

ORIGINAL ARTICLE

Management of the open abdomen in critically ill patients in a level III center in Popayán

Manejo del abdomen abierto en el paciente crítico en un centro de nivel III de Popayán

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Abstract

Introduction. The open abdomen is a useful resource for the treatment of patients with complex abdominal pathology, with the potential for complications. The aim of this study was to adapt the World Society of Emergency Surgery (WJES) 2018 guideline, in a level III hospital and compare the results obtained with those prior to its implementation.

Methods. Quasi-experimental study in two measurements of patients with open abdomen and stay in critical care, during the months of April to October in 2018 and 2019, before and after the adaptation with the healthcare personnel of the WSES 2018 clinical practice guide. Descriptive statistics, Chi square test and SPSS V.25 software were used.

Results. Ninety-nine critically ill patients were included, with a mean age of 53.2 years, with an indication of open abdomen due to traumatic etiology in 28.3%, infectious non-traumatic in 32.3%, and non-traumatic or infectious in 37.4%. Overall mortality was 25.3%, of which 68% were due to causes other than abdominal pathology. Postoperative complications occurred in 10 patients with surgical site infection and 9 patients with enterocutaneous fistula. The use of the double Viasflex was implemented in 63.6%, achieving a closure of the abdominal wall in 79.8% ($p=0.038$) of the cases.

Conclusion. The open abdomen requires a multidisciplinary approach. The use of double Viasflex is a simple and effective tool. The implementation of the guide decreased the percentage of mortality, the days of open abdomen and the stay in intensive care.

Keywords: open abdomen techniques; damage control; wounds and injuries; infections; emergencies; postoperative complications.

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Resumen

Introducción. El abdomen abierto es un recurso útil para el tratamiento de pacientes con patología abdominal compleja, con potencial de complicaciones. El objetivo de este estudio fue adaptar la guía de *World Society of Emergency Surgery 2018*, en un hospital de nivel III de atención de la ciudad de Popayán, Colombia, y comparar los resultados obtenidos con los previos a su implementación.

Métodos. Estudio cuasi-experimental en dos mediciones de pacientes con abdomen abierto y estancia en cuidado crítico, durante los meses de abril a octubre de los años 2018 y 2019, antes y después de la adaptación con el personal asistencial de la guía de práctica clínica WSES 2018. Se utilizó estadística descriptiva, prueba de Chi cuadrado y se empleó el software SPSS V.25.

Resultados. Se incluyeron 99 pacientes críticos, con una edad media de 53,2 años, con indicación de abdomen abierto por etiología traumática en el 28,3 %, infecciosa no traumática en el 32,3 % y no traumática ni infecciosa en el 37,4 %. La mortalidad global fue de 25,3 %, de los cuales, un 68 % se debieron a causas ajenas a la patología abdominal. Las complicaciones postoperatorias se presentaron en 10 pacientes con infección de sitio operatorio y 9 pacientes con fístula enterocutánea. El uso del doble Viasflex se implementó en un 63,6 %, logrando un cierre de la pared abdominal en el 79,8 % de los casos ($p=0,038$).

Conclusión. El abdomen abierto requiere de un abordaje multidisciplinar. El uso de doble Viasflex es una herramienta simple y efectiva. La implementación de la guía disminuyó el porcentaje de mortalidad, los días de abdomen abierto y la estancia en cuidados intensivos.

Palabras claves: técnicas de abdomen abierto; control de daños; heridas y traumatismos; infecciones; urgencias médicas; complicaciones posoperatorias.

Introduction

Abdominal surgery has considerably increased its frequency and thus its complexity. Simultaneous advances in perioperative care have enabled patients to successfully withstand surgical trauma and eventual complications¹. Despite the undoubted benefits of the aforementioned changes, they brought as a consequence new challenges², observing more frequently in critical care services the so-called abdominal catastrophes, a condition that carries a high mortality (20-60%)³. Its treatment is complex and requires a multidisciplinary approach, where the responsibility of the surgical team cannot be delegated.

