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HEMISPHERECTOMY: WHY WE STILL USE IN EPILEPSY TREATMENT? TECHNICAL PITFALLS, RESULTS AND COMPLICATIONS

P.H. Pires de Aguiar[1–5], B. Camporeze[6], A. de Moura Lima[5], I.A. Estevão[6], G. Matricardi[4], S. Simis[4], L. Rodrigues[7], R. Simm[7]

[1]Division of Neurosurgery, Santa Paula Hospital; São Paulo, SP, Brazil;
[2]Division of Neurosurgery, Oswaldo Cruz Hospital; São Paulo, SP, Brazil;
[3]Division of Post-Graduation, Department of Surgery, Federal University of Rio Grande do Sul; Porto Alegre, RS, Brazil;
[4]Department of Neurology, Pontifical Catholic University of São Paulo; Sorocaba, SP, Brazil;
[5]Department of Neurosurgery of Public Servant Hospital of São Paulo; SP, Brazil;
[6]Medical School of São Francisco University; Bragança Paulista, SP, Brazil;
[7]Division of Neurology of Santa Paula Hospital; São Paulo, SP, Brazil

***Contact:** Paulo Henrique Pires de Aguiar phpaneurocir@gmail.com*

***Objective** is to discuss the indications, technical details, risks, complications, results and prognosis of hemispherectomy in the treatment of seizures based on critical literature review and the authors experience.*

***Materials and methods.** It was performed bibliographical consultation from 1920 to 2016, using as keywords "seizures", "epilepsy", "hemispherectomy", in the databases MEDLINE, LILACS, SciELO, PubMed, utilizing language as selection criteria, choosing preferably recent articles in Portuguese, Spanish or English and only articles based in humans studies.*

***Results.** The functional hemispherectomy showed improvent in the quality of life of patients that has the indication to perform this procedure because it allows reducing the frequency of seizures, whether tonic or atonic, tonic-clonic. Furthermore, it has been associated to a low rates of postoperative complications, like superficial hemosiderosis, ependymitis and obstructive hydrocephalus that often it has been showed in anatomical hemispherectomy.*

***Conclusion.** The functional hemispherectomy has been showed a significant impovement in the outcome for those with seizures arising when indicated to selected cases. However, we concluded that there is no important study comparing the functional hemispherectomy approaches with results adjusted for different causative pathologies, what would be for future necessary for an important source of data about this topic.*

***Key words:** neurosurgery, epilepsy, seizures, cerebral hemisphere, hemispherectomy*

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Гемисферэктомия: почему мы все еще используем этот метод в лечении эпилепсии? Технические ошибки, результаты и осложнения

П.Э. Пирес ду Агиар, Б. Кампорезе, А. ду Моура Лима, И.А. Эстевао, Д. Матрикарди, С. Симис, Л. Родригес, Р. Симм

[1]Отделение нейрохирургии Госпиталя Санта Паула; Сан-Паулу, Бразилия;
[2]отделение нейрохирургии Госпиталя Освальдо Круз; Сан-Паулу, Бразилия;
[3]последипломное отделение факультета хирургии Федерального университета Риу-Гранди-ду-Сулл; Порту-Алегри, Риу-Гранди-ду-Сул, Бразилия;
[4]факультет неврологии Папского католического университета Сан-Паулу; Сорокаба, Сан-Паулу, Бразилия;
[5]отделение нейрохирургии Госпиталя для государственных служащих Сан-Паулу; Сан-Паулу, Бразилия;
[6]Медицинская школа Университета Святого Франциска; Браганса-Паулиста, Сан-Паулу, Бразилия;
[7]неврологическое отделение Госпиталя Санта Паула; Сан-Паулу, Бразилия

***Цель исследования** – анализ данных литературы о показаниях к применению, особенностях техники, рисках, осложнениях, результатах применения гемисферэктомии в лечении эпилепсии.*

***Материалы и методы.** Выполнен библиографический поиск источников за 1920–2016 гг. в базах данных MEDLINE, LILACS, SciELO, PubMed; в качестве ключевых слов использованы «эпилептические приступы», «эпилепсия», «гемисферэктомия»; язык публикации был критерием отбора: отдавалось предпочтение самым последним статьям на португальском, испанском или английском языке, а также отбирались только статьи, которые описывают исследования, проводимые на людях.*

