Acta Epileptologica

RESEARCH

Open Access

Posterior quadrant epilepsy surgery: case series of a South American hospital

Mario Velasco[1,2*], Andrés Felipe Cárdenas-Cruz[1], María Paula Aguilera-Pena[1], Alejandro Vargas-Moreno[1,2], Daniel Nariño[1,2], Juan Carlos Pérez[1,2] and Oscar Zorro[1,2]

Abstract

Background: Posterior quadrant epilepsy (PCE) is a type of focal epilepsy that originates in the parietal lobe, occipital lobe, and the parietal-occipital border of the temporal lobe, or in any combination of these regions. PCE has a low incidence, but it can cause a great burden in disability-adjusted life years. In this retrospective cohort, patients of all ages with a diagnosis of PCE between 2006 and 2019 were evaluated in a referral center in Bogotá, Colombia. A descriptive analysis of demographic data, clinical history, imaging findings, type of surgery, histopathological diagnosis, outcome, and follow-up was performed using the Engel scale.

Methods: This study included refractory PCE patients of all ages who were evaluated by the epilepsy surgery group of the Hospital Universitario San Ignacio from 2006 to 2019. Clinical, imaging and surgical variables were obtained from the medical records and analyzed.

Results: Thirteen patients were included in the study, including 8 males and 5 females. The mean age of diagnosis was 8.8 years, while the mean age of surgery was 25 years. The most frequent clinical finding was intellectual disability. The most common findings on magnetic resonance imaging were encephalomalacia and gliosis. In 61.5% of the patients, the lateralization of video-EEG matched with brain magnetic resonance imaging alteration. The most frequent types of surgery performed were lobectomies, lesionectomies and cortical resections. Seizure-freedom was achieved in approximately one third of the patients; however, more than half of the patients were free of disabling seizures or had significant improvement after surgery.

Conclusions: PCE surgery is scarcely performed worldwide, therefore the effectiveness and outcomes are quite variable in the reported literature. In this study, we show that patients with PCE can obtain great benefits in terms of reduction of seizures with a low risk of surgical complications, encouraging the use of this type of procedure in carefully selected patients.

Keywords: Posterior cortex, Epilepsy surgery, Posterior quadrant epilepsy

Background

Posterior quadrant epilepsy (PCE) is a type of focal epilepsy that originates in the parietal lobe, occipital lobe, and in the parieto-occipital border of the temporal lobe, or in any combination of these regions [1]. This type of epilepsy is difficult to define and locate as it generally does not respect the anatomical limits of the different brain lobes. In addition, the seizures can spread through multiple fascicular pathways [2]. Up to now, two routes of spread have been described, the ventral route, which mostly has typical symptoms of temporal lobe epilepsy, and the dorsal route, which has the greatest number of occipital lobe symptoms [3].

*Correspondence: mario.velasco@javeriana.edu.co

[2] Neuroscience Department, Hospital Universitario San Ignacio, Cr16# 75-32 apt 203, Bogota, Colombia 110221
Full list of author information is available at the end of the article

PCE represents less than 10% of all refractory epilepsies and 5–10% of focal epilepsies [1, 4, 5]. The semiology of PCE is often heterogeneous due to false ictal spread, which can mimic symptoms characteristic of frontal and temporal lobe epilepsy [3]. Although there are characteristic phenomena related to the occipital lobe such as visual auras and oculomotor signs, it has been described that they only appear in 50% of patients with a confirmed diagnosis of occipital lobe epilepsy [3]. Surgical resections of the posterior quadrant cortex are uncommon and represent less than 10% of all epilepsy surgeries, which may be due to the low prevalence of the disease and the insufficient identification of epileptogenic regions during presurgical evaluation [6, 7]. Visual disturbances have been reported in more than 50% of patients after surgery [8]. Postoperative crisis-freedom rates range from 25 to 90% [6]. The extent of surgical resection, evidence of well-defined focal lesions, frequency of preoperative seizures, interictal activity in the electroencephalography (EEG), duration of epilepsy, and age at treatment, among others, are parameters that can predict the risk of recurrence [9–11].