The open abdomen (OA) has been proposed to treat or prevent the effects of disturbed physiology in severely injured patients⁴. Although it represents a remarkable therapeutic alternative in its performance, it must be recognized as a non-anatomical disease; a situation that has possible side effects, increasing patient morbidity and determining the mobilization of greater institutional

resources around their care. The indications for its use and the derived complications are not adequately documented at the national level; therefore, its use must be individualized in the patients who would most benefit from it.

In 2018, the World Society of Emergency Surgery (WSES)⁵ published the consensus "The open abdomen in trauma and non-trauma patients" with recommendations for optimal management with OA of traumatized and non-traumatized patients, so the objective of this study was to adapt and implement the WSES guide in a level III hospital in the city of Popayán, Colombia, and compare the results that were being obtained with those found after its implementation in the institution.

Methods

A non-randomized analytical study was carried out, with two measurements, one prior to the intervention in historical controls and the other after the intervention, taking into account all patients 15 years of age or older, attended by the

general surgery group, who required management with an open abdomen and stay in the intensive care unit (ICU), between the months of April and October of 2018 and 2019. Those patients who, in the clinical record they did not have all the required data, were excluded.

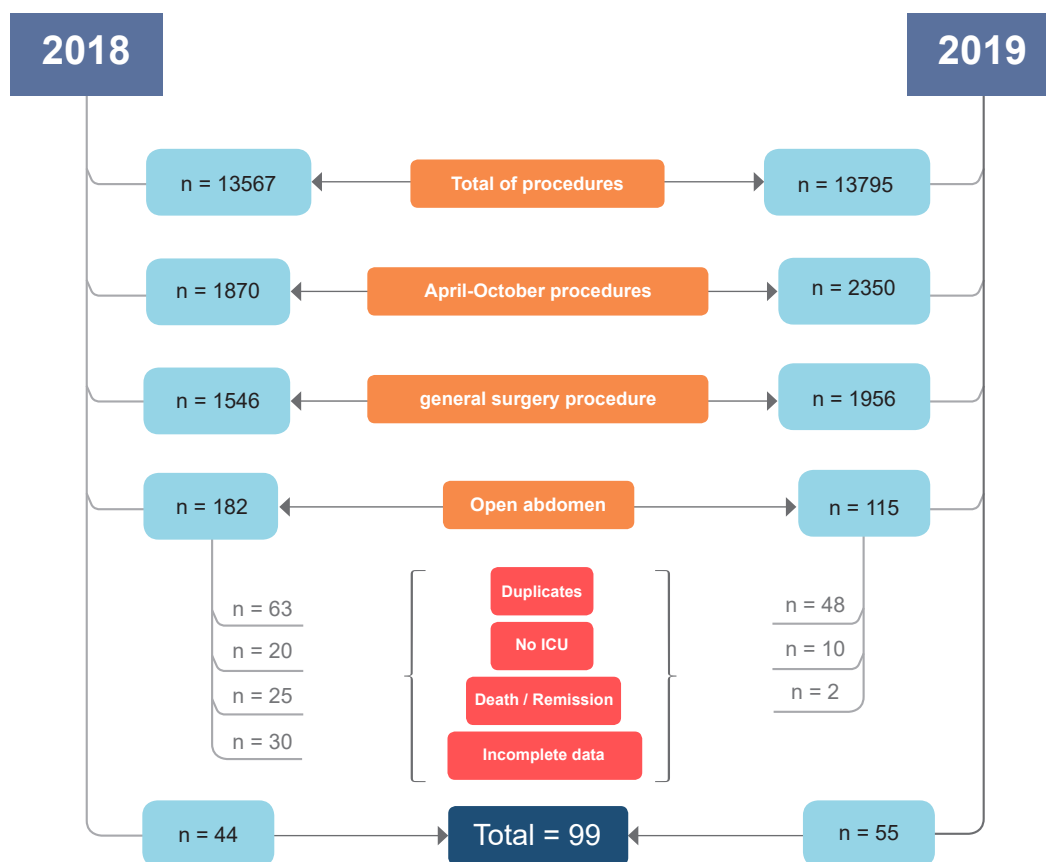
The research group adapted the WSES 2018 clinical practice guideline to the capacity and resources of the institution, and shared it with the staff immersed in the care of this pathology⁵. Once consensus was reached, the recommendations were implemented in the different services and prospective data collection began. The information was obtained by the resident doctors of the General Surgery program, through the review of medical records and registration in the Clinapsis® application. This research was classified as low