Результаты. *Функциональная гемисферэктомия продемонстрировала улучшение качества жизни и снижение частоты приступов – тонических, атонических или тонико-клонических – у пациентов с фармакорезистентными формами эпилепсии. Кроме того, функциональная гемисферэктомия, по сравнению с анатомической, позволяет снизить уровень послеоперационных осложнений, таких как поверхностный гемосидероз, эпендимит и окклюзионная гидроцефалия.*
Выводы. *Применение функциональной гемисферэктомии в отдельных случаях позволяет улучшить состояние пациентов, страдающих фармакорезистентными формами эпилепсии. Однако мы пришли к выводу, что не существует какого-либо значимого исследования, в котором сравнивались бы результаты функциональной гемисферэктомии в зависимости от патологий, ставших показанием к ее выполнению, и которое в будущем может стать важным источником данных по этой теме.*

Ключевые слова: *нейрохирургия, эпилепсия, эпилептические приступы, полушария головного мозга, гемисферэктомия*

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BACKGROUND

The epileptic patients represents 1 % of the population and it has being considered the fourth leading cause of neurological condition, stressing that it is intractable to current antiepileptic drug treatment in 20–25 % [1]. Such that, it has been showed an increase in the number of papers about the neurosurgical approaches in patients affected by medically intractable seizures [1, 2].

Hemispherectomy is a palliative surgical approach that aims to control potentially harmful seizures, for instance, atonic or drop seizures, preventing the spread of epileptic electrical activity [1–5].

Although the hemispherectomy was presented to epilepsy surgery in 1938 by Mckenzie [6], the first consistent description about this procedure it happened in 1950 by R.A. Krynauw [7]. R.A. Krynauw [7] described the use of hemispherectomy to remove the brain hemisphere with hemiplegic infantile in 12 children, such that it showed better control rates of seizures and recovery rates of cognitive function considered significant by the standards of the time. However, although there are benefits to the patients in this procedure, the anatomical hemispherectomy showed high rates of late complications associated to important rates of morbidity and mortality that culminated in its disuse of this procedure [1–3, 8, 9].

Based in the initial results in the control of seizures and high rates of late complications in patients underwent to hemispherectomy, it has been showed in the literature the adaptation of techniques and indications of hemispherectomy that it has been culminating in the reduction of risks and complications rates related to this technique. So that, the anatomical hemispherectomy (first description of the technique hemispherectomy) based in removal of epileptogenic hemisphere evolved to many techniques of functional hemispherectomy, whose it is based in the disconnection between the epileptogenic hemisphere and contralateral hemisphere and deep brain structures without creating a cavit [1–3, 9–17].

Tradicionally, regarding the surgical techniques in the functional hemispherectomy, it was represented by the hemispherotomy [10], and the approaches described by J.G. Villemure and coauthors [16, 18, 19], O. Delalande [10] and J. Schramm [20, 21].

This article is devoted to discuss and clarify the main indications, techniques, risks and complications related to this procedure based in the literature at moment and authors experience.

CASUISTRY AND METHODS

It was performed bibliographical consultation from 1920 to 2016, using as keywords "seizures", "epilepsy", "hemispherectomy", in the databases MEDLINE, LILACS, SciELO, PubMed, utilizing language as selection criteria, choosing preferably recent articles in Portuguese, Spanish or English and only articles based in humans studies. Stressing that, the references were reviewed aiming the selection of relevant papers to be included in this critical review.

SELECTION OF PATIENTS

The adequate selection of the patients implies directly in the success of the hemispherectomy, once different factors have to be considered aiming avoid the misdiagnosis, like the intractability of the patient's epilepsy, the type and localization of seizures, the etiology of the seizures, the age at the surgery, the age of the patient, the radiological and neurological findings [11, 22–25].

Regarding the epileptogenic evaluation for surgery in this patients, it should involve interictal electroencephalogram (iEEG), interictal SPECT, magnetic resonance imaging (MRI) analysis, and age-appropriate neuropsychological/developmental assessment. Furthermore, the intracranial EEG may be imperative in localization of the correct focus of seizure, indicating a complementar surgery after a hemispherectomy [1–3, 18, 25–27]. Functional MRI and EEG may be useful and should be included actually in the protocols of seizure foci investigation [27].

