






# Laparoscopy has better performance than laparotomy in the treatment of stable penetrating abdominal trauma: A retrospective cross-sectional study in a trauma referral hospital in Colombia

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## Abstract

**Background:** Abdominal trauma is one of the leading causes of death. In Colombia, few studies have evaluated the results on related factors and outcomes when comparing laparotomy versus laparoscopy in the management of penetrating abdominal trauma. Therefore, the aim of this study was to investigate the feasibility and safety of laparoscopy in the treatment of stable penetrating abdominal trauma in a limited resources environment in a middle-income country.

**Methods:** Retrospective cross-sectional study was conducted in Bogota, Colombia from January 2018 to October 2020. Patients over 18 years old, hemodynamically stable with penetrating abdominal trauma without other body parts injuries, that underwent laparoscopy and/or laparotomy surgical exploration and treatment were included. Frequencies, percentages, correlations, and odds ratio were calculated.

**Results:** A total of 52 patients were analyzed (26 laparoscopy vs. 26 laparotomy). Stabbing injuries were more frequent in both groups (76.9%), as well as involvement of the anterior abdomen. None missed enterotomies were reported in the laparoscopy group. Surgical time and bleeding were significantly lower in the laparoscopic approach group (63 vs. 115 min and 65 vs. 992 cc, respectively). The time to oral intake and length of stay in the intensive care unit was significantly shorter in the laparoscopic management group (2 vs. 3 days and 1 vs. 4 days, respectively).

**Conclusions:** Surgical results found a safe scenario in a limited resources environment for the application of the laparoscopic technique to approach penetrating abdominal trauma in stable patients without missed injuries, low threshold of conversion to open approach, and additionally not presenting a higher percentage of complications compared with the laparotomy group in Colombia.

Operative time, oral intake, and length of hospital stay were lower in the fully therapeutic laparoscopy group.

**KEYWORDS**

abdomen, abdominal wound closure techniques, Colombia, laparoscopy, laparotomy, wounds and injuries

## 1 | INTRODUCTION

Abdominal trauma is one of the leading causes of death in young people in Colombia. The causes of abdominal trauma are diverse leading to gastrointestinal tract perforation with peritoneal contamination, solid organs, and vascular injuries with massive bleeding and hemorrhagic shock.<sup>1</sup> Since the introduction of laparoscopy and its less invasive surgical naturality some concerns have been generated in different regions of the world about the possibility of its use in the context of trauma, despite going against the surgical dogma that defines penetrating abdominal trauma as an absolute indication for laparotomy approach.<sup>1</sup> As a result, the sensitivity, specificity, and accuracy of laparoscopy in abdominal trauma are reported to be nearly 100% in recent studies.

To date, penetrating abdominal trauma has been approached with very strict management protocols that have not allowed variations for a long time.<sup>2,3</sup> Matsevych et al.<sup>2</sup> reported 318 stable trauma patients treated with laparoscopic approach. Thirty-five patients presented with blunt and 283 with penetrating abdominal injuries. The conversion rate was 11.7% for penetrating and 22.9% for blunt abdominal trauma patients. The most common reason for conversion was continuous intra-abdominal bleeding that could not be controlled quickly. Diagnostic laparoscopy was performed in 45%, and therapeutic laparoscopy in 55% of cases. There were no missed injuries. Complications occurred in 21.2% of the converted group and in 9.6% of the laparoscopic group.<sup>2</sup>

Despite the fact that the attention protocols for penetrating abdominal trauma determine laparotomy as the first-line technique, laparoscopy has been started to be used, finding great advantages over laparotomy in terms of operative time, surgical site infection, safety, length of hospital stay, and even costs with very promising data considering its association with lower complications.<sup>2,4,5</sup> The treatment of all stable trauma patients with laparoscopy appears to be a safe approach. Continuous intraoperative bleeding, complexity of injuries, deterioration of the patient, poor visibility, and equipment failure are indications for conversion.<sup>2</sup> In Colombia, there are no studies that have evaluated the results of fully therapeutic laparoscopy in the treatment of penetrating abdominal trauma. Therefore, the aim of this study was to investigate the feasibility and safety of laparoscopy in the management of stable penetrating abdominal trauma in a limited resources environment in a middle-income country.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design

Retrospective cross-sectional study. Data from the prospectively collected trauma database were extracted and analyzed. The data were retrospectively reviewed at a single institution (Hospital Cardiovascular del Niño de Cundinamarca [Bogota, Colombia]) providing trauma services for a population of 3.2 million people, most of whom live in Soacha Province, Bogota, Colombia.