risk and was endorsed by the institutional ethics committee.

Descriptive statistics was used for the analysis, presenting the results in frequencies and proportions for the categorical variables and measures of central tendency and dispersion for the quantitative variables. For the comparison of the practice and the outcomes in the study periods, the Chi square test was used and the level of significance was established at $p < 0.05$. SPSS® software (IBM Company) version 25 was used.

Results

Between the months of April and October of 2018 and 2019, 99 patients managed using the open abdomen technique were included, 44 patients in the year 2018 and 55 in the year 2019.



* ICU: intensive care unit. Source: The authors

Figure 1. Patient selection flowchart.

The selection of the population is described in Figure 1.

The population consisted of 70 men (70.7%), with a mean age of 53 years (SD=20.7), who belonged to 90.8% of socioeconomic strata one and two and were affiliated to the subsidized regime. of social security in health in 84.8% (n=84). In 2018, 21 patients came from the urban area (47.7%), while in 2019, 51 patients came from the rural area (92.7%) (Table 1).

Among the causes that led to leaving the abdomen open, in 2018 non-traumatic inflammatory pathologies of the abdominal cavity occurred in 47.7% (n=21) and inflammatory septic processes in 34.1% (n =15). This behavior changed by 2019, showing trauma as the main indication with 38.2% (n=21), sharing its frequency with infectious pathology in 30.9% (n=17) (Table 2).

Among the different surgical techniques, in 2018 hybrid intermediate management was used

Table 1. Sociodemographic characterization of patients with open abdomen included in the study..

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Gender	Female	13	29.5	16	29.1	29	29.3	0.961
	Male	31	70.5	39	70.9	70	70.7	
Age	Average	57.11		50.13		53.2		0.242
	Standard deviation	18.3		22.1		20.7		
	Range	17-89		18-89		17-89		
Origin	Rural	15	34.1	51	92.7	66	66.7	0.000
	Urban	21	47.7	4	7.3	25	25.3	
	Dispersed	8	18.2	0	0.0	8	8.1	
Social status	1	17	38.6	26	47.3	43	43.4	0.032
	2	19	43.2	28	50.9	47	47.5	
	3	6	13.6	0	0.0	6	6.1	
	4	2	4.5	1	1.8	3	3.0	
Social security system	Linked	4	9.1	0	0.0	4	4.0	0.000
	Subsidized	30	68.2	54	98.2	84	84.8	
	Contributory	10	22.7	1	1.8	11	11.1	

Table 2. Open abdomen indications and temporary closure techniques used.

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Indication	Trauma	7	15.9	21	38.2	28	28.3	0.084
	Non trauma	21	47.7	16	29.1	37	37.4	
	Infection	15	34.1	17	30.9	32	32.3	
	Reintervention	1	2.3	1	1.8	2	2.0	
Surgical technique	Double Vialflex	12	27.3	51	92.7	63	63.6	0.000
	Negative pressure system	2	4.5	1	1.8	3	3.0	
	Free Vialflex in cavity	11	25.0	0	0.0	11	11.1	
	Vialflex simple to skin	3	6.8	0	0.0	3	3.0	
	Others	16	36.4	3	5.5	19	19.2	

in up to 36.4% (n=16), followed by free Viaflex to the cavity and with simple raffia to the skin in 31.8% (n=14), practices that were abandoned after the implementation of the guideline recommendations, with the use of the double Viaflex predominating in 92.7% (n=51), being a statistically significant finding (p=0.000) (Table 2).