Concluding, at the moment, the patients has being indicated to underwent to hemispherectomy procedure based in the presence of theses main criterias:

– patients with medical intractability of seizures [3–5, 11, 28];
– patient with the remaining hemisphere should be normal to have a good result following seizures. Spread of epileptiform discharges to the normal hemisphere on EEG or even rare independent discharges on the normal side however does not imply a poor response to surgery [3, 28, 29];
– patient with the hemisphere contralateral to the hemiplegic should be demonstrated by radiological and functional imaging to have a diffuse abnormality [3, 25, 28–31].

Regarding the controversial and relative criterias in the literature, it has been described the presence of indication to hemispherectomy in this cases:

– patients with contralateral hemiplegic is a relative criteria, once if hemispherectomy is done prior to maximal hemiplegia, the digital dexterity and foot tapping may be lost, but the patient will be able to walk and use proximal muscles of the upper limb. So that, although this loss of function may have to be accepted as the cost of control of debilitating seizures and cognitive decline, in other cases the hemispherectomy may be done when the distal power of upper and lower limbs become completely lost [3, 11, 28];
– neurodevelopment retardation is usually present due to the interference of frequent seizures on the developing normal hemisphere. So that, this would therefore be a relative prerequisite for hemispherectomy [3, 28, 29, 32, 33].

Regarding to the indications of hemispherectomy in childhood, it is necessary to evaluate a few considerations:

– it is important to consider the presence of a significant recovery after the procedure due to the high potential of neuronal plasticity in pediatric patients [26, 34, 35];
– it is necessary to be considered the noxious effects of frequent uncontrolled seizures and the high doses of antiepileptic medications on the developing brain [11, 34, 36];
– it is necessary to be considered the social implications of a debilitating disease and the lost time at schooling due to the disease [26];
– the pediatric age group, mainly below 9 years of age, except for post infarct sequel presented better results in cognitive and motor postoperative [26, 34–37];
– it is necessary to be considered the morbidity of a major surgery at a young age and the possibility of increased neurological deficits in some cases needs to be well appreciated and weighed against the substantial gains offered by surgery towards seizure relief and long-term functional outcome [11, 26, 34, 36].

Tradicionally, this procedure is indicated to severe unilateral hemispheric disturb like trauma cranioencephalics, Sturge–Weber syndrome, Rasmussen syndrome, vascular insults hemispherical and hemimegalencephaly [15, 22, 23, 25, 31]. However, it is still a discussion question if the presence of bilateral abnormalities in the preoperative epileptogenic evaluation is really associated to worse result postoperative in the hemispherectomy [22–25, 31, 38–42]. Such that, it should be also noted papers that suggest the hemispherectomy surgery may be offered at times as a purely palliative procedure for severe cases with bilateral seizure onset when one side predominates [29, 32, 33, 38, 43]. Furthermore, it is also offered in cases where there is bilateral disease with the hope that antiepileptiform medication can control the contralateral hemisphere seizures [29, 32, 33, 38, 43].

HEMISPHERECTOMY TECHNIQUES

Anatomical Hemispherectomy. The first step is open the Sylvian fissure with care to avoid any catastrophic injures to the contralateral vessels [44, 45]. After opening the access through the Sylvian fissure, it is necessary to identify, dissect, clip and divide from lateral to the lenticulostriate branches of the basal ganglia of ipsilateral middle cerebral artery [7, 44–46]. Similarly, it is necessary to divide from proximal to the origin of the calloso-marginal artery of the ipsilateral anterior cerebral artery [2, 7, 44, 45].

After this, in the second step, a cottonoid is placed in the foramen of Monro to protect the underlying choroid plexus and prevent the blood and debris entering the ventricular system for what the callosotomy by interhemispheric aprroach is performed. So that, for the implementation of the callosotomy can be used the microdissection, coagulation, and aspiration techniques from the genu anteriorly to the splenium posteriorly [2, 7, 44, 45].

In the trhird step, lastly, the fronto-basal white matter is divided through the anterior part of the lateral ventricle. So that, the temporal stem is dissected, while the posterior communicating arteries are clipped and divided at its P3 segment [44]. Stressing that the amygdala and the hippocampus are removed employing sub-pial dissection with special care on the preservation of the oculomotor nerve [2, 7, 44, 45]. About the exposed choroid plexus, it may be coagulated or left untouched, according to the surgeon's preference, while the ipsilateral basal nuclei and thalamus may be left in situ for better motor outcome [2, 21, 44, 45].

