HYDROCEPHALUS IN PEDIATRIC POPULATION. EXPERIENCE IN THE NEUROSURGERY DEPARTMENT OF THE BACA ORTIZ PEDIATRIC HOSPITAL, QUITO-ECUADOR, 2016-2019

Hidrocefalia en población pediátrica. Experiencia en el Servicio de Neurocirugía del Hospital Pediátrico Baca Ortiz, Quito-Ecuador, 2016-2019

CARLOS MORALES T [1a], ALICIA TORRES M. [1b], JESUS CASTRO V.[1b], JOSE BERNAL C.[1b], ALEJANDRO CASTRO S.[2c]

[1]Department of Neurosurgery of the Baca Ortiz Pediatric Hospital, Quito. [2] Pontifical Catholic University of Ecuador
[a] Resident of Neurosurgery, [b] Neurosurgeon, [c] Medical Student.

ABSTRACT

Introduction: Hydrocephalus is one of the most common pathologies in the daily care of a Pediatric Neurosurgery Service, so it is important to document the context of its presentation to improve therapeutic behavior. The objective of the present study was to describe the demographic variables, as well as the type, treatment, morbidity, and mortality of patients with hydrocephalus.
Methods: Cross-sectional, retrospective and descriptive study of children with hydrocephalus who underwent surgery in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, from January 2016 to December 2018, using the records of the clinical records from the Department of Statistics and archives of the Neurosurgery Service of our Institution.
Results: From January 2016 to December 2018, 287 patients with a diagnosis of hydrocephalus underwent surgery, presenting 63.7% as a congenital cause and 36.2% acquired; with a predominance of males (57.2%). The most common sign for which patients attended the consultation was macrocephaly (52%). Infectious dysfunctions were 10.1% vs. mechanical dysfunctions 4%. Mortality was not related to hydrocephalus, 1% of deaths were associated with systemic infection and 0.6% with respiratory infection.
Conclusions: Hydrocephalus in pediatric patients constitutes a frequent pathology that can be accompanied by various comorbidities, hence the importance of its timely diagnosis and adequate treatment.
Keywords: *Hydrocephalus, Child, Neurosurgical Procedures, Hospitals, Pediatric. (Source: MeSH NLM)*

RESUMEN

Introducción: La Hidrocefalia es una de las patologías más comunes en la atención diaria de un Servicio de Neurocirugía Pediátrica, por lo cual es importante documentar el contexto de su presentación con la finalidad de mejorar la conducta terapéutica. El objetivo del presente estudio fue describir las variables demográficas, así como el tipo, tratamiento, morbilidad y mortalidad de pacientes con hidrocefalia.
Métodos: Estudio transversal, retrospectivo y descriptivo de niños con hidrocefalia intervenidos quirúrgicamente en el Servicio de Neurocirugía del Hospital Pediátrico Baca Ortiz, desde enero del 2016 a diciembre del 2018, utilizando los registros de las historias clínicas del archivo del Departamento de Estadística y en los archivos del Servicio de Neurocirugía de nuestra Institución.
Resultados: De enero 2016 a diciembre del 2018 se intervinieron quirúrgicamente 287 pacientes con diagnóstico de hidrocefalia, presentando como causa congénita el 63,7%, y adquirida el 36,2%; con predominio del sexo masculino (57,2%). El signo más común por lo cual los pacientes acudieron a consulta fue la macrocefalia (52%). Las disfunciones infecciosas fueron del 10,1% vs disfunciones mecánicas 4%. La mortalidad no tuvo relación con la hidrocefalia, el 1% de muertes estuvieron asociadas a infección sistémica y el 0,6% a infección respiratoria.
Conclusiones: la hidrocefalia en pacientes pediátricos constituye una patología frecuente que puede acompañarse de varias comorbilidades, de ahí la importancia de su diagnóstico oportuno y tratamiento adecuado.
Palabras clave: *Hidrocefalia, Niños, Procedimientos Neuroquirúrgicos, Hospitales Pediátricos. (Fuente: DeCS Bireme)*

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The definition of hydrocephalus is given by the increase in the total volume of cerebrospinal fluid, causing an increase in the size of the ventricles, cisterns at the base and in general the subarachnoid space. [1,2]

The circulation of the cerebrospinal fluid begins in the ventricles, whose choroid plexuses produce it, then transits through the subarachnoid space of the brain and spinal cord, where it is reabsorbed passing to the venous sinuses through Pacchionian arachnoid granulations. Throughout

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this path obstruction, lack of absorption or excess formation can occur, which causes the volume of the ventricles to increase. [1,3]

Hydrocephalus is a quite common pathology within Pediatric Neurosurgery worldwide, occurring with a frequency in girls of 1 to 3 cases per 1000 live births. [2]

In our environment, the reality is similar, since hydrocephalus is one of the most common causes of consultation in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, so its knowledge is essential to be able to perform optimal management, both in its diagnosis as in its treatment, for the benefit of the pediatric population.