APACHE 2 had a similar mean score for the two years, 21.1 (SD 10.5) in 2018 and 21.3 in 2019

(SD 8.1), and base excess had levels greater than -8.2 in 2018 (SD 4.9) and -7.2 in 2019 (SD 6.4) (Table 3).

In the perioperative setting, the use of balanced solutions, such as Ringer’s lactate, was superior to the use of physiological solution, with total values of 89.9% (n=89) in 2019 versus 13.1% (n=13) in 2018 (Table 4). The use of vasopressors and inotropes was frequent in the damage control

Table 3. APACHE II values, excess base and serum lactate of patients with open abdomen included in the study.

	2018			2019			p-value
	Average	SD	Min-Max	Average	SD	Min-Max	
Apache II	21.11	10.6	4 - 46	21.29	8.1	5 - 42	0.387
Excess base	-8.28	4.9	-19.90 - 3.50	-7.27	6.4	-47.00 - 2.60	0.470
Lactate	3.82	2.6	0.87 - 10.00	3.38	2.4	0.80 - 15.00	0.181

SD: standard deviation; Min: minimum; Max: maximum.

Table 4. Hydroelectrolytic intervention, use of vasopressors, inotropes and blood volume expanders in patients with open abdomen treated during 2018 and 2019.

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Sodium chloride pre	Yes	20	45.5	5	9.1	25	25.3	0.000
Hartmann pre	Yes	27	61.4	52	94.5	79	79.8	0.000
Dextrose pre	Yes	10	22.7	28	50.9	38	38.4	0.004
Potassium pre	Yes	0	0.0	8	14.5	8	8.1	0.008
Magnesium pre	Yes	0	0.0	5	9.1	5	5.1	0.040
Vasopressor pre	Yes	5	11.4	2	3.6	7	7.1	0.136
Inotropes pre	Yes	0	0.0	1	1.8	1	1.0	0.369
Sodium chloride pos	Yes	10	22.7	3	5.5	13	13.1	0.011
Hartmann pos	Yes	34	77.3	55	100.0	89	89.9	0.040
Dextrose pos	Yes	18	40.9	35	63.6	53	53.5	0.024
Potassium pos	Yes	6	13.6	17	30.9	23	23.2	0.043
Magnesium pos	Yes	4	9.1	18	32.7	22	22.2	0.005
Phosphorus pos	Yes	0	0.0	8	14.5	8	8.1	0.008
Albumine pos	Yes	0	0.0	20	36.4	20	20.2	0.000
Gelofusine pos	Yes	5	11.4	21	38.2	26	26.3	0.003
Vasopressor pos	Yes	12	27.3	51	92.7	63	63.6	0.000
Inotropices pos	Yes	3	6.8	19	34.5	22	22.2	0.001

* Pre: group operated prior to the intervention; Pos: group operated after the intervention.

phase (63.3%), with 27.3% (n=12) for 2018 and a significant increase for 2019 up to 92.7% (n=51). Similarly, inotropic management went from 6.8% (n=3) in 2018 to 34.5% (n=15) in 2019, the differences being statistically significant.

The metabolic flow managed with dextrose solutions increased in 2019 to 63.6% (n=35) and the use of vasopressor and inotropic support in preoperative management did not present differences in the two years. Regarding the use of colloid solutions, it was found that albumin, as a flow redistributor, was only used in 2019, in 36.4% (n=20), and in relation to other types of expanders, such as Gelatin succinate was also increased for 2019 (n=21, 38.2%), compared to 2018 (n=5, 11.4%).

Nutritional intervention was performed in 72.7% of patients in 2018, with an increase to 94.5% in 2019, mainly due to the increase in the use of enteral nutrition (from 25% to 53.8%), contrary to what happened with parenteral nutrition, which was used in 31.3% of patients (n=10) in 2018 and decreased to 15.4% (n=8) by 2019. These changes were considered favorable and the difference was statistically significant (p=0.029) (Table 5).

