



SURGERY FOR POSTERIOR FOSSA TUMORS IN CHILDREN IN THE PRONE POSITION: AN ANALYSIS OF SURGICAL TECHNIQUE

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Abstract. Today, 95% of all posterior fossa surgeries in Japan are performed in the prone position, while in the United States and Europe these figures are 80% and 60%, respectively. This global trend to switch to the prone position is mainly due to the high risk of venous air embolism in the sitting position. From 1999 to 2013, the first author of this article used only the sitting position to remove posterior fossa tumors. During this period, he performed 606 surgeries. In patients with large/giant tumors (most often pilocytic astrocytomas with cysts), the surgeon often encountered the problem of a sharp recession of the cerebellum and rupture of the bridging veins, sometimes outside the surgical access zone. This situation led to either massive blood loss or venous air embolism.

Material and methods. Therefore, starting in 2013, we began to selectively use the prone position for hemispheric cerebellar pilocytic astrocytomas. This initial experience allowed us to evaluate the surgical features of the operation and apply it to more complex interventions. Since mid-2016, against the background of the trend towards using keyhole approaches, we have increasingly used the prone position in surgery for PCF tumors, sometimes removing them even from the burr hole. Since the end of 2016, we have begun routinely using the prone position for various tumors of the fourth ventricle. From November 2016 to September 2017, the first author performed 113 surgeries for PCF tumors in children, of which only 4 operations were in the sitting position. Thus, in less than a year, the prone position has become the main one in surgery of all tumors of the posterior cranial fossa in our practice. In this article, we would like to share our practical considerations both on the use of the prone position and on its advantages and disadvantages that should be taken into account by a doctor who has no experience of surgery of the posterior cranial fossa in the prone position.

Key words: tumors of the posterior cranial fossa, operations in the prone position.

Аннотация

Сегодня 95% всех операций на ЗЧЯ в Японии проводятся в положении «лежа», для США и Европы эти цифры составляют 80 и 60% соответственно. Эта мировая тенденция перехода на положение «лежа» связана, главным образом, с высоким риском венозной воздушной эмболии в положении «сидя». С 1999 по 2013 г. первый автор этой статьи использовал только положение «сидя» для удаления опухолей ЗЧЯ. За этот период им выполнено 606 операций. У пациентов с большими/гигантскими опухолями (чаще это были пилоидные астроцитомы с кистами) хирург часто сталкивался с проблемой резкого западения мозжечка и обрыва «мостиковых» вен, иногда вне зоны хирургического доступа. Такая ситуация вела либо к массивной кровопотере, либо к венозной воздушной эмболии.

Материал и методы. Поэтому, начиная с 2013 г., мы стали селективно использовать положения «лежа на животе» при полушарных пилоидных астроцитомах мозжечка. Этот первичный опыт позволил нам оценить хирургические особенности операции и применить его при проведении более сложных вмешательств. С середины 2016 г. на фоне тенденции к использованию keyhole-доступов мы шире стали использовать положение «лежа на животе» в хирургии опухолей ЗЧЯ, иногда удаляя их даже из фрезевого отверстия. С конца 2016 г. мы начали рутинное использование положения «лежа на животе» при различных опухолях IV желудочка. С ноября 2016 г. по сентябрь 2017 г. первым автором выполнено 113 операций по поводу опухолей ЗЧЯ у детей, из них лишь 4 операции в положении «сидя». Таким образом, менее чем за год положение «лежа на животе» стало основным в хирургии всех опухолей ЗЧЯ в нашей практике. В данной статье мы хотим поделиться своими практическими соображениями как об использовании положения «лежа», так и о тех его преимуществах и недостатках, которые следует учитывать врачу, не имеющему опыта хирургии ЗЧЯ в положении пациента «лежа на животе».

Ключевые слова: опухоли задней черепной ямки, операции в положении «лежа на животе».

