affects the quality of life of patients [6, 7]. However, there are still no clear studies on the mechanism, risk factors and prevention strategies of OH after DCS. This article aims to review the research status of OH after DCS.

At present, the definition of OH widely used in clinical research is the consensus statement issued by the Consensus Committee of the American Society for Autonomic Neuroscience and the American Academy of Neurology in 1996 [8]. That is, when the posture actively changes to a standing position, Systolic blood pressure (SBP) drops ≥20 mm Hg and/or Diastolic blood pressure (DBP) drops ≥10 mm Hg within 3 minutes, with or without fatigue, dizziness, vertigo, blurred vision, With orthostatic symptoms such as nausea, OH was considered to be present.

2. Pathogenesis

Studies have shown that OH reflects autonomic nervous system dysfunction [9]. The complete autonomic nervous system is composed of sympathetic nervous system and parasympathetic nervous system, and the sympathetic nervous system plays an important role in blood pressure regulation [10]. In general, activation of the sympathetic nervous system increases vascular tone and cardiac contractility, whereas activation of the parasympathetic nervous system has the opposite effect [10]. It

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is worth mentioning that the central autonomic circuits (hypothalamus, cortex, brain stem and spinal cord) and peripheral circuits (autonomic ganglia and receptors) control the sympathetic and parasympathetic nervous systems and blood pressure regulation [11]. In addition to this, baroreflex is also a key cardiovascular reflex mechanism that participates in blood pressure regulation during orthostatic challenge to maintain blood pressure stability [12]. It is worth noting that the high-risk population of DCS patients requiring cervical decompression surgery is middle-aged and elderly people [1], who are often accompanied by anatomical and physiological function degradation of the autonomic nervous system and decreased baroreflex sensitivity [13], so some patients may already have OH before cervical decompression surgery.

3. Diagnostic tests and methods

Head-up tilt test (HUTT) has long been regarded as the most valuable means in OH diagnosis [14]. However, in clinical practice, the tilting bed is not a common medical device like the electronic blood pressure monitor in spine surgery wards. In addition, Elsamadicy et al. found that elderly DCS patients were mostly in a weak state [15]. Therefore, HUTT may not be suitable for DCS patients. Recent studies have reported that active sit-to-stand test may be an effective alternative method for the diagnosis of OH [16]. This diagnostic method is not only labor-saving, but also easy to accept, especially providing great convenience for elderly DCS patients with limited mobility [16]. In addition, Ong[17] et al. found that only assessing blood pressure at the first postoperative physical therapy may delay the diagnosis of OH, thus underestimating the incidence of OH. Yang et al. [18] suggested that the measurement time be set at the time point of the patient's first ambulation after surgery. Therefore, it is very important for clinicians and nurses to comprehensively consider the clinical characteristics of DCS patients and select appropriate and effective diagnostic tests and methods. For example, in frail patients with DCS, a sit-to-stand test may be more appropriate. However, for younger patients with better physical function, the measurement method from supine to sitting to upright position is more appropriate. Either way, measurements should be taken at the first postoperative ambulation of the patient to more accurately assess the OH status.

4. Differential diagnosis of symptoms

The clinical manifestations of OH are diverse, including orthostatic dizziness, blurred vision and limb weakness [6], among which orthostatic dizziness is the most common symptom [6]. According to a study involving 90 Parkinson's patients, up to 88% of OH patients experienced orthostatic dizziness during the head-up tilt test [19]. It is worth noting that dizziness is also one of the atypical symptoms of cervical spondylosis of vertebral artery type [20]. Therefore, it is essential to accurately identify the triggers of dizziness in patients with DCS. In general, dizziness caused by OH is closely related to changes in body position, with symptoms aggravated in standing positions and alleviated in sitting or lying down [21]. However, dizziness in vertebral artery type cervical spondylosis is caused by head movement. When the head rotation aggravates the compression of the vertebrobasilar artery, vertigo or blurred vision can be induced [22].

According to the literature, not all patients with OH show orthostatic symptoms [21]. However, the dyssynchrony between blood pressure drop and orthostatic symptoms increases the potential adverse risk [21, 23]. Single or multiple measurements of blood pressure in different positions cannot always accurately diagnose OH, nor accurately predict the occurrence or severity of OH-related symptoms [24]. Therefore, comprehensive symptom assessment is essential for the diagnosis of OH [25]. To assess the combined symptom burden and severity of OH, Kaufmann et al. [26] developed the Orthostatic Hypotension Questionnaire (OHQ) as a self-report tool. In addition, Suarez et al. [27] developed the Autonomic Symptom Profile questionnaire (ASP) to assess orthostatic symptoms. It is important to note that these tools can only provide information about orthostatic symptoms and cannot truly determine whether it is orthostatic or nonorthostatic. To this end, Baker et al. [28] developed the Orthostatic Discrimination and Severity Scale (ODSS), which was designed to help identify and distinguish non-specific symptoms.