The ICU stay was similar in the two populations, with mean days of 9.5 and 9.4, respectively. The ventilatory support time was longer in 2019

(5.1 vs. 7.3 days), as was the total hospital stay (14.0 vs. 19.2 days), but the difference was not statistically significant.

The outcomes defined as infectious complications were present in 40.4% (n=40) of the patients, categorized regardless of the underlying pathology and the length of hospital stay, with pulmonary infection associated with the infections being more frequent in 2018 (n=7; 43.8%) and bacteremia (n=4; 25.0%); predominating in 2019 the surgical site infection (n=15; 45.5%), with a statistically significant difference (p=0.023) (Table 6).

On the other hand, non-infectious complications occurred in 67 patients (67.7%), derived from the care process and the hospital stay, with physical deconditioning being the main one in both periods, with 70.7% (n=58). It was a higher percentage of enterocutaneous fistula in 2019 (n=6; 10.9%) compared to 2018 (n=3; 6.8%), although the difference was not statistically significant.

Among surgical outcomes, there was a significant increase in OA closure from one population to another, from 70.5% in 2018 (n=31) to 87.3% in 2019 (n=48) (p= 0.038). In addition, the time for closure of the abdomen decreased, from a mean time of 9.5 days in 2018 to 7.4 days in 2019. The most used surgical technique in both periods was

Table 5. Indication of management and nutritional support, types and days of intervention.

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Received nutrition	No	12	27.3	3	5.5	15	15.2	0.003
	Yes	32	72.7	52	94.5	84	84.8	
Nutrition	Enteral	8	25.0	28	53.8	36	42.9	0.029
	Average	6.4		5.7		5.9		
	SD	7.4		6.6		6.7		
	Parenteral	10	31.3	8	15.4	18	21.4	
	Average	12.3		11.4		11.9		
	SD	7.9		3.8		6.3		
	Mixed	14	43.8	16	30.8	30	35.7	
	Average	21.6		13.6		17.3		
SD	18.2		9.4		14.5			

SD: standard deviation.

Table 6. Description of infectious and non-infectious complications in the study period.

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Infectious complications	No	29	65.9	30	54.5	59	59.6	0.252
	Yes	15	34.1	25	45.5	40	40.4	
Flebitis	Yes	2	12.5	8	24.2	10	20.4	0.339
HAP	Yes	7	43.8	11	33.3	18	36.7	0.478
UTI	Yes	1	6.3	1	3.0	2	4.1	0.593
Eschar	Yes	0	0.0	1	3.0	1	2.0	0.482
SSI	Yes	2	12.5	15	45.5	10	20.4	0.023
Bacteremia	Yes	4	25.0	6	18.2	5	10.2	0.579
Others	Yes	3	18.8	2	6.1	5	10.2	0.169
Non-infectious complications	No	18	40.9	14	25.5	32	32.3	0.102
	Yes	26	59.1	41	74.5	67	67.7	
Tracheostomy	Yes	2	7.4	4	7.3	6	7.3	0.982
Pressure zone	Yes	4	14.8	12	21.8	16	19.5	0.452
Diaphragmatic injury	Yes	0	0.0	6	10.9	6	7.3	0.075
Deconditioning	Yes	24	88.9	34	61.8	58	70.7	0.011
Fistula	Yes	3	6.8	6	10.9	9	9.1	0.482
Oter non-infectious	Yes	3	11.1	7	12.7	10	12.2	0.834

* HAP: hospital-acquired pneumonia; UTI: urinary tract infection; SSI: surgical site infection.

raffia by anatomical planes, followed by partial closure of the cavity with approximation of the skin. Overall mortality represented 25.3% (n=25), with a noticeable decrease between 2018 (n=15; 34.1%) and 2019 (n=10; 18.2%). The causes of death associated with the open abdomen showed an even greater reduction, from a 46.7% (n=7) to 10.0% (n=1) (Table 7).