Functional Hemispherectomy (Rasmussen's Modification). In this modification, the temporal lobe is removed with two cortical incisions, one on the superior temporal gyrus, running in parallel to the Sylvian fissure, and a second one placed on the dorsal temporal lobe, down to the temporal base, perpendicular to the first one and localized 8 cm from the temporal lobe pole [44] The hippocampus, the parahippocampal gyrus, the medial part of the uncus, and the lateral part of amygdala are removed with the ultrasonic aspirator after opening the temporal pole, stressing that the ipsilateral third cranial nerve should be protected.

The next step involves to provide the access into the ipsilateral lateral ventricle through the resection of the suprasylvian cortex by two parallel incisions perpendicular to the Sylvian fissure [15, 17, 45, 47]. So that, this step ends with transection of the corona radiata [44].

The next step is the completion of the transventricular parasagittal callosotomy, after to removal this cortical block [44]. The pericallosal artery constitutes the medial border of the resection, while working at the knee of the corpus callosum. The remaining anterior and posterior callosal fiber tracts are disconnected from the ependymal surface toward the cingulate gyrus [15, 44, 45, 47].

Lastly, the resection of the anterior and posterior concections of the frontal lobe and parieto-occiptal lobes is necessary [15, 44]. Such that, the anterior cerebral artery, the superior circular sulcus and the M1 segment of the middle cerebral artery are the borders for the transection of the corona radiata. The posterior disconnection takes place after fully opening the Sylvian fissure and promptly elevating the parietal opercula [45, 47].

Stressing as the final of this procedure, the disconnection line extends from the posterior part of the lateral ventricle opening, to the trigone of the temporal pole cavity [44, 45, 47].

Transsylvian Functional Hemispherotomy (Schramm's Modification). Regarding the skin incision, it is curved from anterior to the tragus up to the superior frontal area incision and the temporalis fascia is opened in the same way [2, 11, 44]. The bone flap, whose dimensions is 4 × 5 cm, is placed just above the Sylvian fissure with the usage of neuronavigation. The inferior and anterior borders are formed by the temporal operculum and the limen insulae, respectively. The anterior border is 5 cm anteriorly, and the pulvinar's projection represents the posterior border [11, 44, 48].

After this step, the Sylvian fissure is widely opened to expose the circular sulcus and insula, as well as all branches of the middle cerebral artery are identified and properly exposed and skeletonized [48]. In order to perform an unco-amygdalo-hippocampectomy, the temporal horn is opened from the inferior circular sulcus [11, 48].

Such that, the next step involves the transection of the long fibers of the corona radiata, as a consequence of the opening of the ipsilateral lateral ventricle in its entire length. So that, the insular cortex is visible and may be resected with segurancy [44].

Finally, it is perfomed the mesial disconnection, whose procedure involves disconnection of the fronto-basal white matter fibers followed by disconnection of the corpus callosum, and concerns disconnection of the occipital and parietal white matter fibers [11, 44, 48].

Lateral Periinsular Hemispherotomy (Villemure's Modification). The Villemure's description of hemispherectomy is a lateral disconnection procedure of the fronto-parieto-temporal opercular cortices [11, 16, 43, 44]. A barn-door skin incision is made, centered on the insula, with a bone window from the coronal suture, to 3–4 cm posterior to the external auditory canal [11, 16]. The inferior part should be just above the middle fossa, and ideally should go high enough, to the mid-convexity, to provide access to the suprasylvian circular sulcus. Adequate exposure would provide access to the brain 2.0–2.5 cm below and above the Sylvian fissure. The dura mater is reflected either caudally or rostrally [11, 16, 44, 49].

This technique is divided into three steps: the supra-insular, the infra-insular, and the insular phase. The subpial resection technique is employed during all the phases of this procedure [11, 16, 44].