### 2.2 | Inclusion and exclusion criteria

All adult stable penetrating abdominal trauma patients approached with laparoscopy and laparotomy from January 2018 to October 2020 were included in the study. The cases recorded as converted-to-laparotomy, diagnostic laparoscopy, fully therapeutic laparoscopy, or laparoscopic-assisted were analyzed. Patients younger than 16 years, patients with other body parts injuries, or those who had undergone successful nonoperative management (NOM) were excluded from the study. Cases with missing records were also excluded from the study.

### 2.3 | Data collected

All patients included in the study were allocated to either the laparoscopy or laparotomy group. Laparoscopy was divided into diagnostic laparoscopy (DL), assisted laparoscopy (AL), and fully therapeutic laparoscopy (FTL). All operations were performed under general anesthesia by a surgeon equally dexterous with advanced laparoscopic techniques and open procedures. The outcomes and the length of hospital stay (LOS) were calculated and compared between both groups. LOS was calculated from the date of admission to the date of discharge from hospital. To describe the severity of intraabdominal injuries, the American Association for the Surgery of Trauma (AAST) classification was used. Injury mechanism, surgical approach, conversion, length of intensive care unit and hospital stay, and outcomes were recorded and analyzed in patients with stable penetrating abdominal trauma. The complications of Clavien–Dindo (CD) Grades 3–5 were considered significant and reviewed. Demographic data, location of injury, comorbidities, and complications were recorded for both groups.

## 2.4 | Definition of procedures and techniques

Evacuation of liquid blood or clots, placement of hemostatic agents, and mobilization of any intra or retroperitoneal organs for diagnostic purposes were not considered FTL. FTL was defined as the laparoscopic management of intraabdominal injuries (more than observation or hemostatic agent application). Therapeutic procedures were fully laparoscopic or laparoscopic-assisted. In the fully laparoscopic procedures, all interventions were performed intracorporeally. During AL, the injured bowel was eviscerated through assisted access to perform extracorporeal repair, resection, or anastomosis in patients with multiple injuries. Assisted access was a 4- to 8-cm incision of the abdominal wall, usually incorporating the injury site. During each laparoscopic procedure for trauma, the standard diagnostic, decision-making, and therapeutic steps were followed, as described by Koto et al.<sup>5</sup>

## 2.5 | Statistical analysis

For statistical analyses, IBM SPSS<sup>®</sup> V24 was used. Frequencies and percentages were calculated. Continuous data are presented as mean and standard deviation (SD). Discrete data are presented as median and range. To establish the correlations between the two groups and each variable a bivariate analysis with the  $\chi^2$  test and Fisher's exact test and the Mann Whitney test or Student's *t* test were carried out (according to the distribution of the quantitative variable). The odds ratio (OR) was also calculated. Statistical significance was determined with a  $p < 0.05$

## 3 | RESULTS

A total of 52 patients were analyzed, distributed in two groups of 26 cases, patients that underwent laparoscopy and to laparotomy in the context of stable penetrating abdominal trauma. The patients of the laparoscopy group had an average age of 28 years ( $SD = 9.01$ ) with a predominance of the male gender of 76.9%. In this group stab wounds were more frequent in 76.9% of the cases ( $n = 20$ ), with 88.8% of the injuries in the anterior abdominal wall ( $n = 21$ ). The time between the traumatic injury and the evaluation in the emergency department had an average of 2.12 h ( $SD = 1.30$ ). The 38.5% ( $n = 10$ ) of the patients presented peritoneal irritation (Table 1). The type of injuries were classified based on the AAST classification with an incidence of Grade I 21.1% ( $n = 11$ ), Grade II 71.1% ( $n = 37$ ), Grade III 5.7% ( $n = 3$ ), and Grade IV 1.9% ( $n = 1$ ).

Diagnostic laparoscopy was performed in 100% ( $n = 26$ ) of the cases and 88.5% ( $n = 23$ ) of patients required treatment of intra-abdominal organs injuries. The main clinical sign associated with intra-abdominal organ injury, was peritoneal irritation, which was present in 38.4% ( $n = 10$ ) of the cases. The mean operative time was 63.12 min ( $SD = 32.17$ ) in the laparoscopic approach group. The average bleeding was 65.77 cc ( $SD = 94.87$ ). In 7.7% ( $n = 2$ ),

conversion to laparotomy was performed, due to uncontrolled bleeding from the transverse mesocolon and small bowel mesentery.