Discussion

The open abdomen is part of the damage control surgery strategies and its indications vary from one region to another. In the United States, OA is a damage control surgery related to the management of abdominal trauma ⁶, while in the United Kingdom, it is more common for abdominal sepsis. These figures are similar to our institutional data, with presentation around 30% for trauma and 40% for non-trauma.

Defining the best technique for temporary abdominal closure is controversial. Factors including the nature of the injury, the experience of the

treating group, and the availability of associated therapies allow for subjectivity of the surgical behavior. Different reviews conclude that negative pressure systems may have better results, but the general quality of the available data is poor ⁷. In our environment, negative pressure systems were not used frequently, given the preference of the treating group and generally the limited institutional access to these supplies during the intervention period of the study; however, by implementing the recommendations of the WSES 2018 consensus ^{5,8} in our institution, the standardization of the abdominal double Vialflex (Bogota bag) was allowed, as it is a simple, easily accessible, safe and economical method, this being the second recommendation of greater weight mentioned by the guide, limiting the complications of intermediate techniques rarely used at present. In addition, similar to the data reported by some authors, it has the advantage of more reliably monitoring abdominal content ⁹⁻¹¹.

From the analysis of this group of patients, the significant incidence of infectious complica-

Table 7. Clinical outcomes, surgical management, hospital stay, discharge and mortality of patients with open abdomen included in the study.

		2018		2019		Total		p-value
		n	%	n	%	n	%	
Open abdomen closure	No	13	29.5	7	12.7	20	20.2	0.038
	Yes	31	70.5	48	87.3	79	79.8	
Surgical closure technique	Close by planes	20	64.5	33	68.8	53	67.1	0.382
	Components separation	0	0.0	2	4.2	2	2.5	
	Raffia to skin	10	32.3	13	27.1	23	29.1	
	Closure by second intention	1	3.2	0	0.0	1	1.3	
OA days	Average	9.5		7.4		8.3		0.137
	SD	8.3		7.3		7.8		
Number of abdominal surgeries	Average	3.5		3.6		3.6		0.123
	SD	2.4		2.2		2.3		
Days in ICU	Average	9.5		9.4		9.4		0.553
	SD	7.1		5.4		6.2		
IMV days	Average	5.1		7.3		6.3		0.152
	SD	3.9		4.5		4.4		
days of hospitalization	Average	14.0		19.2		16.9		0.060
	SD	11.6		9.2		10.6		
Discharge	Death	15	34.1	10	18.2	25	25,3	0.070
	Alive	29	65.9	45	81.8	74	74,7	
Cause of death	Related to OA	7	46.7	1	10.0	8	32,0	0.054
	Other cause	8	53.3	9	90.0	17	68,0	

* OA: open abdomen; SD, standard deviation; ICU: intensive care unit; IMV: invasive mechanical ventilation.

tions is evident, mainly pneumonia, which did not affect outcomes such as prolongation of mechanical ventilation or hospital stay, so it is possible that there was no significant impact on the other crucial outcome measures. The use of negative pressure systems is a management strategy with reduced risk of postoperative infection¹², contrary to the results of this study, where the rate of postoperative infection increased in patients managed with double Vialflex ($p=0.023$), a finding that may infer the impossibility of the technology to offer constant suction of the bacterial inoculum and the inflammatory exudate.

The risk of iatrogenic injury in multiple revisions of the abdominal cavity makes the appearance of fistulas more likely than, according to Giudicelli et al. (2017), it can reach 20% and occur as soon as eight days after the initial laparotomy, in a greater proportion in patients

managed with double Vialflex^{13,14}. Although the presentation of this complication was variable over time, with an increase from 6.8% to 10.9% for patients treated in 2019, it could be explained by the increase in the use of the Vialflex double containment system, being a percentage that can be extrapolated to the available literature.

It is described in the literature that prolonged rest is associated with a significant increase in morbidity¹³, hence the physical deconditioning present in our study population was a significant finding among non-infectious complications.