First in the supra-insular phase, the resection of the frontal and parietal opercula is carried out, leaving the underlying insular cortex completely exposed [11, 18, 44, 49]. Transection of the corona radiata is performed while opening the lateral ventricle from the frontal horn to the trigone. All tissue entering the callosum from the medial wall is transected, in order to perform a transventricular parasagittal callosotomy [11, 18]. The orientation and localization is confirmed with the falx, the pericallosal vessels and the cingulum [11, 18, 44]. At the level of the splenium, the extension of the medial incision anteriorly to reach the choroidal fissure will interrupt the fimbria-fornix and disconnect the hippocampus [18, 44, 49]. The last step of this stage consists of disconnecting the frontal lobe just anterior to the basal ganglia, going from the rostrum in the direction of the sphenoid wing, while staying in the frontal horn [11, 16]. During the infra-insular phase a temporal lobotomy is performed (resection of the temporal operculum, transection of the temporal stem, uncus, and removal of the amygdala and the anterior hippocampus) [18, 44]. At this stage, if the resection is maximal, the optic tract is visible [18, 49]. Finally, during the insular phase the insula can be resected by subpial aspiration or undermined with an incision at the level of the claustrum/external capsule [11, 16, 18].

Vertical Parasagittal Hemispherotomy (Delalande's Modification). The first step to initiate this approach is perform a linear transverse incision, whose opening allow a small parasagittal frontoparietal craniotomy with 3 × 5 cm localized 1–2 cm from midline and 1/3 anterior and 2/3 posterior to the coronal suture [11, 44, 50].

After the skin incision, it is necessary reach the ependyma of the lateral ventricle through a limited cortical resection in the frontal cortex, whose dimensions are 3 × 2 cm [11, 44, 50]. Upon entering the lateral ventricle, the surgeon identifies the foramen of Monro and the posterior aspect of the thalamus, while the corpus callosum is found by following the roof of the lateral ventricle mesially [11, 44, 50]. So that, the body and splenium are resected to the roof of the third ventricle and the arachnoid cisterns are exposed [11]. Posterior disconnection of the hippocampus is achieved by cutting the posterior column of the fornix at the level of the ventricular trigone [11, 50]. The vertical incision is performed lateral to the thalamus, guided by the choroid plexus of the temporal horn, then following the temporal horn from the trigone to most anterior part of ventricle, keeping the incision in the white matter [11, 44, 50].

The callosotomy is then completed by resecting the genu and the rostrum of the corpus callosum to the anterior commissure [44, 50]. The next step is the resection of the posterior part of the gyrus rectus, which will allow the visualization of the anterior cerebral artery and optic nerve and provide enough space for the last disconnection step – a straight incision anterolaterally through the caudate nucleus from the rectus gyrus to the anterior temporal horn [11, 44].

OTHERS TECHNIQUES AND COMBINED APPROACHES

Regarding to anothers variations of hemispherectomy, it has been described the hemispheric deafferentation [13, 51], the transopercular hemispherotomy [11], the cerebral hemicorticectomy [42] or the transcortical subinsular hemispherotomy [13, 51].

The choose of the surgical combined hemispherectomy approaches depending on the kind of technique the neurosurgeon prefer, pre-operative electrographic, neuropsychological, image evaluation the functional hemispherectomy may associated with procedures like anatomical hemispherectomy [52], callosotomy, hippocampectomy, amygdalohippocampectomy, anterior and posterior commissurotomy and others [1–3, 34, 36, 53, 54].

Regarding the role of endoscopic procedures for epilepsy surgery, it has been sowed a growing of essays about this matter, although the different disconnection techniques by endoscopic approaches are initial and controversial [3], once in our opinion it not possible to infer that a specific technique of hemispherectomy has less morbidity or better outcome if results are not adjusted for different causative pathologies.

Lastly, with regards the anatomic variation and the difficult to find the landmarks of hemispherectomy in some patients, some centers use neuronavigation as a solution for this situation once the use of neuronavigation implies in the reduction in size of the craniotomy. An example is the advantageous usage of a neuronavigator in hemimegalencephaly cases, where the anatomical distortion could be easily misleading [45].

DISCUSSION AND RESULTS IN EPILEPSY SURGERY

Although lasting complications rates of hemispherectomy are very variable on this type of epilepsy surgery, the presence of contralateral homonymous hemianopsia, hemiparesis, postoperative akinetic state, hemiparesis, apathy or aggression, buccal apraxia manifesting as drooling of saliva, memory deficits, persistence of seizures, hemosiderosis, hidrocephalus, cerebralspinal fluid leaks, intracranial postoperative hematomas, osteomielitis, ependymitis, trivial head traumas, infection, hypothermia, "aseptic meningitis", neurological deficits and hemiparesis are risks to be considered during the surgical act [1–3, 5, 23, 25, 26, 32–37].