METHODS

A retrospective, descriptive, and cross-sectional study of 287 children with a diagnosis of hydrocephalus attended at the Neurosurgery Service of the Baca Ortiz Pediatric Hospital was conducted from January 2016 to December 2018.

The data was collected from the medical records that are in the archives of our Institution, taking particular interest in the following statistical variables: Sex, age of the patient, the reason for consultation for which the patient goes to the medical professional, the study of initial image used for diagnosis, type of congenital or acquired hydrocephalus, surgical treatment used, morbidity and mortality in the first 6 months after surgery.

For the qualitative analysis, the average and percentage were used, while the mean and mode were used for the quantitative variables. The database was storage in the Excel spreadsheet of the Microsoft Office 2010 package. The final report was prepared using the Word processor, also belonging to the Microsoft Office 2010 package.

RESULTS

In the Neurosurgery Service of the Baca Ortiz Pediatric Hospital during the period from January 2016 to December 2018, a total of 287 patients were treated, of whom 150 patients were admitted with a diagnosis of hydrocephalus without any prior treatment, showing greater predisposition in the male sex, with a total of 164 children representing 58%, unlike the female sex which constituted a total of 123 patients, which represents 42% of the total. (*Figure 1*)

Of the 287 patients attended in the period from January 2016 to December 2018, 31.7% of patients were younger than 1 year, 26.1% were between 1 and 5 years old, 28.5% were between 6 and 10 years and 13.5% of patients attended were between 11 and 14 years old. (*Figure 1*)

Of the 150 patients attended with a diagnosis of hydrocephalus without any prior treatment, the predominant reason for consultation was macrocephaly, which was present in 78 patients (52%), followed by vomiting with 37 (24.6%), headache in 22 (14.9 %) and seizures in 13 (8.6%). (*Figure 2*)

Regarding the first radiological method used to diagnose hydrocephalus for the first time in the 150 patients, simple cerebral tomography (CT) represents 75.3% (113); followed by transfontanelar echography with 18.6% (28) and Cerebral Magnetic Resonance Imaging (MRI) with 6% (9 cases). (*Figure 3*)

Of the total of patients included in the study, the 150

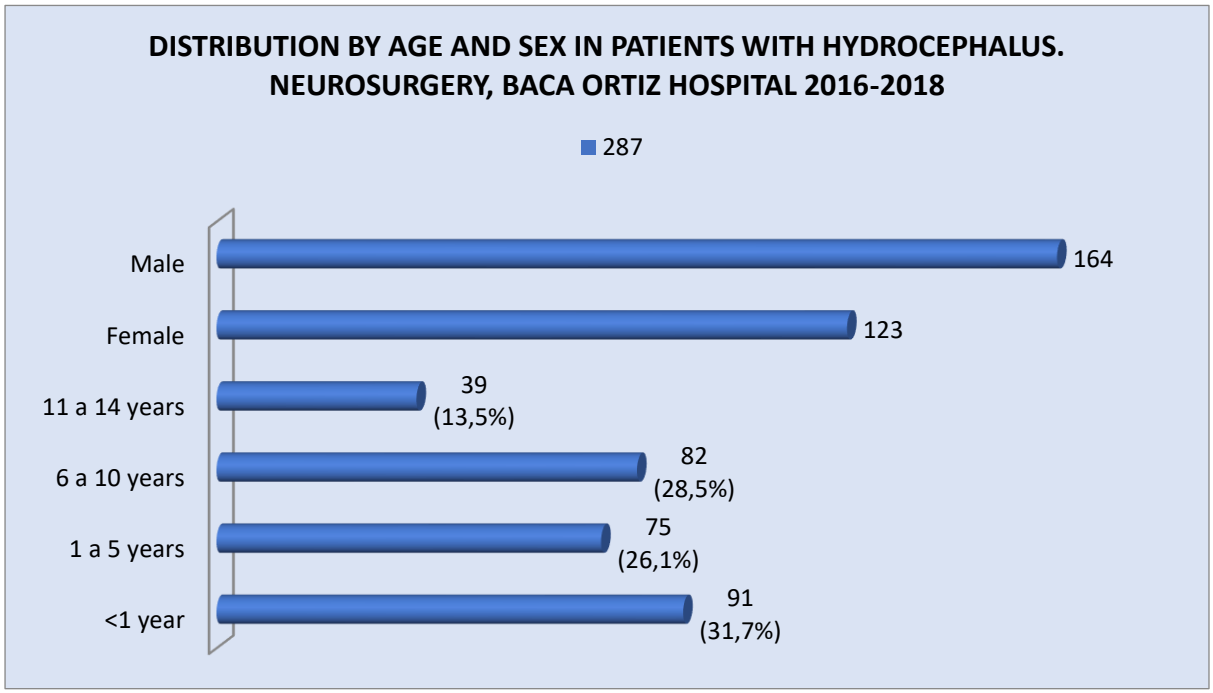

Fig 1. Distribution by age and sex in pediatric patients with hydrocephalus operated in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. (*Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital*)