Excessive administration of crystalloid fluids makes it difficult to close the fascia by contributing to visceral edema¹⁵. For Harvin et al, in their 2013 retrospective review, it was significant to find a decrease in time for cavity closure after the use of hypertonic solution^{15,16}. Interventions that contrast comprehensive support measures, such

as the use of vasopressors and tissue expanders, which allow greater effectiveness in resuscitation, showed a statistically significant difference in the postsurgical approach of the patients included in this study.

Enteral nutrition is indicated in the OA, but multiple mitigating factors mean that the nutritional objectives are not met. However, for our study, nutritional support was implemented in more than 80% of patients. According to Lin *et al*, enteric support can improve caloric delivery, with lower complication rates^{17,18}. In our population, there was a significant improvement in the nutritional management of patients, where enteral nutrition went from 25% to 50%, with a decrease in the indication for parenteral supply.

In a case series described by Sánchez *et al*, achieving a closure of the abdominal wall of 65.5% of a total of 499 was significant¹⁹, allowing a positive contrast to the percentage of success found in our study, with an anatomical closure close to 70%, with techniques that mitigate the risk of postincisional hernia defects. The longer the time of use of abdominal containment measures, the lower the possibility of closure^{13,19}; however, in our study the mean number of days of open abdomen was 7.4, being ostensibly lower in 2019, despite the more usual management with double Viasflex.

Primary skin closure requires close follow-up, given the possibility of uncontained evisceration, an alternative that was implemented in 30% of our population, and may also be associated with a higher rate of surgical site infection and the need for subsequent reconstruction of the abdominal wall, findings described in the study by Sava *et al*²⁰.

The study population presented significant clinical severity, with an average APACHE II score of 21 points, thus defining mortality rates in surgical patients of 30%²¹. In this study, we report a 25% overall postoperative mortality, with a significant decrease from 34.1% in 2018 to 20% in 2019 after implementation of the 2018 WSES guideline recommendations. In the literature, studies reporting included similar populations showed comparable results, with mortality ra-

tes between 11-31%^{21,22}. They also reported that mortality in most of their patients was due to the natural evolution of the disease and not related to the technique used²³⁻²⁵. Furthermore, we can infer that management with double Viasflex can play an important role in reducing the mortality rate by preventing compartment syndrome and its dreaded complications²⁶⁻²⁸.

The limitations of this study were given by the size of the sample, as it did not reach statistically significant differences in some variables, especially in mortality as the main outcome. Similarly, the apparent loss of patients in the historical court could negatively affect the internal validity of the study. Among the strengths are, demonstrating the external validity of the guide, in a general hospital of level III of attention in Colombia, as well as the adherence of the health personnel to the recommendations adapted to the availability and resources of the institution. In addition, it allowed to validate the Bogotá bag as a temporary closure system of the abdominal cavity, since it is by far the most used in our local environment.

Conclusion

The implementation of the 2018 World Society of Emergency Surgery (WSES) guideline in our institution showed a notable decrease in mortality rates and hospital stay in the critical care unit, with an increase in the possibilities of final abdominal restraint, resulting in a decrease in hospital costs.

Compliance with ethical standards

Informed consent: In the present investigation, the basic bioethical principles were fulfilled, the protection of the identity of the subject under study was guaranteed as established in Art. 8 of the Helsinki code; in Colombian legislation, law 1581 of 2012 and decree 1377 of 2013 constituting a general framework for the protection of personal data, and resolution 8430 article 11, determining this study as minimal risk, due to its prospective nature.

Conflicts of interest: The authors of the research report having no conflict of interest regarding the opinions and behaviors that have been discussed and reflected in the document.

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Author's contributions:

- Conception and design of the study: DAFB, GJSR, AMMG
- Data acquisition: DAFB, BGVQ, LJJR, AMMG, GJSR
- Data analysis and interpretation: DAFB, GJSR, AMMG
- Drafting the manuscript: DAFB, GJSR, AMMG, LJJR, BGVQ
- Critical review: AMMG, GJSR

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