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Research Article

Association of the Gastroschisis Prognostic Score (GPS) in Gastroschisis Newborns with the Causes of Morbidity and Mortality

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Abstract

Gastroschisis is a congenital anomaly in which the intestine and other abdominal contents protrude through a paraumbilical defect of the anterior abdominal wall. The objective of this work was to associate the GPS score with morbidity and mortality in newborns with gastroschisis in 4 hospitals in the state of Puebla, as well as to analyze the causes of these cases according to the scale. A retrospective, multicenter cohort study was carried out in four hospital centers in the city of Puebla. Each of the records of newborns diagnosed with gastroschisis during the period from March 2014 to December 2019 was analyzed. It was possible to conclude that there exists an association with statistical significance between the GPS score with the causes of morbidity and mortality.

Keywords: *Pediatrics; Gastroschisis; Gastroschisis Prognostic Score*

Introduction

Gastroschisis is a congenital anomaly in which the intestine and other abdominal contents protrude through a paraumbilical defect of the anterior abdominal wall [1]. The Gastroschisis Prognostic Score (GPS) was developed by Cowan., *et al*. with the use of the information collected in the CAPSNeT database through the score given to intestinal appearance by pediatric surgeons at the pre-surgical time. The technique for surgical closure depends on the degree of intestinal inflammation, the size of the defect, and the general conditions of the newborn. In general, the prognosis is good with a survival rate of ≥ 90%; however, in developing countries, the risk of mortality reaches up to 46% [2-4].

GPS is based on four criteria to assess intestinal injury: intestinal matting, necrosis, atresia and perforation of the intestine [5,6]. A score < 2 corresponds to a low-risk patient, the patient is considered to be at high risk for morbidity if the score is ≥ 2 points, while scores ≥ 4 indicate a high risk of mortality (Table 1) [5-7].

Parameter	0	1	2/4
Matting	None	Mild	Severe (4)
Necrosis	Absent	---	Present (4)
Atresia	Absent	Suspected	Present (2)
Perforation	Absent	---	Severe (4)

Table 1: *Gastroschisis prognostic score (GPS).*

To associate the GPS score with morbidity and mortality in newborns with gastroschisis in 4 hospitals in the state of Puebla (México), as well as to analyze the causes of these cases according to the scale.

Materials and Methods

This is a retrospective, multicenter cohort, carried out in the following hospitals: Hospital para el Niño Poblano, Hospital General Zona Sur "Dr. Eduardo Vázquez Navarro", Hospital de la Mujer and Hospital General Zona Norte de la ciudad de Puebla. The unit of analysis was each of the records of newborns diagnosed with gastroschisis during the period from March 2014 to December 2019. All newborns with gastroschisis who had a complete GPS evaluation seen in the participating hospitals were included. Newborns with gastroschisis who received initial surgical management in another hospital unit were excluded.

The GPS score was made in a preoperative and simple random way by the different pediatric surgeons who operated on the patients. Establishing healthy patients with a score of 0 - 1, patients with morbidity with a score equal to or greater than 2 and patients with mortality with a score greater than or equal to 4.

The following variables were studied: age, sex, weeks of gestation, age in hours at the 1st surgery, age in days at the 2nd surgery, days of hospital stay, onset in days of the oral route, causes of morbidity of the patients (intestinal occlusion, sepsis, necrotizing enterocolitis, intestinal perforation, septic shock, pneumonia) and the causes of patient mortality (septic shock, short bowel syndrome, multiple organ failure, intestinal necrosis). The data of each patient were collected and captured in a database using the statistical package SPSS Statistics v25 - IBM. Descriptive statistics were performed with measures of central tendency and dispersion for quantitative variables. The qualitative variables were expressed as a percentage. Relative risk (RR) was used for the association of the stratified groups. And for the association of qualitative variables we use chi square and Fischer's exact test, in case we cannot perform the first one.