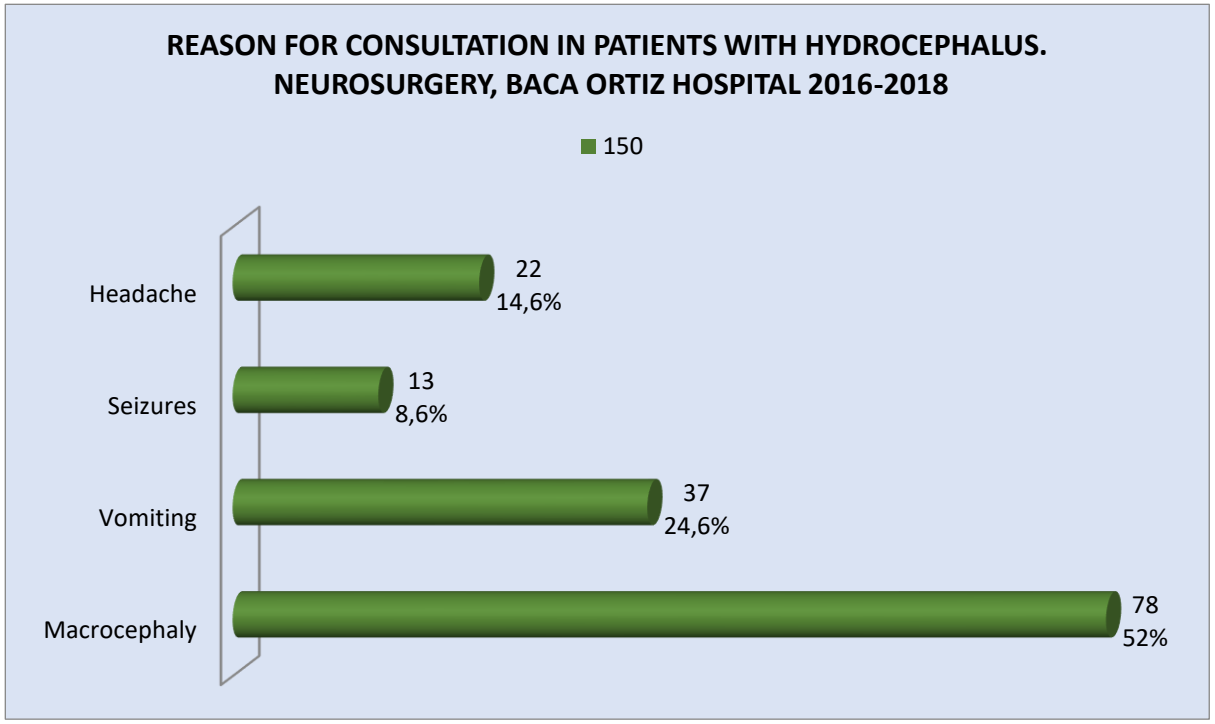

Fig 2. Reason for consultation in pediatric patients with hydrocephalus operated in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. *(Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital)*

patients with a diagnosis of hydrocephalus without any previous treatment and 137 patients who were admitted with a diagnosis of short distal catheter and valve dysfunction whether infectious or mechanical, were included. The main etiology of hydrocephalus was congenital etiology with a total of 183 cases (63.7%), followed by the acquired etiology with a total of 104 cases, representing 36.2%. (*Figure 4*)

Among congenital hydrocephalus cases, 31 cases (16.9%) were associated with myelomeningocele; in which a higher prevalence was evidenced in the female sex with a total of 24

