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ARTÍCULO ORIGINAL

Damage control laparotomy in non-trauma patients reduces the number of ostomies

La laparotomía de control de daños en pacientes sin trauma reduce el número de ostomías

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Abstract

Introduction. The objective of this study was to evaluate if the damage control laparotomy with ligation and delayed intestinal reconstruction (DR), in patients with peritonitis secondary to compromised hollow viscera, reduces the number of ostomies.

Methods. All patients under 18 years of age who entered the clinic with suspected non-traumatic peritonitis and who underwent laparotomy between January 2003 and December 2018 were included. Sociodemographic characteristics, comorbidities, severity scales physiological, intestinal reconstruction techniques and clinical results were evaluated.

Results. A total of 306 patients were included, divided into three groups: 1) 120 (39.2%) underwent resection and anastomosis, 2) 87 (28.4%) underwent ostomy, and 3) 99 (32.3%) underwent initial intestinal ligation. Patients undergoing intestinal ligation presented greater physiological compromise upon admission to the intensive care unit, with an APACHE II score: 14 (interquartile range, IQR= 10-18) in group 1, 13 (IQR = 11-18) in the group 2, and 18 (IQR = 14-24) in group 3 (p<0.01). However, more than half were reconstructed in the following laparotomy:

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mechanical anastomosis (16/99; 16.1 %), manual anastomosis (49/99; 49.5 %), ostomy (34/99; 34.3 %). Also, they had a significantly greater number of new laparotomies, and of days of mechanical respiratory assistance, of stay in the intensive care unit and of hospital stay. There were no statistically significant differences in mortality between the subgroups: group 1= 19 (15.8%), group 2= 16 (18.4%), group 3= 19 (19.2%) (p= 0.79).

Conclusion. In this study, it was possible to avoid the ostomy as the definitive reconstruction technique in more than half of the patients with peritonitis who underwent damage control laparotomy with intestinal ligation.

Keywords: laparotomy; damage control; resuscitation; peritonitis; ostomy.

Resumen

Introducción. El objetivo de este estudio fue evaluar si la laparotomía de control de daños con ligadura y reconstrucción intestinal diferida, en pacientes con peritonitis secundaria a compromiso de víscera hueca, reduce el número de ostomías.

Métodos. Se incluyeron todos los pacientes menores de 18 años de edad que ingresaron a la clínica con sospecha de peritonitis de origen no traumático y que se sometieron a laparotomía entre enero del 2003 y diciembre del 2018. Se evaluaron las características sociodemográficas, comorbilidades, escalas de gravedad fisiológica, técnicas de reconstrucción intestinal y resultados clínicos.

Resultados. Se incluyeron 306 pacientes, distribuidos en tres grupos: 1) 120 (39,2 %) sometidos a resección y anastomosis, 2) 87 (28,4 %) sometidos a ostomía, y 3) 99 (32,3 %) sometidos inicialmente a ligadura intestinal. Los pacientes sometidos a ligadura intestinal presentaron mayor compromiso fisiológico al ingreso a la unidad de cuidado intensivo, con puntuación APACHE II: 14 (rango intercuartílico, RIC=10-18) en el grupo 1, 13 (RIC=11-18) en el grupo 2, y 18 (RIC=14-24) en el grupo 3 (p<0,01). Sin embargo, más de la mitad se reconstruyeron en la siguiente laparotomía: anastomosis mecánica (16/99; 16,1 %), anastomosis manual (49/99; 49,5 %), ostomía (34/99; 34,3 %). Además, estos pacientes sometidos a ligadura intestinal tuvieron un número significativamente mayor de nuevas laparotomías, y de días de asistencia respiratoria mecánica, de estancia en la unidad de cuidado intensivo y de estancia hospitalaria. No hubo diferencias estadísticamente significativas en la mortalidad entre los subgrupos: (grupo 1=19 (15,8 %), grupo 2=16 (18,4 %), grupo 3=19 (19,2 %) (p=0,79).

Conclusión. En este estudio, se logró evitar la ostomía como técnica de reconstrucción definitiva en más de la mitad de los pacientes con peritonitis que se sometieron a laparotomía de control de daños con ligadura intestinal.

Palabras clave: laparotomía; control del daño; reanimación; peritonitis; estomía.

