

DIGEST AND REVIEWS

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DOI: <http://dx.doi.org/10.15674/0030-59872021479-84>**Anesthesia peculiarities in beach chair position
(literature review)****M. V. Lyzohub¹, K. I. Lyzohub², I. V. Kotulskiy¹,
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Beach chair position (BCP) that is applied for shoulder surgery has a number of advantages for surgeons, but it may lead to intraoperative hypotension, bradycardia and postoperative neurologic complications. Objective of the publication is to review up-to-date literature to emphasize complications related to BCP and methods of their monitoring and prophylaxis. Methods. We have analyzed publications from Google Scholar, PubMed, and specialized scientific journals databases. Results. In orthopedic practice the main types of surgical positions that are used for shoulder surgery are the next: semi-BCP — 30°, BCP — 60°, Semi-upright sitting position — 90°. In spite of its correlations with hemodynamic changes the tilt angle is rarely measured in clinical practice. The etiology of nervous system impairment is thought to be hypotension and subsequent brain hypoperfusion that is induced by BCP under general anesthesia. Blood pressure at the standard brachial level is significantly higher than at the meatus acoustic level. That is why today the safety level of blood pressure for BCP surgery is not clearly estimated. The majority of clinical investigations have shown that BCP leads to decreasing of regional cerebral blood flow and brain oxygenation. The high incidence of cerebral desaturation events in BCP (more than 50 %) require its accurate monitoring. The most widely used method is NIRS (near-infrared spectroscopy). Other methods including Doppler scanning of brain vessels and jugular saturation has limited clinical using. In majority of trials of cerebral desaturation events has shown to have controversial impact on postoperative cognitive dysfunction. Serum neurospecific proteins examination may be a perspective method of further investigations for neurologic impairment after surgeries in BCP. Key words. Beach chair position, intraoperative hypotension, cerebral perfusion.

Положення шезлонга або Beach chair position (BCP), яке використовують під час операцій на плечовому суглобі, має низку переваг для хірурга, проте може призводити до інтраопераційної гіпотензії, брадикардії, та, як наслідок, до післяопераційних ускладненнями неврологічного характеру. Мета. Провести аналіз сучасної літератури для виявлення частоти ускладнень, які виникають у разі BCP, методик їхнього моніторингу та запобігання. Методи. Проаналізовано публікації з пошукової системи Google, електронних баз PubMed, Google Scholar, архівів спеціалізованих журналів й інших джерел науково-медичної інформації. Результати. Сьогодні в ортопедичній практиці застосовують такі види напівсидячого положення залежно від кута підйому верхньої половини тулуба: Semi-beach-chair position — 30°, BCP — 60°, Semi-upright sitting position — 90°. Точне вимірювання кута підйому в клінічній практиці використовують украї рідко, хоча він прямо корелює зі змінами гемодинаміки. Передбачуваною етіологією ушкодження центральної нервової системи є гіпотензія з подальшою гіперперфузією головного мозку, що виникає після зміни положення тіла пацієнта в умовах загальної анестезії. Стандартне вимірювання артеріального тиску на рівні плеча дає спотворені показники щодо реального тиску на рівні Вілізієва кола. Чіткі рекомендації щодо безпечного рівня артеріального тиску за операцій у BCP відсутні. Більшість клінічних досліджень показали, що положення шезлонга призводить до зниження регіональної оксигенації мозку та церебрального кровотоку. Висока частота епізодів мозкової десатурації (понад 50 %) обумовлює необхідність її моніторингу у BCP. Сьогодні найчастіше його проводять за методикою NIRS (Near-Infrared Spectroscopy). Менше клінічне значення мають доплерографічне дослідження мозкових судин і сатурації крові в яремній вені. Проте виявлення фактів десатурації здебільшого не впливає на частоту виникнення післяопераційної когнітивної дисфункції. Перспективним напрямом подальших досліджень є аналіз вмісту нейроспецифічних білків після операцій у BCP. Ключові слова. Beach chair position, інтраопераційна артеріальна гіпотензія, мозкова перфузія.

Key words. Beach chair position, intraoperative hypotension, cerebral perfusion

Introduction

In the 1980s, orthopedic procedures for shoulder joint arthroscopy were first used in the beach chair position (BCP). This surgical position has a number of advantages, creating comfortable conditions for surgery. However, BCP is accompanied by a number of specific changes in the functional state of patients, which can lead to complications that should be well known to the anesthesiologist to prevent their negative consequences.

The aim of the study: to analyze the current literature in order to identify the frequency of complications occurring in beach chair position, methods of their detection and prevention.