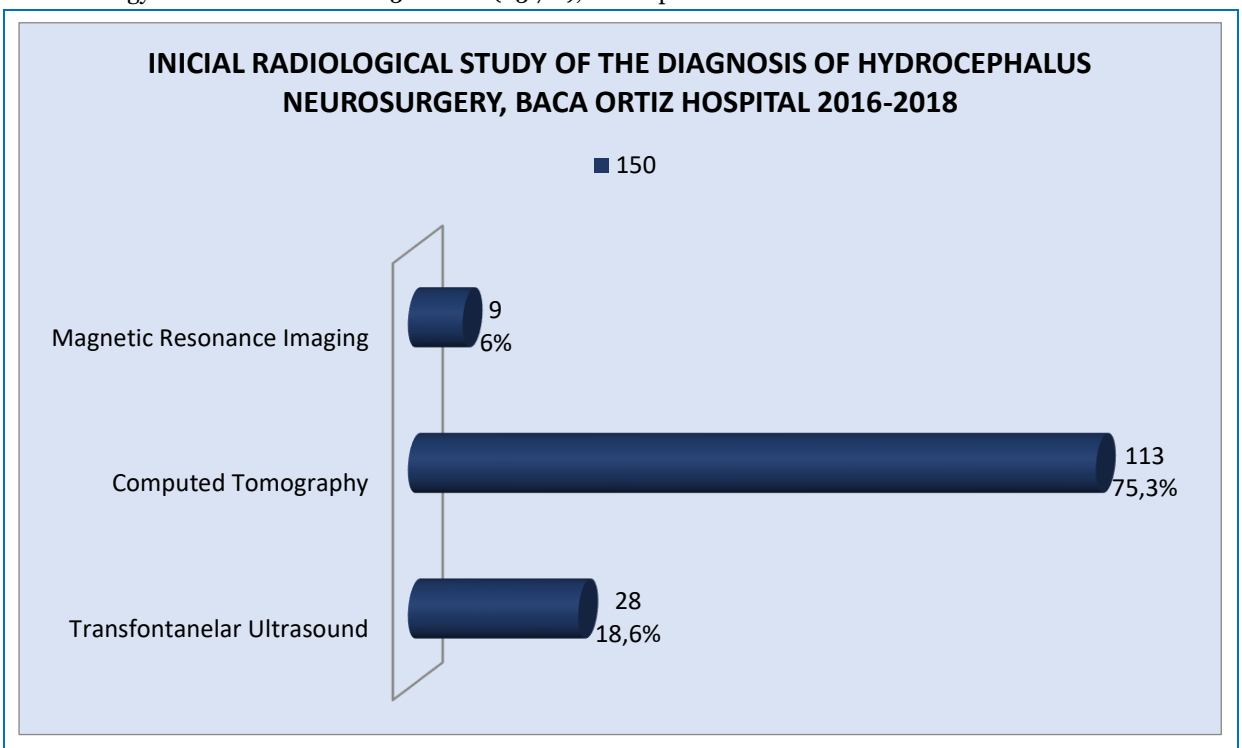

Fig 3. Initial radiological study of the diagnosis of hydrocephalus in pediatric patients operated on in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. *(Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital)*