Introduction

Damage control surgery has been established as a treatment for critically ill patients with traumatic abdominal injuries and in other cavities[1-4]. Strategies of this type of surgery include an abbreviated laparotomy followed by immediate transfer to the intensive care for physiological resuscitation and a surgical definitive repair deferred to a second time in the operating room[5,6]. The physiological basis of the damage control surgery is the need to interrupt the vicious cycle of acidosis, hypothermia and coagulopathy, present in trauma patients, which implies the depletion of the physiological reserve and it entails death[7,8]. The introduction of this surgery was a paradigm shift in the management of severe trauma and has represented a significant increase in survival of critically ill patients. Nowadays, is the standard of care in specialized trauma centers worldwide[9].

As general surgery and emergency surgery suffering from severe intraperitoneal infection or bleeding are exposed to experiencing the effects

of acidosis, hypothermia and coagulopathy, surgeons have been gradually using the principles of the damage control surgery in those with originally non-traumatic diseases that represent serious physiological and anatomical compromise[10,11]. Recently, the number of publications has increased and showed promising results in cases of acute mesenteric ischemia, peritonitis secondary to perforation of hollow viscus, postsurgical peritonitis, acute pancreatitis, necrotizing enterocolitis, hemorrhage or abdominal compartment syndrome[12-16]. In most of them, heterogeneous series are reported with small samples of patients with a varied range of conditions; at times, patients treated with open abdomen and delayed laparotomy for definitive surgical repair, in the absence of criteria for damage control surgery were included[8]. The combination of all these factors make the analysis and the interpretation of the results difficult.

Therefore, it is important to evaluate the indications, the surgical techniques and the clinical results in patients with intra-abdominal non-traumatic diseases subject to damage control laparotomy, grouping them in several categories according to the clinical and intraoperative diagnosis (perforation, mesenteric ischemia) and the pathophysiological condition (hemorrhage, sepsis), to improve and to make more efficient the criteria that characterize the ones who could get better results with this surgery.

The objective of this study was to assess whether damage control laparotomy with ligation and delayed bowel reconstruction, reduces the number of ostomies in patients with peritonitis secondary to hollow viscus involvement.

Methods

Study design

This was a retrospective cohort study, approved by the Ethics Committee of the Fundación Valle del Lili, a level I trauma center with a large volume of patients, located in the Colombian Southwest, with a multidisciplinary team conformed by the Service of General Surgery, Trauma Surgery and Emergency Surgery.

Population

All adult patients over 18 years of age were included, who were admitted at the institution between January 2003 and December of 2018, and underwent urgent laparotomy with a diagnosis of peritonitis.

The inclusion criteria were:

1. Diagnosis of peritonitis secondary to compromised hollow viscera, and
2. Use of some intestinal repair technique (manual or mechanical anastomosis, primary suture), ostomy (ileostomy, colostomy) or intestinal ligature with definitive reconstruction deferred, during the initial laparotomy.

The exclusion criteria were:

1. Peritonitis secondary to trauma,
2. Peritonitis of biliary origin,
3. Peritonitis secondary to pancreatitis,
4. Laparotomy for bleeding (ruptured abdominal aorta aneurysm, digestive bleeding),
5. Mesenteric ischemia,
6. Peritonitis managed with lavage and open abdomen, without intestinal repair,
7. Death before bowel reconstruction, and
8. Lack of information about the strategy of intestinal reconstruction.

Surgical management strategies

The 306 patients were divided into three groups, depending on the management strategy used during the initial laparotomy:

1. Definitive repair, that is primary repair or resection and intestinal anastomosis,
2. Ostomy and delayed repair, or
3. Bowel ligation and delayed definitive reconstruction.

The following considerations are standardized in the Department of Surgery to select

patients to be considered high risk and that, therefore, require delayed repair: signs of intestinal hypoperfusion, score of 15 or more on the APACHE II scale, and comorbidities as diabetes, cardiac disease or cancer; in addition, one or more of the following parameters: respiratory (PO_2 / FiO_2 <200), renal (serum creatinine: 3.5-4.9 mg/dl) or hepatic (bilirubin: 6-11.9 mg/dl), mean blood pressure less than 70 mmHg during surgery, need of vasopressor, and neurological compromise (Glasgow <9), thrombocytopenia (platelets <50,000 mm^3) or both.