PCE has a low frequency of presentation; for this reason, there are few studies that address this pathology. However, it is a disorder that generates a great burdenin disability-adjusted life years, so it is important to know the sociodemographic, clinical and prognostic characteristics of these patients [7]. Here, we present a case series of patients with PCE managed surgically in a University Hospital in Bogotá, Colombia.

Methods

This case series study included patients of all ages who were evaluated by the epilepsy surgery group of the Hospital Universitario San Ignacio from 2006 to 2019, and had a diagnosis of refractory epilepsy of the parietal lobe, occipital lobe and/or parieto-occipital borders of the temporal lobe or in any of these zones and with criteria for performing surgery of the posterior quadrant. Patients with a medical history/incomplete evaluation and those who were not candidates for surgery were excluded. The ethics committee of the Hospital Universitario San Ignacio approved the study (FM-CIE-0590-19 2019/182). The written informed consent was obtained from all participants.

Patients on admission were evaluated by the services of neurology, neurosurgery, psychiatry, neuropsychology, adult or pediatric neurophysiology depending on age and in some cases social services. In all patients, video EEG monitoring was performed from day 1 until completing at least 3 or more seizures, with an average duration of 6 continuous days of monitoring. In addition, all of them had brain magnetic resonance imaging (MRI) with special sequences for epilepsy evaluation, which included images with T1 and T2 sequences in axial planes, coronal and sagittal, fluid attenuated inversion recovery sequences (FLAIR), where additional special cuts perpendicular to the hippocampus axis were made. In patients in whom it was not possible to clearly document the epileptogenic focus with initial studies (video-EEG and brain MRI), invasive telemetry studies were performed with the application of subdural grids or deep intracranial electrodes (SEEG). Upon completion of the initial study phase, a multidisciplinary board was held to define surgical possibilities and the best procedures for patients if they were candidates for surgery.

Patients were identified using the epilepsy surgery program database and data were obtained retrospectively from the Comprehensive Hospital Administration System (SAHI®). The evaluated variables and applied definitions are shown in the research protocol, which were chosen based on existing evidence. Imaging findings, type of surgical resection and extent of surgical resection, histopathological diagnosis, auras presented, follow-up time to patients and outcome of surgery based on the Engel scale [12] were evaluated.

A univariate analysis was performed. The categorical variables were described as a percentage. Quantitative variables with normal distribution were analyzed with the Shapiro-Wilk test. For variables with non-normal distribution, the median and interquartile range were used, and for variables with normal distribution, the mean and standard deviation was used. The data were analyzed using the SPSS® Version 24 for Mac OS program.

Results

Of 345 patients identified, only 13 met the inclusion criteria (Table 1), and 61.5% of the patients were men. The average age of diagnosis was 8.8 years, and the average age of surgery was 25 years. The median seizure frequency was 3 episodes per week (Table 1), and 70% of the patients had a remarkable clinical history of intellectual disability, delayed psychomotor development or neonatal hypoxia.

As for the characteristics of the seizures, all of the cases had a focal onset and in more than 90% of the patients there was a secondary generalization. The symptoms were very heterogeneous; however, in more than a third of patients, motor phenomenology was presented. 57% of patients had auras, with cognitive and simple or complex hallucinations most often described (Table 2). Invasive studies were conducted in more than 50% of the patients, the most common being occipital subdural grids alone or in combination with temporal grids. In 61.5% of