This study was approved by the Research Ethics committees of the Hospital para El Niño Poblano (Folio Number.: HNP 2020-21); Hospital General Zona Sur "Dr. Eduardo Vázquez Navarro" (Folio Number: 03/ENS/INV/REV2017); Hospital de la Mujer (Folio number: 03/ENS/INV/REV2017); and at the Hospital General del Norte (Folio Number: 189/2017).

Results

The study was carried out between March 2014 and December 2019 with a sample of 83 newborns with the diagnosis of gastroschisis. Table 2 lists the main variables, noting that 7 newborns died and from the 76 patients who survived, 60 had some complication.

Variable	Mean	SD	Range (min-max)
Gestation weeks	36.25	1.93	32 - 40
Age in hours at 1st surgery	41.05	44.71	1 - 192
Age in hours at 2nd surgery	4	4.71	0 - 21
Days of Hospital Stay	36	25	0 - 195
Onset in days of the oral route	18.51	14.9	0 - 120

Table 2: *Mean, standard deviation and ranges of the main variables.*

SD: Standard Deviation; Min: Minimum; max: Maximum.

The 83 patients were divided into 3 groups: group 1: those who did not suffer any complications (16 patients), group 2: those who presented any complications (60 patients) and group 3: the patients who died (7 patients).

The patients were stratified according to the causes of morbidity. Of these, 44 presented sepsis (53%), 5 pneumonia (6%), 4 intestinal perforation (5%), 3 necrotizing enterocolitis (4%), 1 septic shock (1%), 3 intestinal occlusion (4%) and 23 did not present morbidities (27%).

The patients who did not have any morbidity or mortality had a mean of hospital stay of 27 days, their standard deviation (SD) was 8 with a range between 15 and 48 days. The patients with morbidity had a mean of 39, SD of 27, its minimum was 15 and the maximum was 195 days. While patients with mortality had a mean hospital stay of 39 days, SD of 24 and a range of 0 to 60. A p of 0.14 was obtained in the hospital stay of all groups.

In patients without complications, the start of the oral route had a mean of 14, SD: 5 and a range of 6-21 days. The morbidity group presented a mean of 20, SD of 16, its minimum was 6 and the maximum was 120 days. While the patients with mortality presented a mean of 13 days, SD: 18 and a range of 0 to 48.

Each group was stratified into 3 subgroups taking into account the GPS score, dividing into patients with a score of 0 - 1, greater than or equal to 2 and greater than or equal to 4 (Table 3).

GPS		0 - 1	2 - 3	> 4	n (%)
Without complications		7	7	2	19%
Causes of morbidity	Intestinal occlusion	0	2	1	3.6%
	Sepsis	17	24	3	53%
	NEC	0	3	0	3.6%
	Intestinal perforation	0	1	3	4.8%
	Septic shock	1	0	0	1.2%
	Pneumonia	2	2	1	6%
Causes of mortality	Septic shock	0	0	3	3.6%
	Short bowel syndrome	0	0	1	1.2%
	Multiple organ failure	0	0	1	1.2%
	Intestinal necrosis	0	0	2	2.4%
Hospital stay (days)	Without complications	179	205	46	19.4% (16)
	Morbidity group	643	1156	549	72.2% (60)
	Mortality group	0	0	202	8.4% (7)
Oral initiation (days)	Without complications	96	117	17	19.4% (16)
	Morbidity group	299	590	326	72.2% (60)
	Mortality group	0	0	91	8.4% (7)

Table 3: *Patients without complications and causes of morbidity and mortality, days of hospital stay and days of fasting according to the GPS score.*

Stratifying the group of morbidities according to the score: in the group of 0 - 1 point there were 20 patients, of which 17 had sepsis (85%), 2 with pneumonia (10%) and 1 with septic shock (5%). In the 2-3 point group, there were 32 patients: 24 were diagnosed with sepsis (75%), 3 with necrotizing enterocolitis (9%), 2 patients with intestinal obstruction (6%), 2 patients with pneumonia (6%) and only 1 with intestinal perforation, corresponding to only 3%. In the group of 4 or more points, there were 8 patients of which 3 had sepsis (37.5%), 3 with intestinal perforation (37.5%), one with pneumonia (12.5%) and one with intestinal occlusion, being 12.5%. By associating 3 independent groups of the GPS score with complications, a $p < 0.05$ was obtained.