Material and methods

The study involved assessment of publications from Google search engine, electronic databases PubMed, Google Scholar, archives of specialized journals and other sources of scientific and medical information.

Results and discussion

Today in orthopedic practice the following types of semi-sitting position are used depending on the angle of rise of the upper half of the torso: semi-beach-chair position of 30° [1], beach-chair position of 60°, semi-upright sitting position of 90° [2], however, accurate measurement of the angle of rise is used very rarely. The advantages of BCP in orthopedic surgery are improved access to the anterior and posterior regions of the shoulders, reduced frequency of traction-induced brachial neuropathy, trauma, surgery time and, most importantly, more physiological conditions during shoulder movement. In addition, BCP provides less swelling of the face compared to lying down [3]. General or regional anesthesia, or a combination thereof, may be used during shoulder surgery [4]. In the majority of conscious patients, the transition from supine to vertical position is accompanied by an increase in systemic vascular resistance. This can have different effects on cardiac output. R. Gillespie et al. [5] found a decrease in stroke volume, systolic and mean blood pressure, which reduced cerebral blood flow by 12 %. In patients under general anesthesia, physiological hemodynamic responses change significantly under the influence of anesthetics on the cardiovascular system. This leads to a decrease in mean blood pressure and, subsequently, cardiac output. Therefore, it is desirable to gradually transfer the patient to a sitting position, and blood pressure should be maintained by infusion therapy and/or use of vasopressors [6]. However, S. Larsen et al. [7] did not find significant changes in hemodynamic param-

eters during the transfer of the patient under anesthesia from a horizontal position in BCP.

BCP, «chaise longue position» is a different variation of one position with similar physiological changes and specific complications. Neurological complications such as stroke, brain death, and vision loss can be extremely rare, but catastrophic. The true frequency of these situations remains unknown, as the available publications are mostly clinical cases. Potentially dangerous are hypotension, bradycardia (probably due to the Bezold-Jarisch reflex), postoperative edema in the shoulder joint and neck [9]. Some complications are due to improper patient placement in BCP. Excessive bending of the head can cause arterial and venous obstruction, leading to swelling of the upper respiratory tract and potential airway obstruction after extubation. There have been reports of spinal cord injuries due to excessive bending of the head. Therefore, current guidelines insist on a neutral fixed position of the head and neck during BCP operations [10].

Intraoperative hypotension (IH) may be one of the risk factors for postoperative complications that are important to address correctly and in a timely manner. About one third of the periodic episodes of IH occur in the period after the induction of general anesthesia, but before the surgical incision and can be described as post-induction or preoperative hypotension [11]. Postinductive hypotension should be differentiated from the phases of IH, as the causes of their occurrence differ at different stages. Propofol, which is used during induction, contributes to a significant reduction in blood pressure [12]. General anesthesia reduces the brain's need for oxygen and patients tolerate episodes of hypotension better. The etiology of intraoperative hypotension is multifactorial: vasodilation (anesthetic), hypovolemia (bleeding), low cardiac output, high intrathoracic pressure (mechanical ventilation), dysfunction of the sympathetic nervous system [13]. The incidence of IH and bradycardia during BCP operations may exceed 60 % [14]. One of the effective methods of preventing IH during BCP operations may be the use of preoperative loading of crystalloid solutions in the amount of 10 ml/kg of ideal body weight [15].

Controlled hypotension is a condition of induced/controlled hypotension during anesthesia to reduce bleeding and improve surgical field imaging. It is very important to perform it taking into account the patient's age, preoperative blood pressure and initial somatic condition, so the degree of antihypertensive anesthesia should be individualized depending on the patient's preoperative blood pressure and not the specific target blood pressure. Moreover, it