Group 1, the definitive repair, after drainage or lavage of the peritoneal cavity and debridement or resection of necrotic or infected tissue, peritonitis was controlled by resection of a compromised intestinal segment and restoration of the gastrointestinal function during laparotomy with primary anastomosis or primary ostomy (group 2). For the management of the abdominal wall, definitive closing or a temporary system for open abdomen was used according to the criterion of the surgeon. Based on the consensus of institutional surgeons the indications of open abdomen are persistent intra-abdominal infection and to prevent abdominal compartment syndrome.

Group 3, the intestinal ligation and definitive deferred reconstruction, after the control of initial infection with wash out or drainage of the peritoneal cavity with debridement or resection of necrotic or infected tissue, intestinal resection was performed and the proximal and distal ends were ligated. Once patient hemodynamic stability was achieved and intestinal reconstruction was considered feasible, the final deferred reconstruction was carried out, either by anastomosis or ostomy.

Statistical analysis

Demographic characteristics were described, baseline status on admission, anatomical severity or physiological and clinical results. Median and range interquartile (RIC) for continuous variable with no normal distribution were used, and mean and standard deviation for continuous variable with normal distribution. The continuous variables were compared using no parametric tests (Kruskal-Wallis) or parametric tests (Anova), depending of its distribution. Categorical variables are summarized using absolute frequencies and percentages, and were compared using chi-square or Fisher's exact tests, when the expected frequencies were below 5. P values less than 0.05 were considered statistically significant. All analyzes were carried out in the Stata/MP™ software, version 14.0 (StataCorp, CollegeStation, TX).

Results

Seven hundred and eight patients with diagnosis of acute abdomen undergoing laparotomy of urgency were identified. Of these, eight were excluded who, after laparotomy, were diagnosed with mesenteric ischemia incompatible with life and therefore did not require a strategy of additional handling. Others excluded were 299 patients in whom, after laparotomy, the peritonitis was managed by wash out of the peritoneal cavity and open abdomen; 11 with ligature during the initial laparotomy but they died before being able to reconstruct, and 84 whose data on the reconstruction intestinal technique were incomplete.

The remaining 306 patients were included in the analysis. They were grouped according to recent management during initial laparotomy: group 1 (120; 39.2%), with definitive repair, that is primary repair or resection and intestinal anastomosis; group 2 (87; 28.4%), with ostomy and delayed repair, and group 3 (99; 32.3%), with intestinal ligation and deferred definitive reconstruction (Figure 1).

Most of the patients (177; 57.8%) included were men and they were in the seventh decade (64 years; IQR = 48-73). The comorbidity presented with higher frequency in these patients was cancer, with a higher proportion between those undergoing ostomy during laparotomy: 43 (35.8%) in group 1; 46 (52.9%) in group 2; and 24 (24.2%) in group 3 (p <0.001); followed by heart disease (70; 22.8%), diabetes (44; 14.4%) and chronic kidney disease (30; 9.8%), with no statistically significant differences between the groups (table 1).

Patients who underwent intestinal ligation had higher Apache II score upon admission to the intensive care unit: group 1: 14 (RIC: 10-18); group 2: 13 (RIC: 11-18); group 3:18 (RIC: 14-24); (p <0.001). Those with primary repair or resection and anastomosis during the laparotomy, significantly required higher volume of red blood cells transfusion [group 1: 4 (RIC: 2-7); group 2: 3 (IQR: 2-7); group 3: 4 (IQR: 2-6); p = 0.001] during the first 24 hours.

Secondary peritonitis was the pathological condition with higher representation (261; 85.3%) within the included patients. In most of the cases, the peritonitis was widespread in 96 (80%) cases in group 1, in 65 (74.7%) in group 2, and in 88 (88.9%) in group 3 (p = 0.04). Purulent, in 93 (77.5%) in group 1, in 63 (72.4%) in group 2, and in 68 (69.4%) in group 3 (p = 0.39); and postsurgical, in 74 (61.7%) in group 1, in 53 (61.0%) in group 2, and in 45 (45.4%) in group 3 (p = 0.03) (Table 2).