The therapeutic surgical laparoscopic procedures, were performed with sutures in the different injured organs as follows: 11.5% ( $n = 3$ ) required diaphragm primary repair, 34.6% ( $n = 9$ ) stomach primary repair ( $n = 12$ ), 42.3% ( $n = 11$ ) small bowel primary repair and 15.4% ( $n = 4$ ) colon primary repair. The 88.5% ( $n = 23$ ) of the repairs were performed using fully therapeutic laparoscopy with intracorporeal sutures and knots (Table 1). Only one gastric resection was performed in 3.8% ( $n = 1$ ). No intestinal or colonic resections were required. No missed bowel or solid organs missed injuries were reported.

The average time for oral intake was 2 days ( $SD = 1.37$ ) in the laparoscopy group. None of the patients needed ICU with an average length of hospital stay of 1 day ( $SD = 0.27$ ). Just one case (3.8%) presented a postoperative complication that was a grade III surgical site infection, being one of the cases that needed conversion to open approach. No reintervention or mortality was reported.

All the patients were discharged based on the absence of fever, tachycardia, abdominal pain, bowel obstruction, and the capability of tolerating oral food intake. Bivariate analysis reported that the surgical time, bleeding and time to oral intake of laparoscopy were statistically significant vs laparotomy with a  $p$  value  $< 0.01$  (Table 2).

## 4 | DISCUSSION

The pathophysiological response to abdominal trauma is characterized by the release of proinflammatory mediators (cytokines, arachidonic acid metabolites, complement factors, acute phase proteins, and hormonal mediators) leading to systemic inflammatory response syndrome. Endothelial cell damage, leukocyte accumulation, disseminated intravascular coagulation, and microcirculatory abnormalities ultimately lead to parenchymal cells apoptosis and necrosis developing a multiple organ dysfunction syndrome or multiple organ failure.<sup>6</sup> Regarding the above, several studies on minimal invasive surgical procedures, such as laparoscopy, have shown a lower surgical induced inflammatory response compared to open surgery in addition to other benefits.<sup>7</sup>

In the same way, multiple benefits in morbidity and mortality of laparoscopy have been demonstrated, significantly improving the general clinical outcome of patients but only some of these advantages of minimally invasive surgery have been investigated in abdominal trauma.<sup>1</sup> Historically, peritonitis has been considered a contraindication for laparoscopy, due to the theoretical risk of malignant hypercapnia caused by increased absorption of carbon dioxide in the presence of severe intra-abdominal infection and peritoneum inflammation and toxic shock syndrome risk owing to the increased passage of toxins and bacteria into the circulation favored by high intraperitoneal pressure. Even so, in recent decades, this topic has been further investigated and the benefits of laparoscopy have also been demonstrated in cases of peritonitis.<sup>8</sup>

**TABLE 1** Sociodemographic characteristics, clinical condition, and technical aspects in patients treated with laparoscopy versus laparotomy.