Annotatsiya

Bugungi kunda Yaponiyada ZChYa (orqa bosh miya chuqurligi) dagi barcha operatsiyalarning 95% «yotgan» holatda amalga oshiriladi, AQSh va Yevropa uchun bu ko'rsatkich mos ravishda 80% va 60% ni tashkil qiladi. Bunday global tendensiya bemorning «o'tirgan» holatida venoz havo emboliasini xavfining yuqoriligi bilan bog'liq. 1999 yildan 2013 yilgacha ushbu maqola muallifining birinchisi faqat «o'tirgan» holatda ZChYa o'simtalarini olib tashlash amaliyotini qo'llagan. Ushbu davr mobaynida u tomonidan 606 ta operatsiya bajarilgan. Katta/gigant o'simtali (ko'pincha kistali piloid astrositomalar) bemorlarda, jarroh ko'pincha miyada keskin cho'kish va "ko'prik" venalarining uzilishi bilan to'qnash kelgan, ba'zan bu holatlar operatsiya maydonidan tashqarida sodir bo'lgan. Bunday vaziyat ko'p qon yo'qotilishiga yoki venoz havo emboliasiga olib kelgan. Material va metodlar. Shu sababli 2013 yildan boshlab biz selektiv tarzda bosh miya yarim shar piloid astrositomalarida "qorin bilan yotgan" holatni qo'llashni boshladik. Ushbu dastlabki tajriba bizga operatsiya jarayonidagi xususiyatlarni baholash va murakkabroq aralashuvlarda ham qo'llash imkonini berdi. 2016 yilning o'rtalaridan boshlab, keyhole-kiruvchi operatsiyalar tendensiyasi fonida, biz ZChYa o'simtalarini olib tashlashda "qorin bilan yotgan" holatdan kengroq foydalanishni boshladik, ba'zida hatto faqat frezali teshik orqali o'simtani olib tashladik. 2016 yil oxiridan boshlab biz IV qorinchadagi turli o'simtalar operatsiyalarida "qorin bilan yotgan" holatdan muntazam foydalanishni boshladik. 2016 yil noyabrdan 2017 yil sentabrigacha birinchi muallif tomonidan bolalarda ZChYa o'simtalarini bo'yicha 113 ta operatsiya bajarilgan, ulardan atigi 4 tasi "o'tirgan" holatda bo'lgan. Shunday qilib, bir yildan kamroq vaqt ichida "qorin bilan yotgan" holat bizning amaliyotimizda ZChYa dagi barcha o'simtalar jarrohliligining asosiy usuliga aylandi. Ushbu maqolada biz "qorin bilan yotgan" holatning qo'llanilishi bo'yicha o'z amaliy mulohazalarimiz, shuningdek, bu holatning afzallik va kamchiliklari bilan o'rtoqlashmoqchimiz, ayniqsa ZChYa o'simtalarini "qorin bilan yotgan" holatda operatsiya qilish tajribasiga ega bo'lmagan shifokorlar uchun.

Kalit so'zlar: orqa bosh miya chuqurligi o'simtalarini, "qorin bilan yotgan" holatda operatsiyalar.

Posterior cranial fossa tumors are a more common neurooncological pathology in childhood [1, 2]. The vast majority of them are medulloblastomas, pilocytic astrocytomas, and ependymomas [1]. More than half of the tumors are localized in the midline, anatomically occupying the cerebellar vermis and the cavity of the fourth ventricle [1, 3]. They often cause occlusive hydrocephalus. Historically, the vast majority of such tumors were operated on in the sitting position. This trend