The proportion of re-laparotomy was significantly higher between the patients who underwent intestinal ligature: group 1: 1 (IQR: 0-2); group 2: 1 (IQR: 0-3); group 3: 3 (IQR: 1-4); (p <0.001). But less than two thirds of the patients had a definitive closing of the fascia towards the

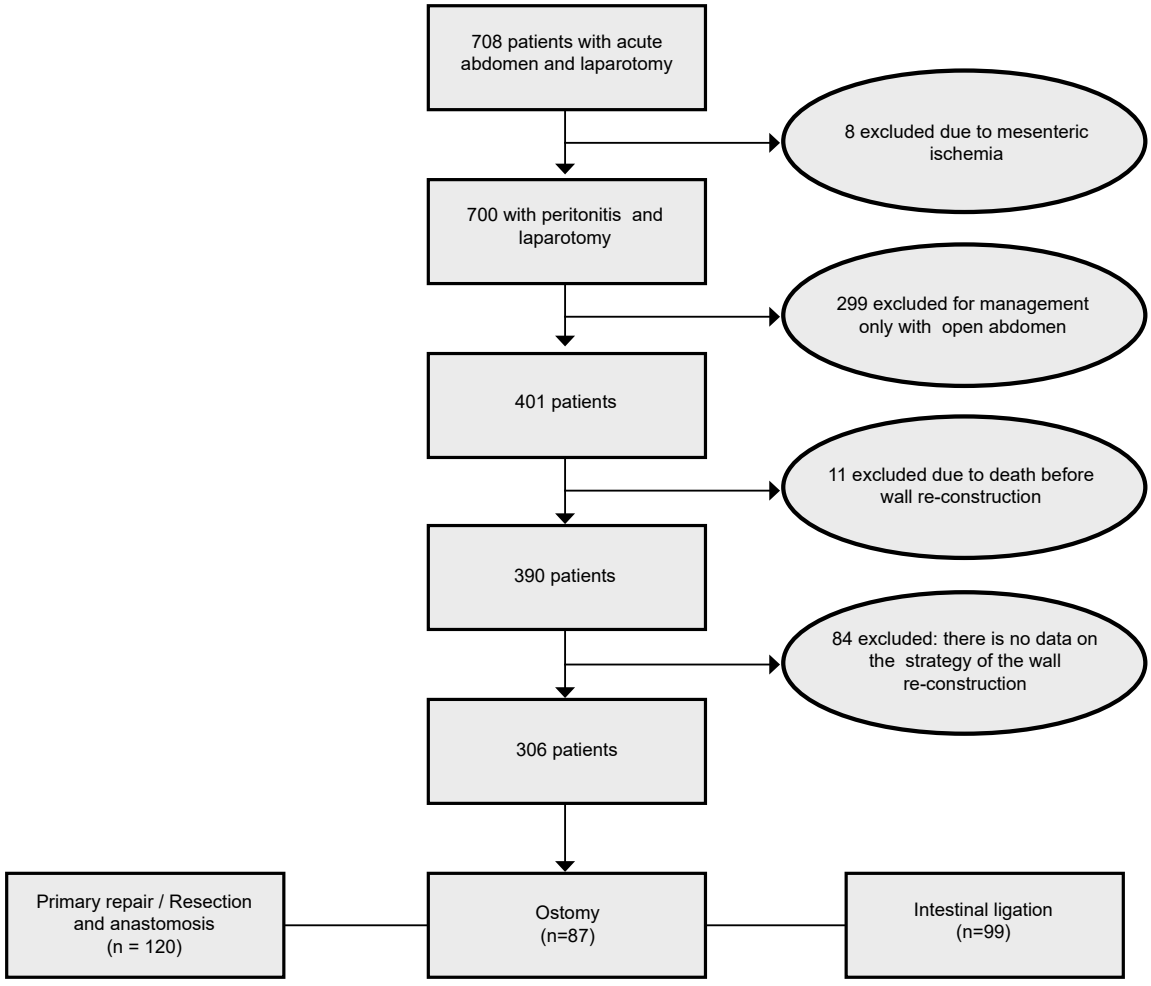

Figure 1. Distribution of patients diagnosed with acute abdomen undergoing emergency laparotomy.

Table 1. Sociodemographic variables, severity scales, resuscitation components and comorbidities of the patients included in the study.