Regarding to the reason for hemispherectomy failure, it should be highlighted that it is not always apparent for an individual case [32]. So that, among the reasons persistence of the seizures in outpatients follow-up of hemispherectomy surgery include: (1) misdiagnosis implying in the unrecognized seizures emanating from the contralateral hemisphere; (2) the progression of disease implying in the development of a new seizure focus in the contralateral hemisphere; or (3) technical error implying in the failure to adequately disconnect or resection the entire hemisphere [29, 32, 38, 43].

Regarding to the intraoperative risk of bleeding, it has been showed a comparation of the bleeding rates among the different diseases [22, 52]. So that, it was showed a significant bigger in blood loss intraoperative in patients affected by hemimegalencephaly when compared to another diseases [22, 52]. Furthermore, the acumulus of clots in the third ventricule and in lateral ventricule may be observed in many cases of anatomical hemispherectomy [1]. Stressing that the late complications are related to residual cavity surgery which was in contact to the wall of lateral ventricle through the foramen of Monro causing recurrent bleeding that results in hemosiderosis, ependymitis of wall ventricle and consequently cerebrospinal fluid flow obstruct associated to cranial nerves disturb [1–3].

Regarding to the risk of meningitis, it still remains as a controversial question. Such that, while there are authors that suggesting the presence of low-grade fever can be seen as well as other symptoms of "aseptic meningitis" such as lethargy, decrease in appetite, and irritability after the procedure; there are others authors defend the idea that in these cases of aseptic meningitis there are only a lack of isolated pathogen once there is no definitive test that demonstrates the absence of infectious agents [1, 11, 23].

S. de Ribaupierre et al. [11], in 2004, described the results of quality of life in a case series of patients underwent to this procedure, whose results showed that 84 % of the children were able to walk either alone or with help, and all children who were able to walk before surgery retained the ability to walk. Moreover, this essay concluded that the hemiparesis is generally more important in the upper than in the lower extremities. Nevertheless, in spite of the significant results of this procedure with regards the quality of life of this patients, until thirty per cent of the patients will develop recurrence of the seizures and others symptoms depending of the etiology [8, 55]; like a case series with pediatric patients described in 2005 showed bigger distal extremity motor loss in patients with perinatal strokes compared to other epilepsy etiologies, irrespective of time of epilepsy onset or surgery [56].

Regarding the comparation between the functional and anatomical approach, the literature has been observed a low rate of mortality associated an anatomical and functional hemispherectomy surgery, ranging from 2 to 7 % [1, 4, 5, 8, 22, 23, 32, 33, 44, 48, 54] and ranging from 0 to 4 % [1–3, 15–21, 25, 54, 56, 57], respectively. So that, the most frequent of all the complications in the anatomical hemispherectomy surgery is the hydrocephalus, was observed in a rate from 9 to 81 % [11, 29, 32, 33, 58–61] against the incidence rate of functional hemispherectomy complications that ranging from 0 to 16 % [1–3, 14–19, 52–54, 57].

Regarding to the treatment of refractory epilepsy, the comparison between the anatomical and functional hemispherectomy showed comparable result in control of the seizures for anatomical hemispherectomy (85 % control of hemispheric seizures rate for resection procedure against 82 % for disconnection procedures) [1, 3, 11, 17], however with higher rate of permanent complications that functional hemispherectomy (raging from 2 to 33 % against 0–16 %) [1, 3, 11, 29, 32, 33]. Stressing that, higher than 80 % of patients have been presented seizure-free since hospital discharge while another 11.5 % have had at least 80 % reduction in their seizure frequency, as well as the majority of patients have shown an improvement in their intellectual capacity and sociability [1, 17, 58].

In 2004, it was published a review about many types of procedures for epilepsy that concludes that temporal resection is an efficient and scientifically validated treatment of drug-resistant temporal lobe epilepsy [62]. So that, the extra-temporal resections, hemispherotomy, and palliative surgery often allow cure of epilepsy, or a decrease of seizure frequency. Regarding to control of the seizures, it showed that in spite of the anatomical hemispherectomy is a procedure that presents a high rates of seizure control, it is associated to an increased mortality and morbidity by late complications.