Table 1 Population characteristics

Case	Age at surgery (years)	Sex	Lateralization	Personal/Family History	MRI Findings	Type of surgery	Pathology	Engel at 1 year	Engel at the last follow-up	Complications
1	24	M	Right	Epilepsy in the family	Encephalomalacia	LO	Polymicrogyria	3	3	No
2	34	F	Right	No	Cortical dysplasia	LO	Cortical dysplasia	NDS	2	No
3	9	F	Left	No	Polymicrogyria	Lo- Posterior Callosotomy	N/A	NDS	1	No
4	6	M	Right	Perinatal hypoxia	Cortical dysplasia- heterotopies	LO- LT	EMH	3	4	No
5	28	M	Left	No	Gliosis	CPA	N/A	1	1	No
6	41	M	Right	Surgery for right occipital gangliocytoma	Gangliocytom[a]	LO- LT	Reactive astrocytosis	2	2	No
7	46	M	Left	No	EMH- Encephalomalacia	LT- Parietoccipital corticectomy	EMH- Parietoccipital gliosis	4	4	Iso
8	4	F	Right	No	No	Parietal corticectomy	Reactive astrocytosis	3	3	No
9	52	F	Right	No	No	Temporoccipital corticectomy	N/A	1	1	No
10	15	F	Right	No	No	LT- Parietal lesionectomy	Reactive astrocytosis	2	2	No
11	22	M	Right	Perinatal hypoxia	Gliosis	LT- Occipital lesionectomy	Cortical dysplasia	4	4	No
12	20	M	Left	No	Encephalomalacia	Parietal corticectomy	N/A	2	2	No
13	28	M	Right	ECA with cranioplasty	EMH- Encephalomalacia	LT- Parietoccipital lesionectomy	EMH- Parietoccipital gliosis	1	1	No

N/A Not available, *NDS* Not available for loss of follow-up, *ECA* Brain trauma, *LO* Occipital lobectomy, *LT* Temporary lobectomy, *CPA* Anatomical posterior quadrantectomy, *EMH* Hippocampus mesial sclerosis, *ISO* Infection of the operating site

[a] Tumor relapse was suspected

Table 2 Demographics and clinical characteristics

Population (*n*(%))				
Men				8 (61.5)
Age (years)				**Mean (IQR)**
Diagnosis				8.8 (7.6)
Surgery				25 (15)
Onset symptoms (median (RQ))				8 (9)
Features				**Median (IQR)**
Ictal frequency[a]				3 (13.5)
Crisis-free time (months)				1 (2)
Number of medicines				3 (2)
Type of aura	**ELO**	**ELP**	**PCE**	**Total (%)**
Complex hallucinations	1	0	0	1 (7)
Simple hallucinations	1	0	1	2 (14)
Negative visual	1	0	0	1 (7)
Flicker	1	0	0	1 (7)
Somatosensory	0	0	1	1 (7)
Cognitive	0	0	1	1 (7)
Vertigo	0	0	1	1 (7)
No aura	6	1	4	6 (43)

ELO Occipital lobe epilepsy, *ELP* Parietal lobe epilepsy, *PCE* Posterior Quadrant Epilepsy

[a] *Seizures per week*

the patients, the lateralization of video EEG was concordant with brain MRI findings.

In more than 80% of the patients, some forms of MRI injury or lesion were documented, of which the most common finding was encephalomalacia followed by gliosis (Table 3). In only three cases, there was a correlation between imaging findings and pathological results after surgery (Table 1).

A lobectomy was performed in approximately 60% of the patients. Only one complete anatomical procedure of the posterior quadrant was performed (Table 4). Regarding pathological findings, up to 53% reported non-specific findings with reactive astrocytosis and gliosis, followed by cortical dysplasia and mesial sclerosis (Table 3). The only surgical complication was surgical site infection, which occurred only in one patient.

The median follow-up time was 1.4 years. Seizure freedom was achieved in 30.7% of the patients; however, 61% of the patients were found to be free of or significantly less affected by crippling seizures till the last follow-up. In only one case there was worsening of symptoms, from Engel Class III to IV (Table 4). Approximately 15% of the patients had visual complications after surgery, one patient was found to have left homonymous hemianopsia and one with decreased visual acuity.