Patient characteristics and surgical variables	Laparoscopy n (%)	Laparotomy n (%)	p value
Male	17 (65.4)	23 (88.5)	0.215 <sup>‡</sup>
Average age (DE)	28 (9.0)*	32.27 (13.3)*	0.124 <sup>†</sup>
Stab wound	20 (76.9)	20 (76.9)	0.671 <sup>‡</sup>
Gunshot wound	6 (23.1)	6 (23.1)	0.671 <sup>‡</sup>
Time for admission (hours)	2.12 (1.3)*	1.85 (0.6)*	0.396 <sup>†</sup>
Hemodynamic instability	0 (0.0)	9 (34.6)	-
Peritoneal irritation	10 (38.5)	9 (34.6)	0.696 <sup>‡</sup>
Anterior abdominal wound	21 (88.8)	12 (46.2)	0.490 <sup>‡</sup>
Lateral abdominal wound	0 (0.0)	7 (26.9)	-
Thoracoabdominal anterior wound	0 (0.0)	7 (26.9)	-
Thoracoabdominal wound	5 (19.2)	0 (0.0)	-
Diagnostic laparoscopy	26 (100)	-	-
Therapeutic laparoscopy	23 (88.5)	-	-
Surgical time in minutes	63.12 (32.1)-	115.19 (83.6)*	0.008 <sup>†</sup>
Bleeding in cubic centimeters	65.77 (94.8)*	992.31 (1151.4)*	0.000 <sup>†</sup>
Conversion to laparotomy	2 (7.7)	-	-
Diaphragm suture	3 (11.5)	8 (30.8)	0.220 <sup>‡</sup>
Stomach suture	9 (34.6)	3 (11.5)	0.215 <sup>‡</sup>
Small intestine suture	11 (42.3)	4 (15.4)	0.735 <sup>‡</sup>
Colon suture	4 (15.4)	7 (26.9)	0.220 <sup>‡</sup>
Solid organ suture	-	8 (30.7)	-
Intracorporeal knots	23 (88.5)	-	-
Bowel resection	0 (0.0)	2 (7.7)	-
Gastric resection	1 (3.8)	0 (0.0)	-
Colon resection	0 (0.0)	1 (3.8)	-
Forgotten injuries	0 (0.0)	1 (3.8)	-
Oral tolerance in days	2 (0.0)*	3.19 (1.7)*	0.001 <sup>†</sup>
Attention in intensive care unit	0 (0.0)	4 (15.4)	-
Total length of hospital stays in days	1.92 (0.27)*	4.92 (5.5)*	0.123 <sup>†</sup>
Complications	1 (3.8)	1 (3.8)	0.838 <sup>‡</sup>
Preoperative evisceration	-	5 (19.2)	-
Postoperative eventration	-	2 (7.7)	-
Trauma-derived mortality	0 (0.0)	5 (19.2)	-

Abbreviation: SD, standard deviation.

\*Mean (SD).

†Student's *T*.

‡Chi-squared.

**TABLE 2** Statistical measures of the variables.

Patient characteristics and surgical variables	p value	OR (CI)
Male	0.21 <sup>†</sup>	4.5 (0.35–59.1)
Average age (DE)	0.12 <sup>†</sup>	
Stab wound	0.67 <sup>‡</sup>	0.6 (0.056–6.44)
Gunshot wound	0.67 <sup>‡</sup>	0.6 (0.056–6.44)
Time for admission (hours)	0.39 <sup>†</sup>	–
Hemodynamic instability	–	–
Peritoneal irritation	0.69 <sup>‡</sup>	0.7 (0.132–3.86)
Anterior abdominal wound	0.49 <sup>‡</sup>	0.5 (0.069–3.647)
Lateral abdominal wound	–	–
Thoracoabdominal anterior wound	–	–
Thoracoabdominal wound	–	–
Diagnostic laparoscopy	–	26 (100)
Therapeutic laparoscopy	–	23 (88–5)
Surgical time in minutes	0.00 <sup>†</sup>	–
Bleeding in cubic centimeters	0.00 <sup>†</sup>	–
Conversion to laparotomy	–	–
Diaphragm suture	0.22 <sup>‡</sup>	1.5 (1.138–2.067)
Stomach suture	0.21 <sup>‡</sup>	4.5 (0.354–59.10)
Small intestine suture	0.73 <sup>‡</sup>	1.4 (0.171–12.23)
Colon suture	0.22 <sup>‡</sup>	1.4 (1.068–1.1.835)
Solid organ suture	–	–
Intracorporeal knots	–	–
Bowel resection	–	–
Gastric resection	–	–
Colon resection	–	–
Forgotten injuries	–	–
Oral tolerance in days	0.00 <sup>†</sup>	–
Attention in intensive care unit	–	–
Total length of hospital stays in days	0.12 <sup>†</sup>	
Complications	0.83 <sup>‡</sup>	1.0 (0.962–1.128)
Preoperative evisceration	–	–
Postoperative eventration	–	–
Trauma-derived mortality	–	–

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>†</sup>Student's *T*.

<sup>‡</sup>Chi-squared.

Regarding diagnostic approach, computerized axial tomography or magnetic resonance imaging do not provide ample effectiveness in the study of hollow viscera and mesentery lesions, however, its advantage is that it does not require peritoneal violation. On the

other hand, laparoscopy has shown in several studies high precision for the detection of abdominal injuries in stable patients with penetrating or blunt trauma despite peritoneum lesion, as well as significantly reduce of nontherapeutic laparotomies rate up to a 73%.<sup>3</sup> Lower morbidity rates, shorter hospital stay, and surgical time have also been reported in the context of abdominal trauma.<sup>9</sup>

By observing these advantages among others, laparoscopy is emerging as a safe and effective technique. In this sense, knowing these advantages in patients with abdominal trauma attended by an institution of fourth level of complexity in Cundinamarca, Colombia, will allow to identify the benefits of the surgical technique, standing up the surgeon actions when the laparoscopic approach becomes part of the therapeutic options, promoting a safety professional's decision and intervention when it is indicated. Additionally, it will influence morbidity and mortality from abdominal trauma patients and supports the professional and participating health center image.