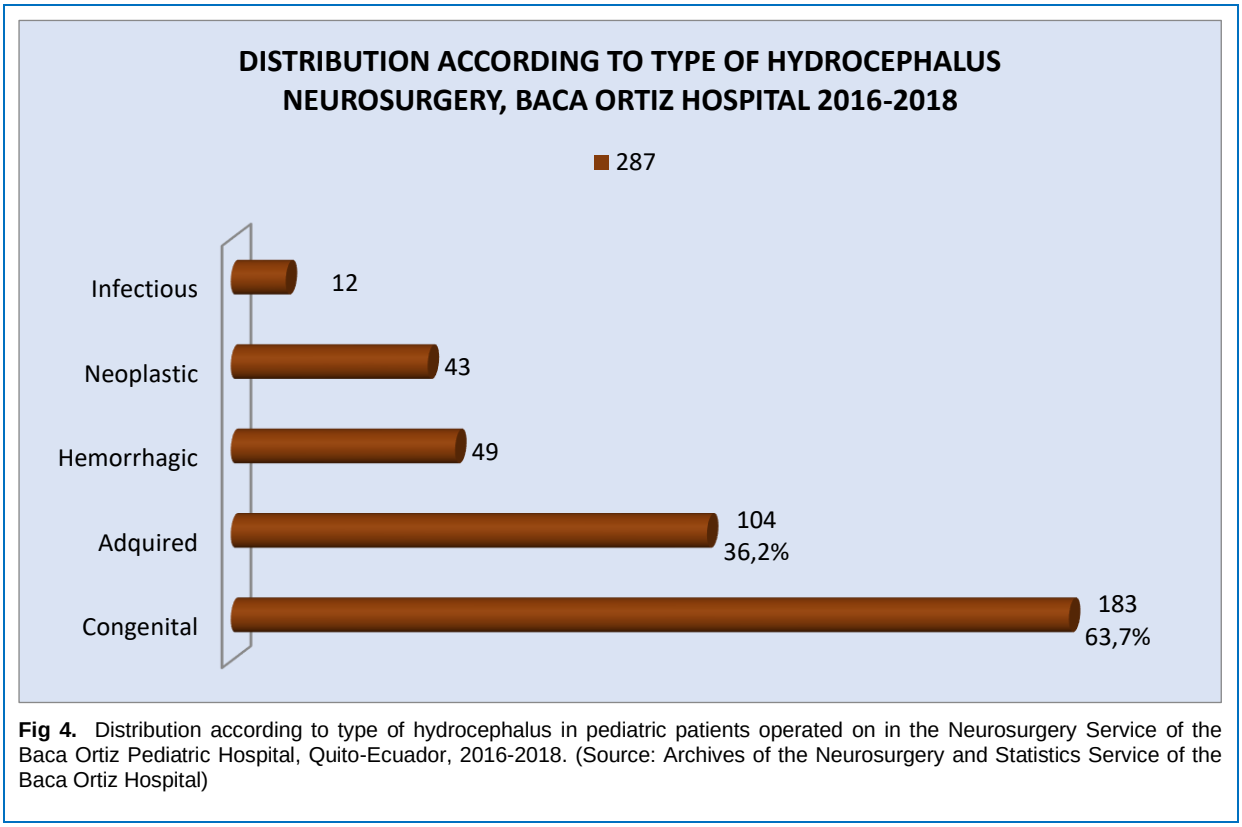

Fig 4. Distribution according to type of hydrocephalus in pediatric patients operated on in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. (Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital)

cases (77.4%) as opposed to the male sex, in which it occurs in 7 patients (22.5%).

Of the total of 104 patients with acquired hydrocephalus, the hemorrhagic etiology was identified as the main cause or etiology, with a total of 49 cases (47.1%), mainly in patients who were born premature due to immaturity of the germinal matrix; followed by tumor etiology with 43 cases (41.3%) and infectious etiology in 12 cases (11.5%). (*Figure 4*)

Regarding the treatment carried out at the Baca Ortiz Pediatric Hospital in the period from January 2016 to December 2018, in the 150 patients diagnosed with hydrocephalus without prior treatment, in 131 patients (87.3%) a Ventricle-Peritoneal Shunt placement was performed. (VPS), in 4 patients (2.6%), Ventriculo-Atrial Shunt (VAS) placement was performed, although it should be borne in mind that the placement of this latter type of shunt was never considered as the first option when On the contrary, it was considered only in cases in which the VPS was unsuccessful, which was generally due to an infectious cause or problems such as abdominal cysts. The placement of External Ventricular Drainage (EVD) was performed as the first surgical procedure in 11 patients (7.3%), which subsequently ended in VPS system placement and in 2 cases (1.3%) an Endoscopic Third Ventriculostomy (ETV) was performed. which was performed in patients diagnosed with hydrocephalus secondary to a tumor. (*Figure 5*)

Of the 148 surgical procedures performed where a shunt system was placed (peritoneal or atrial), 26 patients presented signs of valve dysfunction in the first 6 months after surgery. Valvular dysfunction was infectious in 15 patients (10.1%), of which 12 patients (80 %%) had ventriculitis and 3 (20%) with bypass system colonization. Obstructive mechanical valve dysfunction occurred in 6 cases (4%), and mixed valve dysfunction, which includes abdominal cysts, occurred in 5 cases representing 3.3%. (*Figure 6*)

Regarding mortality, of the total number of patients attended in the Neurosurgery Service of the Baca Ortiz Hospital during the study period, 5 patients died (1.7%), however, it should be taken into account that in no case the death was related to the underlying pathology or the surgical procedure used, since 2 patients (0.6%) died of pulmonary complications and 3 patients (1%) died of septic symptoms. (*Figure 6*).

DISCUSSION

Hydrocephalus occupies up to 40% in the list of pathologies treated in Pediatric Neurosurgery.[1,12] In our case series, we have 58% of hydrocephalus treated without prior treatment, while series such as that of Villegas et al report 33% of hydrocephalus of idiopathic etiology. [2]

In relation to the presentation according to sex, we see that in most of the publications there is a predominance of male children, with a percentage greater than 50-60%,[2] likewise, in our research we found a greater number of children male sex with hydrocephalus (57.2%).

The type of hydrocephalus can be divided into congenital and acquired; Thus, in our study we found that 63.7% were congenital and 36.2% were acquired, in other series 33% of congenital hydrocephalus were reported, within which 51% of patients with myelomeningocele who developed hydrocephalus were identified, This incidence was documented in 5 years of study.[2,12,13] For us, the patients with myelomeningocele and hydrocephalus evaluated in 2 years were 16.9% (31 patients) of the total congenital