Variables	Total (n=306)	Primary repair / resection and anastomosis (n=120)	Ostomy (n=87)	Intestinal ligation (n=99)	*p*
Age, median (IQR)*	64 (48-73)	62 (46-73)	64 (51-76)	64 (49-74)	0,32
Male gender, n (%)	117 (57,8)	69 (57,5)	56 (64,4)	52 (52,5)	0,26
APACHE-II score upon admission to ICU, median (IQR)	15 (11-20)	14 (10-18)	13 (11-18)	18 (14-24)	<0,001
SOFA score * upon admission to ICU, median (IQR)	6 (2-13)	4 (1-14)	6 (2-13)	7 (3-11)	0,06
UGR * in 24 hours, median (IQR)	4 (2-7)	4 (2-7)	3 (2-7)	4 (2-6)	0,001
UPFC * in 24 hours, median (IQR)	4 (3-8)	4 (3-8)	7 (4-12)	4 (3-7)	0,02
Comorbidities					
Diabetes, n (%	44 (14,4)	21 (17,5)	11 (12,6)	12 (12,1)	0,46
Heart disease, n (%)	70 (22,8)	23 (19,2)	18 (20,7)	29 (29,3)	0,17
Cancer, n (%)	113 (36,9)	43 (35,8)	46 (52,9)	24 (24,2)	<0,001
Chronic kidney disease, n (%)	30 (9,8)	17 (14,2)	5 (5,7)	8 (8,1)	<0,10

* IQR: interquartile range, ICU: Intensive Care Unit, SOFA: Sequential Organ Failure Assessment, UGR: red blood cell units, UPFC: fresh frozen plasma units.

end of the hospitalization: 62 (51.7%) of group 1; 36 (41.4%) of group 2; and 61 (61.6%) of group 3 (p = 0.02). In addition, patients with ligation required more mechanical ventilation days, intensive care unit stay and hospital stay, with statistically significant differences with respect to the other subgroups (Table 3).

Regarding the technique of intestinal reconstruction after the initial laparotomy, in less than half (34/99; 34.3%) of patients ostomy was used, in 49 (49.5%) manual anastomosis, and in 34 (34.3%), mechanical anastomosis. Fifty-four (17.6%) patients died, no statistically significant difference between the groups: 19 (15.8%) in group 1; 16 (18.4%) in group 2; and 19 (19.2%) in group 3 (p = 0.79).

Discussion

The hypothesis of this study was that damage control laparotomy in patients with peritonitis of non-traumatic origin and secondary to hollow viscus compromise could reduce the number of ostomies.

The findings suggest that in patients with multiple comorbidities, generalized purulent or fecal peritonitis, and with serious physiological compromise, it is feasible to use the intestinal ligature with delayed reconstruction. Even though this group required a greater number of reoperations with laparotomy, and increase of mechanical ventilation days, intensive care unit days, hospital stay days, this technique avoided the ostomy in more than half of the patients, which ended with definitive reconstruction definitive of the gastrointestinal system before being discharged from the hospital: 49/99 (49.5%) with deferred manual anastomosis, and 16/99 (16.1%) with deferred mechanical anastomosis.

In previous studies, it has been established that damage control laparotomy is an effective strategy for the management of patients with

Table 2. Classification of peritonitis in the patients included in the study.

Variables	Total (n=306)	Primary repair / resection and anastomosis (n=120)	Ostomy (n=87)	Intestinal ligation (n=99)	*p*
Based on origin, n (%)					
Primary peritonitis	3 (0,9)	0 (0)	1 (1,1)	2 (2,0)	
Secondary peritonitis	261 (85,3)	110 (91,7)	74 (85,1)	77 (77,8)	0,03
Tertiary peritonitis	42 (13,7)	10 (8,3)	12 (13,8)	20 (20,2)	
Based on location, n (%)					
Localized peritonitis	57 (18,6)	24 (20)	22 (25,3)	11 (11,1)	0,04
Generalized peritonitis	249 (81,4)	96 (80)	65 (74,7)	88 (88,9)	
Based on material, n (%)					
Purulent peritonitis	224 (73,4)	93 (77,5)	63 (72,4)	68 (69,4)	0,39
Fecal peritonitis	81 (26,6)	27 (22,5)	24 (27,6)	30 (30,6)	
Based on time, n (%)					
Postoperative peritonitis	172 (56,2)	74 (61,7)	53 (61)	45 (45,4)	0,03

Table 3. Clinical outcomes of patients with peritonitis who underwent damage control laparotomy.