The age of the patients studied is close to the fourth decade of life, which coincides with the study by Bain et al.,<sup>10</sup> who in New York City found in patients with penetrating abdominal trauma in a 10-year time line an average age of 31 years,<sup>10</sup> similar age range (30 years) referred to by Chestovich et al.<sup>11</sup> in their research carried out in Las Vegas (Nevada-United States),<sup>11</sup> as well as Rodas et al.<sup>12</sup> in their study in Havana (Cuba).<sup>12</sup> This age range compatible with young victims of abdominal trauma can be associated with the statistics in our country, which establish trauma as the major cause of mortality in this age group. However, studies in Europe and the East, such as Malkomes et al.,<sup>13</sup> in their study carried out in Germany, average age of 36.2 ± 14 years was defined<sup>13</sup> and the study by Lin et al.<sup>14</sup> carried out in Taiwan, established an average of 43.8 ± 11.6 years.<sup>14</sup> Regarding sex, men present the highest frequency in this event, which is also reported by Bain et al.,<sup>10</sup> Malkomes et al.,<sup>13</sup> Chestovich et al.,<sup>11</sup> Lin et al.,<sup>14</sup> and Rodas et al.<sup>12</sup>

In this study, 76.9% of sharps weapon injuries were presented, which is similar to that documented by Malkomes et al.<sup>13</sup> (76.5%), and slightly lower than that published by Bain et al.<sup>13</sup> (85.71%), but it differs significantly from what was found by Chestovich et al.,<sup>11</sup> who documented 54.3% of sharps weapon injuries. These differences can be explained by the sociocultural characteristics of the population, being in our country the sharps weapons used most frequently in assaults and crimes, as shown by the national institute of legal medicine in its study of personal injuries carried out from 1999 to 2019 in Colombia.

Conversion to laparotomy was found in 7.7%, different from the study carried out by Bain et al.,<sup>10</sup> where a conversion rate of 17.9% is reported. Regarding the analysis of procedures and evaluation of technical factors, in this study, the ability of surgeons to achieve sutures of organic lesions and their respective intracorporeal knots were observed in 88.8% of the cases.<sup>10</sup> Regarding visceral repairs, the following figures are reported: 11.5% (*n* = 3) required sutures in the diaphragm, 34.6% (*n* = 9) in the stomach (*n* = 12), 42.3% (*n* = 11) in the small intestine and 15.4% (*n* = 4) in colon. In comparison with Bain et al.<sup>10</sup> who reported a percentage of visceral repair of 14.28% in the liver and 10.71% in the diaphragm among the most frequent.<sup>10</sup> A

similar study carried out in Australia, showed a 30.95% repair of liver injuries.<sup>15</sup> However, these results differ from the study by Malkomes et al.,<sup>13</sup> who found 25% predominant lesions in the small intestine and colon (4), the foregoing being similar to that documented by Chestovich et al., who also reported 23.4% of liver injury.<sup>11</sup>

Complications occurred in 3.8% in a single patient, this being the late conversion to laparotomy due to hemorrhagic collection that could not be addressed by laparoscopic drainage, this data is slightly lower than that reported by Lin et al in their study carried out in Taiwan (4.2%)<sup>14</sup> and by Bain et al.,<sup>10</sup> who in New York City reported 5.35% of complications in 56 patients.