has changed significantly over the past 30 years. Thus, today 95% of all operations on the posterior cranial fossa in Japan are performed in the lying position, while for the USA and Europe these figures are 80 and 60%, respectively [4-6]. Each of these positions has its own advantages and disadvantages. It is important to note that the global trend of switching to the lying position is mainly associated with the high risk of VVE developing when performing surgery in the sitting position [6]. Our decision to selectively use the prone position was not dictated by this reason alone. From 1999 to 2013, the first author used only the sitting position to remove tumors of the PCF. During this period, 606 operations were performed. In patients with large/giant tumors (most often, these were pilocytic astrocytomas with cysts), the surgeon often encountered the problem of a sharp recession of the cerebellum and rupture of the "bridging" veins, sometimes outside the zone of surgical access. This situation led to either massive blood loss or VVE, caused significant stress for both the patient and the team, increased the duration of the operation, and in some cases led to persistent neurological deficit. Therefore, starting in 2013, we began to selectively use the prone position for hemispheric pilocytic astrocytomas of the cerebellum. This initial experience allowed us to evaluate the surgical features of the unusual position, the features of the arrangement of equipment and participants in the operation, to understand possible limitations and difficulties, and to gain confidence in the possibility of performing more complex operations. Since mid-2016, against the background of the trend to use keyhole approaches, we have increasingly begun to use the "lying on the stomach" position in surgery for small tumors of the PCF; sometimes, medium-sized tumors were removed even from a burr hole (Fig. 1). Since the end of 2016, we have begun "routinely" using the "lying on the stomach" position for tumors of the fourth ventricle. From November 2016 to September 2017, the first author of this article performed 113 operations for tumors of the PCF in children, of which only 4 operations were in the "sitting" position. Thus, in less than a year, the prone position has become the main one in surgery for all tumors of the PCF in the practice of the first author of this article, in which we would like to share our practical considerations on the use of the prone position, as well as the advantages and disadvantages associated with it.

General idea of removal of a tumor of the fourth ventricle in the prone position

Features of patient preparation

From a surgical point of view, the patient does not require any special preparation. Of the anesthetic features, it is important that when installing venous catheters for infusion of various fluids, it is necessary to take into account that the upper part of the patient's body will be completely inaccessible to the anesthesiologist after draping the surgical field and positioning the surgical team around the patient. Orotracheal intubation is performed with a reinforced tube due to the likelihood of kinking of a conventional tube, especially a small diameter one. The installation of a gastric tube is desirable in all cases due to the high risk of regurgitation (we use orogastric probing. At the end of the operation, the tube is removed in the operating room). A protective eye gel is placed under the eyelids and the entire area of the face is carefully sealed with a sterile transparent film (Fig. 2). At the very beginning of using the "lying on the stomach" position in the surgery of the posterior cranial fossa, we had 2 cases of chemical keratitis due to the leakage of the agent for treating the surgical field into the eyes sealed according to the "standard technique". The explanation turned out to be very simple: in the "lying on the stomach" position, the area of the lateral angle of the eye is one of the lowest points of the face, where the disinfectant flows when treating the surgical field. The use of a urinary catheter is desirable even when planning very short operations, since it will be problematic to insert it during the operation if necessary.

Features of surgery planning

The surgeon works from one or both sides of the patient, positioned at the line of his shoulders. The main direction of the microscope optical axis: "at an acute angle" to the projection of the IV ventricle floor (Fig. 3). Our initial concern concerned the accessibility of the most rostral parts of the tumor - in the area of the cerebral aqueduct and the superior velum. Both surgical experience and the analysis of MRI data with geometric constructions of "angles of attack" completely dispelled this prejudice (Fig. 4). The ipsilateral posterolateral pole of the tumor causes the greatest difficulties. In about 1 / 3 of cases, it is necessary to change the position of the surgeon and microscope and be ready to work from both sides of the patient. For maximum comfort of manipulation, the patient's head should be bent so that the plane of the IV ventricle floor is as close to vertical as possible. In this case, there are no problems with the rostrocaudal accessibility of the tumor poles (Fig. 5). The skin incision is approximately 1/3, sometimes even 2 times shorter than a similar incision in the sitting position. On average, a 5 cm incision is sufficient. Unlike the sitting position, the lower extension of the incision does not increase the accessibility of the rostral parts of the IV ventricle. Now we plan the lower edge of the incision at the level of the upper edge of the C1 vertebra or even the edge of the foramen magnum with a wide C0-C1 interval (in some cases, we removed the tumor of the IV ventricle through an anatomically wide C0-C1 interval, which is impossible to do in the sitting position). The surgeon should be more concerned about the lateral accessibility of the tumor - it is this that dictates the size of the craniotomy. Regardless of the severity of hydrocephalus, we do not use external ventricular drainage (EVD) intraoperatively (in the sitting position, in all patients with hydrocephalus, EVD is implanted immediately after they are put under anesthesia). Features of the personnel and equipment arrangement

We adapted the existing equipment arrangement, taking into account that such devices as the anesthesia machine, consoles with devices, and a microscope are virtually stationary and can only be moved within small limits (Fig. 6). This approach to solving the problem of "adaptation" of all participants in the operation has proven highly effective. In fact, all of them, except for the surgeon, continued to work in familiar conditions. In addition, the proposed arrangement allows, if necessary, to easily and quickly change the side of the surgeon's work.