Discussion

Progress has been made in the surgical evaluation and management of drug-resistant epilepsy; however, PCE surgical treatment results are not well known, due to the low prevalence of PCE and the difficulties in defining the epileptogenic zone. The study with the highest number of patients treated for PCE was carried out by Harward and collaborators, where 584 patients were identified throughout the medical literature, with other case series ranging from 6 to 52 patients [8].

In the present series, the interval from diagnosis to the surgery was approximately 17 years. One reason is

Table 3 Imagenological and pathological findings

Magnetic resonance imaging findings (*n*(%))		**Pathological findings (*n*(%))**	
Normal	2 (15.3)	Available	9 (69.2)
Abnormal	11 (84.6)	Not available	4 (30.7)
Alteration		**Diagnosis**	
Unilobar	3 (23)	Reactive astrocytosis	4 (30.7)
Multilobar	4 (30.7)	Gliosis	3 (23)
Bilateral	4 (30.7)	Cortical dysplasia	2 (15.3)
Injury type		Mesial sclerosis	2 (15.3)
Encephalomalacia	5 (38.4)	Polymicrogyria	1 (7.6)
Gliosis	4 (30.7)		
Mesial sclerosis	3 (23)		
Cortical dysplasia	2 (15.3)		
Polymicrogyria	1 (7.6)		
Ventricular enlargement	1 (7.6)		
Heterotopia	1 (7.6)		
Porencephaly	1 (7.6)		
Cortical atrophy	1 (7.6)		
Hydrocephalus	1 (7.6)		

Table 4 Surgery type and outcomes

Surgery (*n*(%))		**Follow-up time - Median years (IQR)**	
Type of procedure		1.4 (3.7)	
Lobectomy	8 (61.5)	**Engel score at 1 year after surgery (*n*(%))**	
Lesionectomy	6 (46.1)	Class I	3 (27)
Amygdalohippocampectomy	2 (15.3)	Class II	3 (27)
Posterior callosotomy	1 (7.6)	Class III	3 (27)
Corticectomy	1 (7.6)	Class IV	2 (18)
Lobectomy extension regarding compromised region		**Engel score at the last follow-up**	
Occipital	4 (30.7)	Class I	4 (30.7)
Temporo-occipital	3 (23)	Class II	4 (30.7)
Parietal	2 (15.3)	Class III	2 (15.3)
Temporal	2 (15.3)	Class IV	3 (23)
Temporo-parietal	1 (7.6)		
Temporo-parieto-occipital	1 (7.6)		

that diagnosing and delimiting the epileptogenic area is challenging and both EEG and MRI can give false locations [3]. Another reason may be the delays that occur in Colombia's health system.

As for the semiology, in our series, patients mostly had motor- and sensory-type seizures. These results are similar to those presented in a study conducted in Beijing, where most patients showed simple motor and generalized tonic-clonic seizures [7]. Regarding auras, only visual symptoms were present in 23% of the patients, results similar to the revised literature, which reported that they occur in less than 50% of patients with occipital lobe epilepsy [3]. In approximately 84% of the patients, a focal abnormality was evident in brain MRI. This proportion was much higher compared to other series, which means that the etiology in most cases is structural and there is a deficit in the diagnosis of secondary PCE to another type of etiologies [7]. Additionally, PCE is most commonly diagnosed from injuries evidenced in MRI in conjunction with video EEG, which is consistent with our results. However, these can sometimes misrepresent the epileptogenic area, therefore a comprehensive evaluation of all patients who are candidates for epilepsy surgery may be required for better outcomes [3, 7].

In PCE, it has been shown that the results of video EEG are unclear, with many being false locations of epileptic activity [3]. In this series, approximately 40% of patients did not have a concordance regarding the laterality evidenced in MRI and video-EEG. In addition, video EEG showed very heterogeneous results in terms of the location of epileptic discharges, and this is believed to be explained by the rapid seizure spread. Given this high non-concordance rate, invasive studies were needed for 50% of patients to define the epileptogenic area. This alternative should be used when the other approaches give conflicting results, additionally providing a functional map to preserve visual, language, and sensitive function [3].