A meta-analysis carried out by Hajibandeh et al.,<sup>7</sup> demonstrates the benefits of the laparoscopic technique, such as: lower probability of wound infection (OR: 0.55; 95% confidence interval [CI] 0.37–0.81,  $p = 0.003$ ), healthcare-associated pneumonia (OR: 0.22, 95% CI: 0.13–0.37,  $p < 0.00001$ ), shorter hospital stay (mean difference [MD]: –3.05; 95% CI: –4.68 to –1.42,  $p = 0.0002$ ) and procedure time (MD: –27.99, 95% CI: –43.17 to –12.80,  $p = 0.0003$ ) compared with laparotomy.<sup>7</sup> The average surgical time in laparoscopy was 63.12 min, which was lower than that reported by Nicolau et al.,<sup>16</sup> who reported a surgical time of  $74.5 \pm 41$  min. The surgical time for conversion was  $148.2 \pm 58.73$ , slightly higher than that reported by Nicolau et al. ( $136 \pm 93.63$ ).<sup>16</sup>

The hospital stays averaged 1.92 days, significantly less than that reported in the studies by: Bain et al. [10] (3.1 days), Malkomes et al.<sup>13</sup> (7.9 days), Chestovich et al.<sup>11</sup> (6 days), and Lin et al. ( $5.0 \pm 3.6$  days).<sup>14</sup> In this sense, a much shorter hospital stay can be inferred with laparoscopy compared to laparotomy.<sup>11</sup> In this study, mortality was 19% which is higher than that reported by Chestovich et al.,<sup>11</sup> for whom this outcome was 6.1% and by Malkomes et al.<sup>13</sup> study (1.7%), and much more different from the result mentioned by Bain et al. who did not report mortality in their study.<sup>10</sup>

In the literature, several studies document the effectiveness of diagnostic laparoscopy. In this sense, Cocco et al.<sup>15</sup> refer in their study conducted in Australia with 146 patients with abdominal sharp wounds, which found a 100% sensitivity, 60.9% specificity, a negative predictive value of 100%, and a positive predictive value of 40%.<sup>15</sup> Moreover, Rodas et al.<sup>12</sup> in Cuba found a sensitivity between 18% and 67%, specificity between 36% and 96%, a negative predictive value between 31% and 51%, and a positive predictive value between 63% and 90% for shock, signs of bleeding, perforation of the gastrointestinal tract, significant bleeding, evisceration, peritonitis, and peritoneal penetration.<sup>12</sup>

The findings of this study should be interpreted within the context of its design. It's a single-center nonrandomized study with a small sample. The results should therefore be viewed as hypothesis-generating to conduct future studies. All data were retrospectively collected from the electronic medical records and the outcomes are based on what has been registered. Strengths of this study are the detailed short and long-term clinical outcomes of fully therapeutic approach for stable penetrating abdominal trauma, the patients' follow-up, and the adherence to the indications for early conversion to laparotomy.

## 5 | CONCLUSIONS

Surgical results in this study found a safe scenario in a limited resources environment for the application of the laparoscopic technique to approach penetrating abdominal trauma in stable patients without missed injuries, low threshold of conversion to open approach, and additionally not presenting a higher percentage of complications compared to the laparotomy group. Operative time, oral intake, and length of hospital stay were lower in the fully therapeutic laparoscopy group. It also shows a decrease in the laparotomy deleterious effect in the context of penetrating abdominal trauma by offering the laparoscopic technique to patients who meet the selection criteria reaching lower mediate and late comorbidities. The absence of missed injuries in the group treated with laparoscopy can be highlighted, which is the greatest fear in surgeons' unions to change the paradigm of performing laparotomy in patients with penetrating abdominal trauma.

### AUTHOR CONTRIBUTIONS

**Efrain Jose Isaac Gómez:** Conceptualization; data curation; formal analysis; investigation; methodology; resources; software; validation; writing—original draft; writing—review & editing. **Luis Felipe Cabrera Vargas:** Conceptualization; data curation; formal analysis; investigation; methodology; resources; software; validation; writing—original draft; writing—review & editing. **Ivan David Lozada-Martinez:** Formal analysis; investigation; methodology; software; validation; writing—original draft; writing—review & editing. **Mariana Reyes:** Investigation; Validation; writing—original draft; writing—review & editing. **Mauricio Pedraza:** Investigation; Validation; writing—original draft; writing—review & editing. **Nicolas Forero:** Investigation; Validation; writing—original draft; writing—review & editing. **Daniela Guardo-Carmona:** Investigation; Validation; writing—original draft; writing—review & editing. **Alexis Narvaez-Rojas:** Investigation; Validation; writing—original draft; writing—review & editing.

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### CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

### DATA AVAILABILITY STATEMENT

The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### ETHICS APPROVAL

This study was approved by the ethics committee of our hospital.

### GUARANTOR

All authors have read and approved the final version of the manuscript. The corresponding author had full access to all of the data in this study and takes complete responsibility for the integrity

of the data and the accuracy of the data analysis. The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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