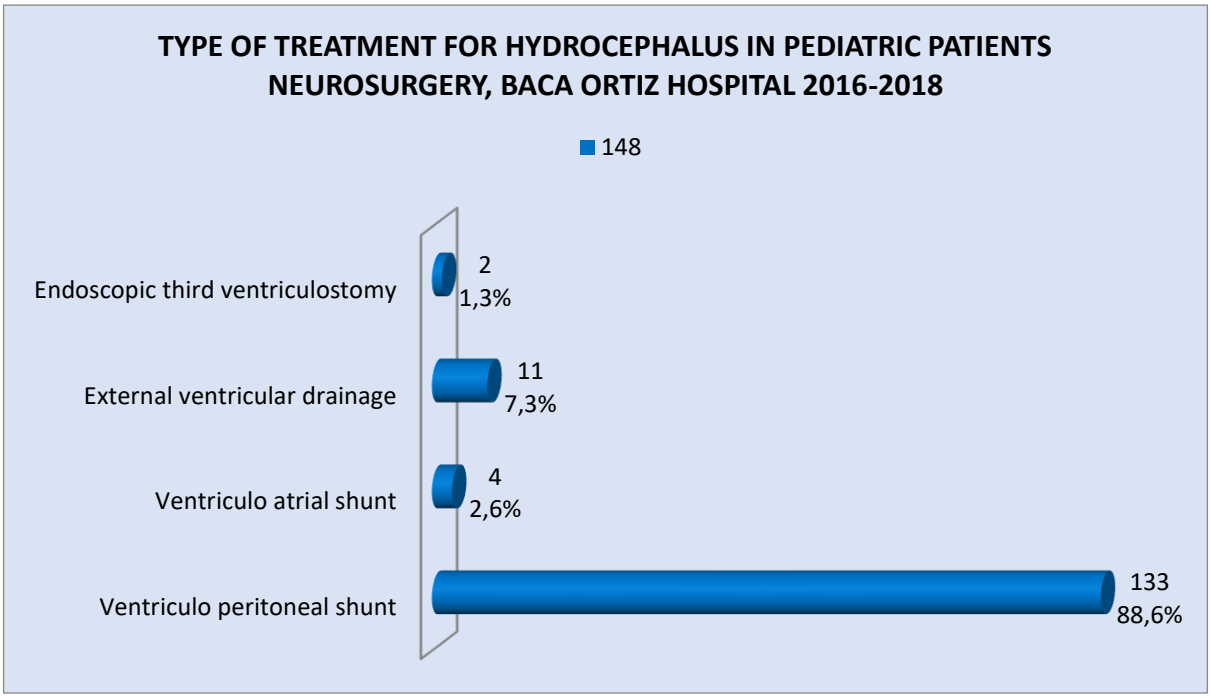

Fig 5. Type of treatment performed for hydrocephalus in pediatric patients operated on at the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. *(Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital)*

hydrocephalus without treatment, instead in the study. Mori

3 who evaluated 107 children found myelomeningocele as the cause of hydrocephalus in 54% of cases, which is similar to 56% of children with myelomeningocele who developed hydrocephalus in the Kuetcher case series.[4] In most From the studies, the factors responsible for congenital hydrocephalus are unknown, however, the most frequent causes are caused by congenital malformations such as Silvio aqueduct stenosis, Chiari or Dandy Walker malformation. [1,15]

Among the acquired causes we have 11.5% of infectious cause, which is comparable to that obtained by Villegas [2], who reported 10% of infectious cause as well as the Mori [3] and Kestle series. [4]

The clinical manifestations present as endocranial hypertension syndrome, which will vary according to the age of the patient and the time of evolution. [1,2,5] In neonates and young infants, macrocephaly, irritability, and neurological depression will predominate due to having patent sutures and patent fontanelles. [6,12,13,15] Likewise, the sign with the highest prevalence in our study was macrocephaly with 52% of cases.

In the older child who no longer has fontanelles (closed skull), we will appreciate a clinical picture of headache, vomiting and lethargy, [6,13,15] which in our case series was the second and third cause of consultation.

If the onset of hydrocephalus has been slowly progressive, delays in psychomotor development, learning difficulties, and visual problems may be the predominant signs. [6,11,12,13,14]

In relation to imaging, we can mention transfontanelar ultrasound, the same one that, although it has limitations, is still performed, and in experienced hands it can be an initial method of diagnosis; this is how in our hospital we received 18.6% of patients with ultrasound-guided diagnosis. However, in our institution we have a CT scanner, therefore we use this diagnostic method in all our cases. Like most series, CT is the preferred imaging technique.[6,16] If necessary, a brain MRI may be indicated, which will allow much better visualization of some structures such as the Silvio aqueduct, the IV ventricle, as well as all tumor pathology or anatomic malformation causing hydrocephalus. [6,16] In our experience this diagnostic method was use in 6% of the cases.