In our series, the most common histopathological finding was reactive astrocytosis, followed by gliosis. These results differ from those presented in a cohort study in which the most common findings were cortical dysplasia and tumor etiology [13]. In only three cases, there was correlation between imaging findings and pathological results after surgery.

The rate of seizure freedom in previous studies range from 25 to 92%; however, most studies report crisis freedom in less than 50% of patients [3–14]. Here, our series showed freedom of crisis in 30% of patients [14]. Depending on the type of resection, a range of 62 to 72% seizure freedom rate has been reported, with the highest rate after complete resection of the posterior quadrant [14]. In our series of cases, a complete resection was performed only in one patient with a Class I Engel score.

Sometimes the complete disconnection of the epileptogenic area from the surrounding parenchyma, involving the ictal propagation pathways, is sufficient for crisis control, even when the pathological substrate remains in-situ [15, 16]. Temporo-parieto-occipital, or parieto-occipital (when there is no evidence of ictal origin from temporary structures) disconnections have been described, procedures being preferred when there are unilateral lesions in the posterior quadrant, which are identifiable in MRI or in functional studies and in the absence of hemispheric lesions [17]. In this series, no such procedures were performed for the management of pharmaco-resistant epilepsy of the posterior quadrant, given the imaging, clinical and neurophysiological characteristics of the cohort, which, after the completion of the specialized board, led to a decision on the implementation of other types of interventions, with better long-term outcome potentials.

There is limited experience with PCE surgery in Latin America. In Colombia, there are institutions that have been performing epilepsy surgery for several years; however, there is not enough published data from the experience with surgery in PCE. The strength of this study is that it describes in more detail patients with epilepsy in the posterior quadrant undergoing surgery in Colombia, and with this, we want to promote local demographic characterization of PCE, taking into account the different social, economic and political connotations that can differentiate our patients from other series of international cases. The most important limitation in this case series is the patient follow-up time. Most patients, due to the administrative issues associated with the health system, fail to get medical appointments for proper post-operative control or antiepileptic drug adjustment, which can influence the effectiveness. In addition, other limitations are the small number of patients and patient enrollment from a single center, which makes it difficult to generalize this information to the Colombian population. However, this work could contribute to improving the characterization of PCE patients in Colombia.

Conclusions

PCE surgery is scarcely performed worldwide, therefore results on the effectiveness and outcomes are quite variable in the literature. In this study, we show that patients with PCE can obtain great benefits in terms of reduction of seizures with a low risk of surgical complications, encouraging the use of this type of procedure in carefully selected patients.

Abbreviations
PCE: Posterior quadrant epilepsy; EEG: Electroencephalography; MR: Magnetic resonance imaging; SEEG: Deep intracranial electrodes; N/A: Not available; NDS: Not available for loss of follow-up; ECA: Brain trauma; LO: Occipital lobectomy; LT: Temporary lobectomy; CPA: Anatomical posterior quadrantectomy; EMH: Hippocampus mesial sclerosis; ISO: Infection of the operating site; ELO: Occipital lobe epilepsy; ELP: Parietal lobe epilepsy.

Acknowledgements
Not applicable.

Authors' contributions
MV: study design, database information extraction, data analysis, manuscript writing. AFC, MPA: data analysis, manuscript writing. AVM: manuscript writing, English translation, DN: study design, manuscript writing. JCP, OZ: manuscript writing. The author(s) read and approved the final manuscript.

Funding
All research funds came from the Hospital Universitario San Ignacio.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Project was carried out in accordance with the code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. This study was approved by the research office and the ethics committee of the Hospital Universitario San Ignacio in Bogota (FM-CIE-0590-19 2019/182). The written informed consent was obtained from all participants.