is against the background of controlled antihypertensive anesthesia that critical reductions in blood pressure are more common [16]. Perioperative blood pressure management is a key factor in patient monitoring, as intraoperative hemodynamic instability can lead to postoperative cardiovascular, neurological, renal, and other complications. To date, most studies on the use of controlled hypotension in orthopedics have a low level of evidence, so the question of safety remains open [17]. When managing blood pressure in a sitting position, the anesthesiologist should be aware of the possibility of insufficient brain perfusion if the lower limit of autoregulation is not reached during the operation. Adequate tissue perfusion is essential during anesthesia. At present, in the case of controlled hypotension in BCP, its safe limits are not clearly defined. A reduction in mean blood pressure (BP) of more than 20 % is often chosen to determine perioperative hypotension [6]. However, it is not blood pressure but the degree of organ perfusion that is the ultimate goal of using blood pressure optimization strategies. Perfusion pressure is usually the difference between «inflow pressure» (which is the CAT for most organs, including the brain and kidneys) and «outflow pressure». It is known that CAT thresholds for patients operated on in BCP should be higher to ensure adequate cerebral perfusion pressure. It is also extremely important to be aware of the effect of gravity on the measured blood pressure. K. Tanabe et al. [18] compared the CAT measured at the level of the IV rib and the external auditory canal (approximate level of the Willis circle), and showed that the difference is about 14 mmHg. Reduction of CAT by 40 % or an episode of CAT less than 50 mmHg during surgery was associated with cardiac complications in high-risk patients. Even short episodes of intraoperative CAT of less than 55 mmHg are associated with acute renal and myocardial damage [19]. Y. Y. Jo et al. [20] provided research showing that not only preload but also preoperative heart rate may be important factors in the development of hypotension after transferring patients to an upright position under general anesthesia. In a retrospective study involving 384 patients, more episodes of hypotension were observed in a cohort of patients taking antihypertensive drugs [21]. Common therapeutic approaches to correct hypotension are the use of vasoactive agents, especially vasopressors and infusion media.

The most threatening consequence of hemodynamic instability during BCP operations is hypoperfusion of the brain with possible neurological disorders. Prolonging surgery potentially increases the risk of cerebral hypoperfusion. According to J. Chan [1],

19 of the 25 subjects underwent cerebral desaturation event (CDE) during HRV operations. Other authors found that patients in the regional anesthesia group had significantly less CDEs and had significantly better neurobehavioral test results the day after surgery. Higher hemodynamic stability in BCP has also been demonstrated compared to patients who underwent surgery under general anesthesia [22]. Lateral positions are also used during shoulder surgery, but cerebral ischemic events are observed only in the context of BCP surgery [23]. Vertical position is considered an independent factor in intraoperative cerebral ischemia, there are reports of a series of cases of cerebral and spinal ischemia, the cause of which was incorrect optimization of blood pressure in the perioperative period [24]. There is also information on the development of hemiparesis in patients with congenital asymmetry of the Willis circle, which leads to limited collateral blood flow (incomplete Willis circle may be present in 40 % of patients) [25].

The following techniques are currently available to monitor blood supply to the brain: NIRS (near-infrared spectroscopy), jugular vein blood saturation, transcranial Doppler. NIRS is widely and successfully used as a real-time measurement method to assess cerebral oxygenation (rScO₂), brain perfusion and the possibility of early detection of cerebral desaturation. However, the correlation between CDE, cerebral blood flow, and effects on cognitive function remains unknown [26–28]. I. Meex et al. [29] CDE was not detected in non-anesthetized volunteers in BCP, whereas in 55 % of patients in a similar situation under general anesthesia, such episodes were recorded. Interestingly, CDEs are more common in women with BCP [30]. T. Ghandour et al. [2] found no differences in regional brain oxygen saturation between patients in the 60° and 90° chair tilt positions, but a direct relationship was found between decreased CAT and cerebral oxygen saturation. C. Songy et al. [31] found a statistically significant decrease in saturation in the case of raising the head end from 0° to 30°, from 30° to 45° and from 45° to 60°. Similar results were obtained by J. Chan et al. [1], who studied changes in cerebral oximetry at 30°. Episodes of desaturation were found in 76 % of patients, and the time course of saturation was as follows: a sharp decrease after positioning, followed by a gradual decrease until the end of the operation. E.A. Shin et al. [32] in observations of 60 patients during shoulder arthroscopy determined that the choice of anesthetic did not affect brain oxygenation or hemodynamics. Recent studies of new neurospecific proteins after BCP surgery have shown an increase in serum tau protein, the concentration of which correlates with the duration of cerebral desaturation event [33].

Conclusions

The most common complications that may occur in BCP are hypotension, bradycardia, and related brain desaturation episodes. The latter very rarely cause catastrophic neurological consequences. Today, there are no clear criteria for a safe blood pressure level in BCP, but it is known that due to gravity, the rate of SAT at the shoulder level averages 14 mmHg lower than in the area of the Willis circle.

The high frequency of cerebral desaturation episodes (over 50%) necessitates its monitoring in BCP, which is most often performed using the NIRS technique. However, cerebral perfusion methods are weakly correlated with postoperative cognitive function and further in-depth studies of systemic and cerebral circulation, cognitive function, and neuro-specific protein concentrations in these patients are needed to select a safe level of intraoperative blood pressure maintenance.

Conflict of interest. The authors declare no conflict of interest.

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ANESTHESIA PECULIARITIES IN BEACH CHAIR POSITION (LITERATURE REVIEW)

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