In contrast, in the mortality group, the causes were divided into septic shock, short bowel syndrome, multiple organ failure, and intestinal necrosis. 1 patient died of multiple organ failure, 2 patients as a result of intestinal necrosis, 3 patients from septic shock and 1 with short bowel syndrome; thus covering the seven deaths of the study.

The score of 0 - 1 had a relative risk (RR) of 0.8 (95% CI, 0.51; 1.27), in the score greater than or equal to 2 a RR: 0.96 (CI: 95%, 0.69; 1.33) was obtained, while that the association between a score greater than or equal to 4 and mortality obtained a relative risk of 7.6 (CI: 95%, 4.27; 13.54).

Discussion

Although the survival of patients with gastroschisis is greater than 90%, they continue to have prolonged hospital stays secondary to associated morbidities [5,6].

Cowan., *et al*. divided their study population based on the scores obtained through the scale, as follows: < 2 points as low risk, ≥ 2 points to predict morbidity, and ≥ 4 points to predict morbidity and mortality. Newborns with 2 or more points demonstrated greater morbidity than those patients with a score of 0 - 1 (p 0.001) [5-8]. However, in our series we found patients with a score < 2 with morbidities, thus excluding them from the low risk criterion; Likewise, it was observed that patients with scores greater than 2 obtained on the GPS scale did not present complications during their hospital stay, so they were not considered high-risk patients, despite the score obtained in the pre-surgical assessment. In the group of 2 - 3 points there were 7 patients without morbidity and 2 more in the group of 4 - 5, representing more than half of the sample of healthy patients in this study.

Compared with the newborns studied by Shalaby., *et al*. the score of the GPS scale obtained in the 24 infants was distributed as follows: 9 infants with GPS 0 points, 11 patients with GPS 1 point, 2 patients with 4 points and 2 cases with 6 points. It is worth mentioning that the two cases with a score on the GPS scale of 6 points did not survive (p 0.03) [9]. This result is similar to that obtained by our group since the sample studied with a score of 6 or more points in from the scale, we observed that 83% of the patients died.

On the other hand, the main cause of morbidity that appeared in the patients was sepsis in 53%, followed by pneumonia, intestinal occlusion, necrotizing enterocolitis and intestinal perforation, as reported by Cowan., *et al*. where he mentions sepsis as a cause of complication in patients with gastroschisis. However, it is not in the first place of the causes, since it is displaced by cholestasis, which occurs in 18% of patients, with 4% above sepsis; Considering also other causes such as infection of the surgical site, intestinal obstruction, intestinal necrosis and compartment syndrome [8]. These data are comparable to those published by Tarca., *et al*. where in a total of 114 patients, 87 of them presented complications related to the closure of the defect: necrosis and/or intestinal perforation [10]. Shalaby, *et al*. concluded that the main cause of mortality was sepsis, which was found to be related to the transfer time of patients to a unit for surgical intervention [9].

Regarding the causes of mortality, Tarca., *et al*. report that the main diagnosis of death in their patients was multiple organ failure secondary to severe sepsis, presented by patients in 61%, followed by bronchopneumonia with 53%, 10 however, we report as the main cause of death septic shock in 43% of cases, followed by intestinal necrosis in 29% and the rest divided between short bowel syndrome and multiple organ failure. It is important to mention that the 7 patients who died in this study had a score of ≥ 4 points, which places them at high risk for morbidity and mortality, according to the data provided by CAPSNet and the study carried out by Cowan., *et al* [5,6,8].

In this study, a score of 0 - 1 is not associated with patient morbidity or mortality. A score equal to or greater than two samples is a weak association for morbidity, while a score greater than or equal to 4 is highly associated with patient mortality.

Conclusion

There is a statistically significant association between the GPS score and the causes of morbidity and mortality. However, the only score that is strongly related to its outcome are patients with mortality.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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