Variables	Total (n=306)	Primary repair / resection and anastomosis (n=120)	Ostomy (n=87)	Intestinal ligation (n=99)	*p*
Number of relaparotomies, median (IQR)*	1 (1-3)	1 (0-2)	1 (0-3)	3 (1-4)	<0,001
Fascia closure, n (%)	159 (51,9)	62 (51,7)	36 (41,4)	61 (61,6)	0,02
Skin closure, n (%)	147 (48)	58 (48,3)	51 (58,6)	38 (38,4)	
Days of mechanical ventilation, median (IQR)	5 (2-12)	3 (1-9)	3 (1-8)	8 (4-15)	<0,001
ICU stay *, median (IQR)	12 (5-22)	9 (3-20)	10 (4-16)	15 (10-25)	<0,001
Hospital stay, median (IQR)	25 (14-28)	23 (11-36)	22 (14-32)	31 (21-46)	0,001
In-hospital mortality, n (%)	54 (17,6)	19 (15,8)	16 (18,4)	19 (19,2)	0,79

* IQR: interquartile range, ICU: Intensive Care Unit.

intra-abdominal infection. However, the lack of a control group has not allowed to conclude if there is superiority of this approach and, although several surgical management techniques have been proposed, there is still a lack of evidence to support the effect of this on clinical outcomes when definitive repair procedures are performed during the initial laparotomy, compared with the definitive reconstruction after the abbreviated laparotomy[17,18].

The results of this study support the existing evidence, which suggests that patients with big odds of death according to scales such as Apache II and SOFA, with a heterogeneous number of comorbidities such as cancer, heart disease, diabetes, or kidney disease, could benefit from a principle used in damage control surgery that is expectant. After a timely diagnosis of intra-abdominal disturbance, an abbreviated laparotomy to control the source of infection, the immediate transfer to the intensive care unit for resuscitation and complementary treatment with antibiotics, a second evaluation of the patients is performed that have been resuscitated, with higher stability according to the hemodynamic parameters and with partial control of the source of infection.

Khan et al,[19] published a series of 42 patients with varied conditions such as peritonitis, intra-abdominal abscess, intestinal ischemia and bleeding, in whom the use of the principles of the laparotomy for damage control allow early closing of the abdominal wall, which was associated with less additional complications.

The design of this type of study was based on the registration of a large proportion of patients undergoing bowel ligation during initial laparotomy. Even though the retrospective studies have already known limitations, worth noting that in this cohort of patients, it could be decided and described the techniques of intestinal reconstruction and the clinically relevant results.

The findings of this study have only internal validity due to limitations inherent in its design. However, it has been shown that the use of these techniques in diseases of a similar nature or in other conditions, such as non-traumatic hemorrhage, biliary peritonitis, superinfected necrotizing pancreatitis or tumors with perforation of the hollow viscus, among others, is possible and has beneficial effects on clinical outcomes such as mortality[20].

Based on these results and considering the potential benefits of these surgical strategies of non-traumatic origin, it can be said that it is necessary to continue to expand the available evidence and to implement prospective randomized studies[21], to determine which indications could be more sensitive and which more specific, in patients who could deal with delayed reconstruction. Further, to establish what is the actual effect of deferring the intestinal reconstruction in survival of the patients.

Finally, the primary repair is possible for definitive control in cases of severe peritonitis, as long as the clinical condition and perfusion of the viscus are adequate. In other cases, when the patient's condition is more serious, performing an abbreviated laparotomy and deferring repair may reduce the need for an ostomy as definitive treatment.

In conclusion, in the present study avoiding ostomy as a definitive reconstruction technique in more than half of the patients with peritonitis who underwent laparotomy of damage control with intestinal ligation was achieved. The implementation of this technique in the field of acute care surgery is feasible. However, more prospective studies are required to establish variables that can predict early which patients would benefit more with this type of intervention.

Compliance with ethical standards

Informed consent: This is a retrospective cohort study, with retrospective review of medical records and as such there is no need of an informed consent. It was approved by the Ethics Committee of the Fundación Valle del Lili.

Conflict of interest: The authors state that have no conflict of interest to declare.

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