The treatment used in hydrocephalus varies according to each center, and the placement of the Peritoneal Ventricle Shunt (VPS) system is one of the most widely used. In our study, 88.6% of patients underwent VPS; Likewise, other hospitals opt for this surgical technique, for example, Villegas reports that of the 158 patients diagnosed with hydrocephalus, 78% VPS were implanted.[2] Recently, endoscopic ventriculostomy of the III ventricle (ETV) has been successfully used in cases of obstructive hydrocephalus;[6,17,18,19] in our case, this procedure was infrequent (1.3%).

Among the complications secondary to the placement of the VPS system, Villegas reported mechanical dysfunctions below 25%,[2] instead Kestle, [5] Tuli [7] and Di Rocco [8] reported 40% mechanical dysfunction during the first year after placement and 50% during the second year, which differs from our experience, since only 4% of our patients presented complications related to mechanical obstruction during a 2-year period.

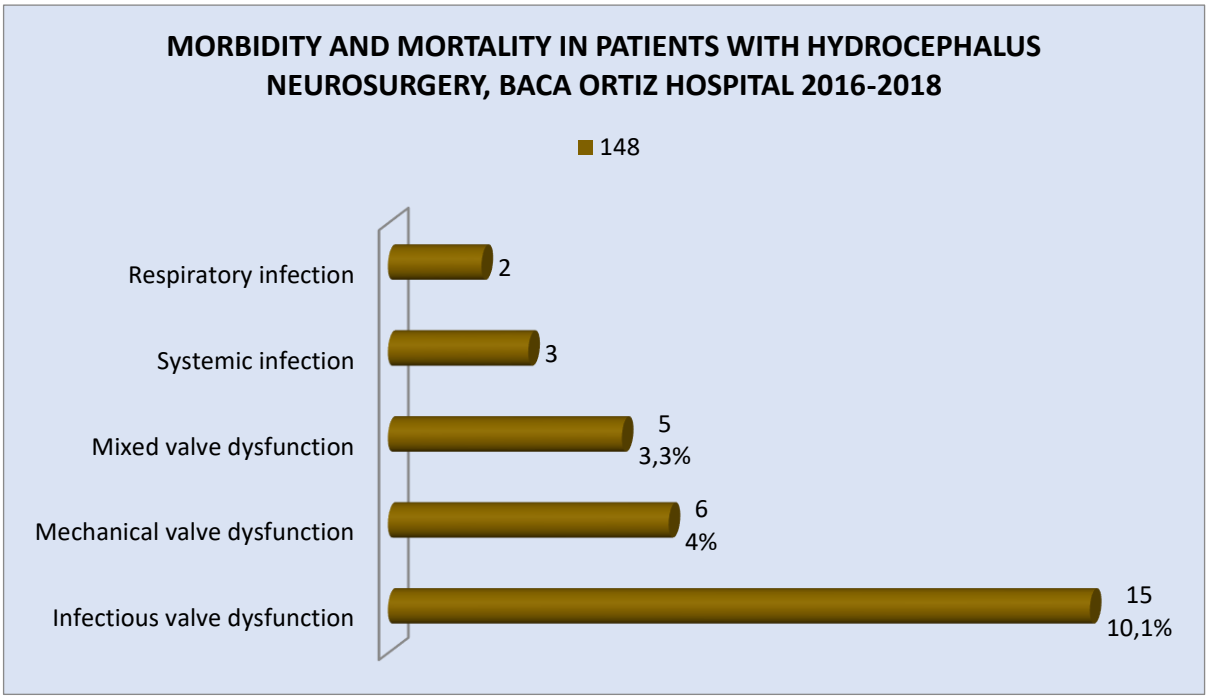

Fig 6. Morbidity and mortality in pediatric patients with hydrocephalus operated in the Neurosurgery Service of the Baca Ortiz Pediatric Hospital, Quito-Ecuador, 2016-2018. (Source: Archives of the Neurosurgery and Statistics Service of the Baca Ortiz Hospital)

In contrast, valve dysfunctions of infectious etiology have a 10% incidence in our experience, over a period of 2 years, which correlates with series such as that of Polank[9] and

Molina,[10] which report on 8 to 10%, although there are other studies that have up to 38% incidence. [11,17,19,20]

Regarding mortality, in our study there are no documented cases of death caused by its underlying pathology, instead we do have 1% mortality associated with systemic infection and 0.6% with respiratory infection; This differs from the results in other series that report the 10.5% mortality associated with hydrocephalus. [2,19,20]

CONCLUSION

Hydrocephalus is a frequent pathology in children, whose most common cause in the congenital type is obstruction of the Silvio aqueduct, without neglecting traumatic, infectious, hemorrhagic or tumor causes in the acquired type. It should be noted that with timely treatment, many children diagnosed with hydrocephalus can lead normal lives, hence the importance of receiving timely and specialized treatment.