Consent for publication
The written informed consent for publication was obtained from all participants.

Competing interests
The authors declare that they have no competing interests.

Author details
[1]Pontificia Universidad Javeriana, Cr16# 75-32 apt 203, Bogota, Colombia 110221. [2]Neuroscience Department, Hospital Universitario San Ignacio, Cr16# 75-32 apt 203, Bogota, Colombia 110221.

Received: 15 February 2021 Accepted: 4 May 2022
Published online: 10 October 2022

References

1. Blume WT, Whiting SE, Girvin JP. Epilepsy surgery in the posterior cortex. Ann Neurol. 1991;29(6):638–45.
2. Jayakar P, Duchowny M, Resnick T, Alvarez L. Localization of seizure foci: pitfalls and caveats. J Clin Neurophysiol. 1991;8(4):414–31.
3. Jacobs J. Networks in posterior cortex epilepsies. Neurosurg Clin N Am. 2020;31(3):325–34.
4. Manford M, Hart YM, Sander JW, Shorvon SD. National General Practice Study of epilepsy (NGPSE): partial seizure patterns in a general population. Neurology. 1992;42(10):1911.
5. Lhatoo SD, Kahane P, Lüders HO. Invasive studies of the human epileptic brain. Oxford: Oxford University Press, Incorporated; 2019.
6. Jehi LE, O'Dwyer R, Najm I, Alexopoulos A, Bingaman W. A longitudinal study of surgical outcome and its determinants following posterior cortex epilepsy surgery. Epilepsia. 2009;50(9):2040–52.
7. Yu T, Wang Y, Zhang G, Cai L, Du W, Li Y. Posterior cortex epilepsy: diagnostic considerations and surgical outcome. Seizure. 2009;18(4):288–92.
8. Harward SC, Chen WC, Rolston JD, Haglund MM, Englot DJ. Seizure outcomes in occipital lobe and posterior quadrant epilepsy surgery: a systematic review and Meta-analysis. Neurosurgery. 2018;82(3):350–8.
9. Boesebeck F. Lateralizing semiology predicts the seizure outcome after epilepsy surgery in the posterior cortex. Brain. 2002;125(10):2320–31.
10. Rossi GF, Pompucci A, Colicchio G, Scerrati M. Factors of surgical outcome in Tumoural epilepsy. Acta Neurochir. 1999;141(8):819–24.
11. Dodrill CB, Wilkus RJ, Ojemann GA, Ward AA, Wyler AR, van Belle G, et al. Multidisciplinary prediction of seizure relief from cortical resection surgery. Ann Neurol. 1986;20(1):2–12.
12. Bell WL. Surgical treatment of the epilepsies—second edition: edited by Jerome Engel, Jr. 816 pages. $135.00. New York, NY: raven press, 1993. ISBN 0-88167-988-7. Surg Neurol. 1994;42(3):279–80.
13. Kawai K. Epilepsy surgery: current status and ongoing challenges. Neurol Med Chir. 2015;55(5):357–66.
14. Liava A, Mai R, Cardinale F, Tassi L, Casaceli G, Gozzo F, et al. Epilepsy surgery in the posterior part of the brain. Epilepsy Behav. 2016;64(Pt A):273–82.
15. De Ribaupierre S, Delalande O. Hemispherotomy and other disconnective techniques. Neurosurg Focus. 2008;25(3):E14.
16. Yang P, Mei Z, Lin Q, Pei J, Zhang H, Zhong Z, et al. Disconnective surgery in posterior quadrantic epilepsy: a series of 12 paediatric patients. Epileptic disorders. 2014;16(3):296–304.
17. Dorfer C, Czech T, Mühlebner-Fahrngruber A, Mert A, Gröppel G, Novak K, et al. Disconnective surgery in posterior quadrantic epilepsy: experience in a consecutive series of 10 patients. Neurosurg Focus. 2013;34(6):E10.

Publisher's Note