Features of manipulations

Work on soft tissues and performing craniotomy are little different from those in the "sitting" position. In case of long-standing severe hydrocephalus, one should be prepared for severe venous bleeding from the emissaries (controlled with wax). In most cases, opening the dura mater does not require performing a "classic" Y-shaped incision - a V-shaped incision to the level of the atlanto-occipital membrane is sufficient. In case of pronounced occipital and/or marginal sinuses, the dura mater incision should be made as quickly and completely as possible, after which bleeding should be controlled by applying a clamp and suturing the sinus with a twisting suture. The most ineffective are attempts at hemostasis (clipping, coagulation, etc.) with partial opening of the dura mater. After the dura mater is opened, it is sutured to the soft tissues inside the surgical wound, and not retracted on "holders" outside. This method allows for more effective separation of the dura mater edges, providing wide "attack angles", which is especially important with a reduced skin incision. Due to slightly increased tissue bleeding, flowing of all fluids into the surgical area, the edges of the bone cut are lined with cotton pads. Then the arachnoid membrane of the large cistern is opened, the spinal subarachnoid space is tamponed with a cotton pad and then the tumor removal stage begins through the Magendie foramen. With an unexpanded Magendie foramen, it is possible to use telovelochoroidal access or dissection of the inferior sail of the fourth ventricle. Due to the patient's position, spatulas are not used (moreover, they are likely to interfere, taking up space in the wound).

The "dynamic retraction" method is used, when one of the instruments in the surgeon's hands alternately acts as a retractor.

The first stage — internal decompression — is performed in the direction "from top to bottom", its goal is to reach the area of usually widened rostral sections of the IV ventricle (area of the aqueduct orifice). We immediately tamponade the aqueduct orifice with a cotton swab to prevent blood from flowing into the ventricular system. With correct patient positioning and vertical position of the IV ventricle bottom, the risk of damaging the trunk is minimal, although there is no such good anatomical orientation as in the "sitting" position at the beginning of the removal. After reaching the rostral sections of the IV ventricle, the orientation in the wound and the tumor/trunk relationship become clear, and further tumor removal differs little from removal in the "sitting" position. The biggest disadvantage is the actual impossibility of effective work without suction. At the beginning of the operation, the wound is constantly filled with cerebrospinal fluid with blood and requires active aspiration. As the tumor is removed, bleeding and the amount of cerebrospinal fluid decrease and it becomes more comfortable to work. As the tumor is removed, the wound tends to straighten its walls (we work without retractors). In order to hold the wound walls in a position convenient for manipulation, it is necessary to use wadded pads, which are placed on the site of the removed tumor and allow atraumatically shifting the edges of the brain wound during the operation. The hemostasis stage has no special features.

Features of the early postoperative period

Our experience shows that with a satisfactory preoperative condition of the patient, no data on brainstem infiltration during the operation and significant deviations during anesthesia, patients operated on in the "lying" position can be transferred to the general department after awakening. Their level of activity and wakefulness in the first few days, according to our subjective estimates, is higher than that of similar patients operated on in the "sitting" position. We see a lower degree of pneumocephalus and especially a smaller amount of air in the ventricular system as the main explanation for this phenomenon (Fig. 7). Perhaps, some contribution to early activation is also made by the absence of NVD and a smaller volume of soft tissue dissection (less pronounced pain syndrome). Some patients could be discharged on the 2nd-3rd day after the operation in good condition. We did not observe such an early discharge in any patient operated in the sitting position.

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