RECOMMENDATIONS

Continue documenting studies on hydrocephalus, to improve diagnosis and timely treatment, especially in places with difficult access to a third-level hospital. Likewise, public policies must be improved and expanded to strengthen and promote foods rich in folic acid supplementation in women in the fertile stage, which will decrease malformations of the central nervous system.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: All the authors. *Drafting the article:* Morales C. Critically revising the article: Morales C, Torres A. *Reviewed submitted version of manuscript:* Torres A. *Approved the final version of the manuscript on behalf of all authors:* Torres A.

Correspondence

Alicia Fernanda Torres Merino. Department of Pediatric Neurosurgery of the Baca Ortiz Pediatric Hospital. 6th floor, 6 December, and Colón Avenue. Quito, Ecuador. 15003. E-mail: alifertorres@hotmail.com, alifertorresme@gmail.com

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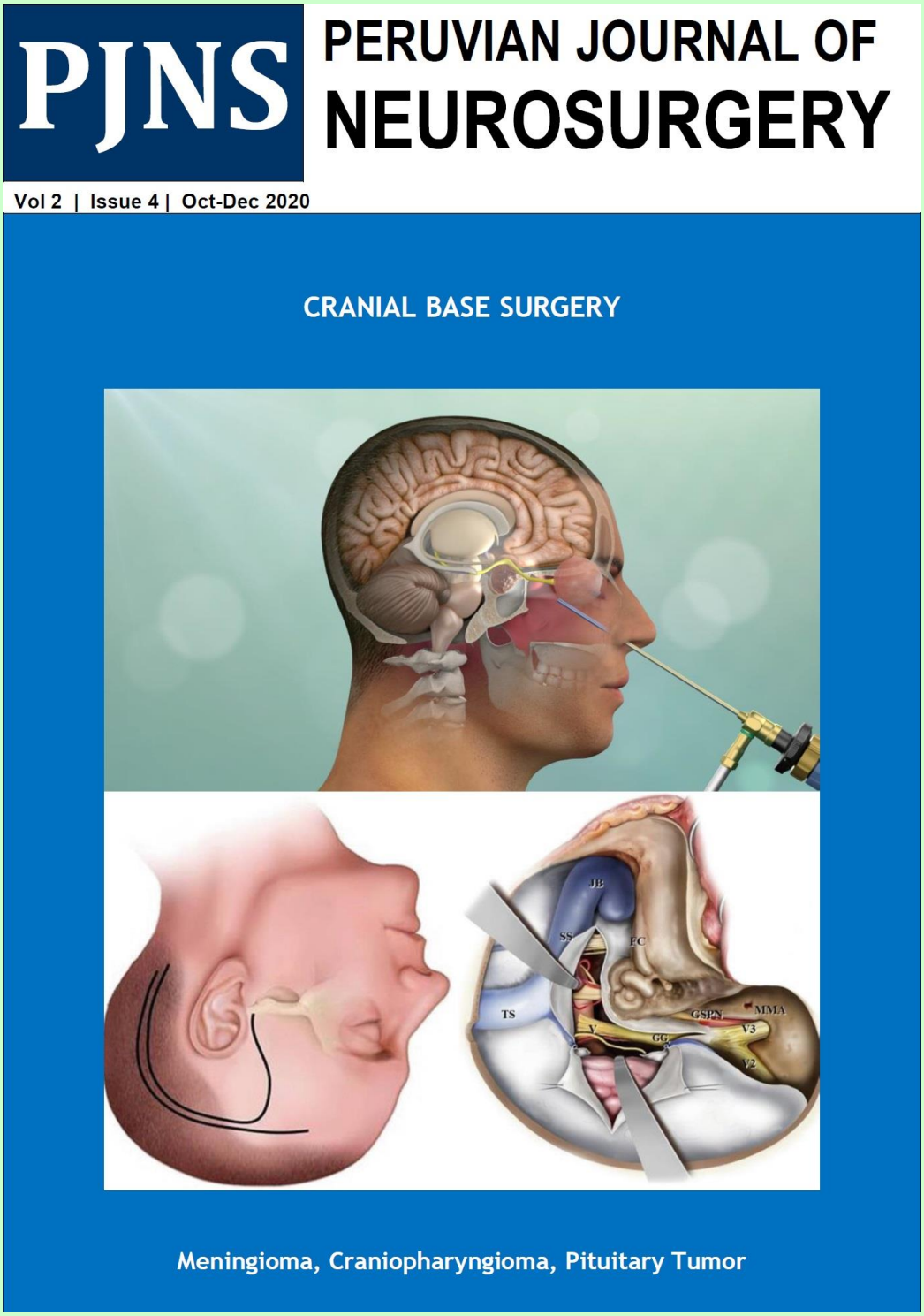
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