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5. Risk Factors

5.1 History of underlying diseases

Previous studies have found that OH is associated with underlying medical history such as hypertension, diabetes, and heart disease [6]. It has been reported that hypertension not only causes vascular damage and stiffening [29] and reduces vascular elasticity and dilation capacity [30], but also increases the burden on the heart [31] and affects the function of the heart to regulate blood pressure fluctuations [32]. In addition, there is no consensus on whether discontinuation of antihypertensive drugs can prevent OH in hypertensive patients. Previous studies have suggested that long-term use of antihypertensive drugs can lead to a rapid drop in blood pressure during postural changes and increase the risk of OH [33]. However, Grobman et al. [34] held the opposite opinion and believed that OH was not a complication induced by antihypertensive drugs. In addition, the overall mortality of OH patients with diabetes increased by 69%[35]. Nonetheless, it remains unclear which factors may further exacerbate the development of postoperative hypotension in DCS patients. Future studies are needed to validate the potential factors highly associated with OH through clinical trials.

5.2 High signal intensity in the spinal cord

Cervical spondylotic myelopathy is a serious consequence of cervical spinal cord compression [36], and is often accompanied by the loss of cervical spinal cord integrity [37]. In the diagnosis of this complex disease, magnetic resonance imaging (MRI) of the spinal cord is an indispensable key tool, and the signal changes in the images accurately reflect the degree of spinal cord compression, providing a strong radiological basis for quantitative assessment of the disease [37, 38]. The intramedullary high signal area shown on MRI images is a visual display of various histological lesions in the spinal cord, including but not limited to edema formation, ischemia, demyelination, abnormal proliferation of glial cells, and pathological changes such as microcavities and cavities [39]. Specifically, after spinal cord injury, excitatory signals from efferent sympathetic nerves are unable to travel through the damaged area, resulting in severe impairment of their function in inducing vasoconstriction and maintaining blood pressure stability [40]. The failure of this physiological mechanism makes the patient especially obvious when facing orthostatic challenges, such as decreased venous return and decreased cardiac output, which in turn causes OH[12].

5.3 Surgery

Studies have shown that the presence of OH before surgery increases the risk of postoperative OH [9]. This may be related to acute cardiovascular changes caused by surgical stress [9]. However, OH is present in about a quarter of patients before surgery, especially those undergoing orthopedic surgery [9]. A large number of studies have suggested that patients with spinal diseases will experience acute physiological and psychological changes during surgery and anesthesia, which will further promote the occurrence of postoperative OH [18, 41, 42]. In addition, some studies have found that there are more complications after posterior cervical spine surgery compared with anterior cervical spine surgery [43, 44]. However, despite this observation, there is currently insufficient evidence to prove that posterior cervical surgery is more likely to trigger OH. Limited by sample size, some studies suggest that there is no clear correlation between surgical approach and OH [17].

5.4 Long time in bed after surgery

For hospitalized patients, diseases and factors that cause or aggravate OH are quite common, among which bed rest is almost a universal factor [45]. Prolonged bed rest reduces plasma volume and systemic blood volume, impairs baroreflex regulation, reduces cardiac output and stroke volume, and inhibits sympathetic responses [46]. Therefore, we suggest further in-depth analysis of the specific relationship between surgery and OH based on a larger sample of DCS in future studies.

6. Management and Prevention

Currently, non-drug therapy is recommended as the first-line treatment for OH [5]. For patients after DCS, the focus is to establish a management system to prevent OH and to prevent OH in the first postoperative ambulation [47]. For example, by asking basic information of patients, past medical

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history and physical examination, we can determine whether there are risk factors for inducing OH [5]. In addition, blood pressure measurements in different positions are routinely performed in elderly patients with DCS [17] to identify high-risk groups of OH before surgery. Secondly, simple activities should be performed after surgery, such as crossing legs, crossing legs or wearing elastic stocks to reduce the retention of peripheral blood pool in lower limbs and improve the speed of blood return, so as to prevent or alleviate symptoms [5]. It is worth noting that patients who get out of bed for the first time after surgery are recommended to stand up slowly to slow down the drop in blood pressure [48]. Or drinking 500mL water quickly in a short time can induce the stimulation of the sympathetic nervous system and increase the blood pressure within 5 to 10 minutes [5].

7. Summary

Because the pathogenesis of OH is complex, the symptoms are hidden, and OH is highly harmful, so the clinical problems related to OH need to be further studied. The sensory and autonomic dysfunction in DCS patients may mask the typical symptoms and clinical manifestations of OH events, which increases the difficulty of clinical diagnosis. From the perspective of DCS, this article summarizes and analyzes the related research on postoperative OH, and points out the current constraints, challenges and future prospects of management. We hope that this article will provide domestic and foreign colleagues with the latest research progress in this field, in order to promote the improvement of the diagnosis and treatment of OH.

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