In 2001, J. Schramm et al. [21] described the results of the keyhole transsylvian hemispherectomy approach in a case series ($n = 20$), whose the mean follow-up period was 46 months. In spite of it showed a mortality, temporal cyst and infection rates of 5 % ($n = 1$) each, it showed that 88 % of patients were in Engel Outcome Class I, 6 % in Class III, and 6 % in Class IV. Regarding to the technique approach, the operation time was significantly shorter (average of 3.6 h) than with the Rasmussen technique (average of 6.3 h) and 25 % shorter than with the transcortical perisylvian technique (average of 4.9 h). Furthermore, the proportion of patients requiring blood replacements was lower (15 versus 58 %), as was the mean amount of transfused blood.

In 2006, J.G. Villemure & R.T. Daniel [16] described the results of the periinsular hemispherectomy approach in a case series ($n = 43$), whose the mean follow-up period was 9 years. It showed a mortality, hydrocephalus and hemorrage rates of 2 % ($n = 1$), 2 % ($n = 1$) and 5 % ($n = 3$), respectively. Regarding to control of seizures, it showed that 90 % of patients were in Engel Outcome Class I, but when compared the etiology this essay described that patients affected by Rasmussen syndrome, vascular diseases and hemimegalencephaly presented 90 %, 93 % and 80 % of patients with Engel Class I, respectively. However, the authors did not differentiate between cortical dysplasia and hemimegalencepaly in their analyses in these series.

In 2000, a paper published by J. Kestle et al. [57] described the results of the periinsular hemispherectomy approach in a case series ($n = 11$), whose the mean follow-up period, age at surgery and seizure onset to surgery was 3 years, 4.8 years and 4.3 years, respectively. It showed 0 % ($n = 0$) of incidence rates of complications like hemosiderosis, deaths, hidrocephalus and ependymitis related to the surgery. So that, it showed useful hand function preserved in 91 % ($n = 10$) associated to behavior difficult in 27 % ($n = 3$) and developmental delay in 63.7 % ($n = 7$). About the diagnosis, this essay was constituted by Rasmussen syndrome ($n = 1$; 9 %), Sturge–Weber syndrome ($n = 1$; 9 %); cortical dysplasia ($n = 5$; 45 %), hemimegalencephaly ($n = 2$; 18 %), porencephaly ($n = 1$; 9 %) and pachygyria ($n = 1$; 9 %).

A.M. Devlin et al. [52], in 2003, described the results of the functional associated to anatomical hemispherectomy approach in a case series ($n = 33$), whose the mean follow-up period and age at surgery was 3.4 years and 4.25 years, respectively. It showed 9 % ($n = 3$) of incidence rates of hidrocephalus associated to difficulty with expressive language in 18,2 % ($n = 6$), improved the hemiparesis in ($n = 5$), improved the behavior disturbs in ($n = 17$) and deteriorate the visual field in ($n = 13$) related to the surgery. Regarding to control of seizures, 52 % ($n = 18$) were seizure free, 9 % ($n = 2$) experienced rare seizures, 30 % ($n = 10$) showed >75 % reduction in seizures and 9 % ($n = 2$) showed <75 % seizure reduction or no improvement. However, when compared the etiology this essay described that patients affected by Rasmussen syndrome, vascular diseases and hemimegalencephaly presented 40 %, 100 % and 27 % of patients with Engel Class I, respectively. It should be noted that the authors did not differentiate between cortical dysplasia and HME in their analyses in these series, and they did not differentiate between Rasmussen syndrome and Sturge–Weber syndrome in their analysis.

S.W. Cook et al. [58], in 2004, showed in a case series of comparation of anatomical hemispherectomy, functional hemispherectomy, and hemispherotomy. So that, it showed no significant differences between the 3 groups once 71 % of patients overall being seizure free at 2 years after surgery. However, there was a slightly better outcome in the hemispherotomy group (83 %) compared with the functional (73 %) and anatomical (59 %) hemispherectomy groups.

CONCLUSIONS

We concluded, based in the literature and authors experience, that hemispherectomy is an efficient procedure regarding to the control of the seizures and it was associated a low rates of complications when indicated to selected cases. Furthermore, although the success rate has been presented as not proportional to the extent of neural tissue resection [1–4, 11, 17], the morbidity and complication rates has been presented as proportional to the extent of neural tissue resection.

Lastly, although there are many essays devoted to describe the results of techniques individually, we concluded that there is no important study comparing the functional hemispherectomy approaches with results adjusted for different causative pathologies, what would be for future necessary for an important source of data about this topic.

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