# Outcome of open abdomen procedure with Bogota bag for temporary abdominal closure: our experience in Alexandria University Hospital

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**Aim**
To evaluate the outcome of abdomen (OA) procedure with Bogota bag as a temporary measure to close the abdomen in patients with abdominal catastrophes in terms of mortality and morbidity.
**Patients and methods**
The study included adult patients who were treated for abdominal catastrophes with OA and Bogota bag for temporary abdominal closure during the period 2007–2016 in Alexandria Main University Hospital. Delayed definite abdominal closure was performed by edge-to-edge closure of the fascia if possible or by approximation of the fascia to the nearest available distance and filling the gap by Dexon mesh in a tension-free manner.
**Results**
A total of 74 patients were included, with a mean age of 38.19±13.60 years. The etiology was blunt trauma in 32.4%, whereas 67.6% had nontraumatic causes. Ten (13.5%) patients died: six patients owing to their original pathology and four patients owing to pulmonary embolism. Old age and high leukocyte count were significant factors for mortality. Regarding postoperative complications, no patients had abdominal compartment, nine patients had wound infection, two patients had intestinal fistulas, one patient had evisceration, whereas 24 patients had incisional hernia.
**Conclusion**
Bogota bag for temporary abdominal closure after OA is an easy and efficient technique for management of abdominal catastrophes by which serious complications of either exposure or closure under tension could be prevented. Postoperative mortality was 13.5% but not related to the technique. Old age and high leukocyte count were found to be significant risk factors affecting mortality.

**Keywords:**
abdominal catastrophes, abdominal compartment syndrome, Bogota bag, damage control

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## Introduction

During surgical management of intra-abdominal catastrophes, whether traumatic or nontraumatic, surgeons may be confronted with situations in which the abdominal wall cannot be closed primarily [1,2]. Loss of abdominal wall, retroperitoneal edema or collection, and edematous intestine or omentum owing to peritonitis may be the factors resulting in difficult approximation of the edges of the fascia and hence challenging abdominal closure [3]. Forced trials to close the abdomen in these patients may trigger intra-abdominal hypertension or abdominal compartment syndrome with physiologic derangement or even multiorgan failure in a vicious circle that could be interrupted only by abdominal decompression [4,5]. In addition, the cumulative experience of trauma surgeons confirms the principles of damage control (DC) conservative operative techniques, and short operative times, even when all organ repairs have not been completed [6].

The open abdomen (OA) is a procedure for initial management of both traumatic and nontraumatic intra-abdominal emergencies [7]. The OA could be defined as purposely delayed fascial closure of the abdomen after the cavity is opened [8]. Benefits of the OA technique in these cases include facility of re-exploration, watching the abdominal contents, reduction of the risk of intra-abdominal hypertension, and fascial preservation for further closure of the abdominal wall [6].

The OA technique may have serious complications. Development of an entero-atmospheric fistula (defined as the leak of gastrointestinal content into the OA field) may be considered the most drastic and potentially life-threatening complication of OA [9]. Other complications of OA include fluid and protein loss with subsequent nutritional insufficiency and catabolic state, loss of abdominal domain from fascial retraction, and the development of huge ventral hernia if not closed early [10,11].

To minimize complications of OA, the strategy of temporary abdominal closure (TAC) has been adopted. TAC refers to the method of providing protection to the abdominal viscera during the time the fascia remains open [5,12]. TAC allows planned abdominal re-explorations and facilitates a definitive closure once the underlying pathology has been resolved [4]. Various measures have been described for TAC such as Negative Pressure Wound Therapy, Wittman's patch, absorbable mesh, dynamic retention sutures, skin closure, plastic silo, and the Bogota bag [13,14].

A Bogota bag is a sterile plastic bag that can be used for closure of abdominal wounds. Its use was first described by Oswaldo Borraez while a resident in Bogota, Colombia [15]. Compared with other methods of TAC, Bogota bag is an inexpensive method that is available in almost all medical institutions. It acts as a hermetic barrier that avoids evisceration and loss of fluids, and the abdominal contents can be visually inspected, which is particularly useful in cases of ischemic bowel [3].

The aim of this study was to evaluate the outcome of OA procedure with Bogota bag as a temporary measure to close the abdomen in patients with abdominal catastrophes in terms of mortality and morbidity.

## Patients and methods

This is a prospective study that was conducted in Alexandria University Hospitals during the period from March 2007 till June 2016. The study included 74 patients who satisfied the study eligibility criteria. These included adult patients in whom emergency laparotomy was to be performed, and the intraoperative surgeons' decision was that their peritoneal cavities could not be closed. These patients were managed with OA and Bogota bag as TAC.

Patients under the age of 13 years were excluded as they were treated by pediatric surgeons according to the protocol of our hospital.

At the emergency department, initial resuscitation and clinical assessment were performed for all patients as well as the relevant investigations. If the primary diagnosis requires emergency laparotomy, it was performed by expert consultants, and the patients' primary problems were dealt with. When the decision was taken to leave the abdomen open either to prevent abdominal compartment syndrome or owing to inadequate tissue to approximate the defect, Bogota bag (3 l genitourinary irrigation bag) was sterilized and used for TAC. The Bogota bag was sutured by polypropylene interrupted sutures to the fascia of the anterior abdominal wall in a tension-free manner (Fig. 1), and then the whole wound was covered by dry gauze. Patients were shifted to the ICU, where close monitoring for their vital signs and the wound was done.

Decision for definite abdominal closure, if possible, was taken by the treating team according to the status of intra-abdominal pressure, nutritional status, and the patients' condition. In case of need for re-exploration, or if the patient's condition did not allow definite closure for 15 days, Bogota bag was replaced by a new one. Edge-to-edge fascial closure was tried for all patients using continuous full-thickness Prolene 1 sutures with or without insertion of a 30 cm×30 cm Dexon (Covedien-Medtronic, Dublin, Ireland) mesh to support the anterior abdominal wall (Fig. 2). However, in patients whose abdominal wall could not be closed by edge-to-edge technique without creating abdominal tension, approximation of the edges to the nearest available distance without tension was done after insertion of a 30 cm×30 cm Dexon mesh intraperitoneally, and the gap between the approximated edges was filled by another part of a Dexon mesh, sutured to the edges of the fascia.

After discharge, all patients were followed up after 14 days, 3, 6, 12, 24, and 36 months for detection of any complications.

### Outcomes

*Primary end point was as follows:*

(1) Incidence of postoperative mortality of the patients during their hospital stay.

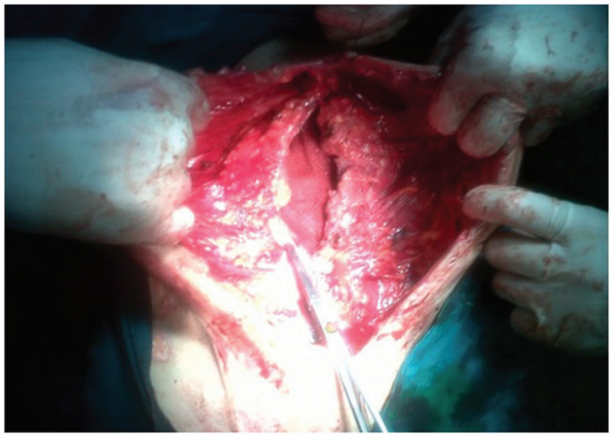
*Secondary end points were as follows:*

(1) Incidence of early postoperative complications (evisceration and prolapse, intestinal fistula, wound infection, compartment syndrome, and burst abdomen) detected by the treating team during the patient's hospital stay.

**Figure 1**

Bogota bag is sutured to the fascia of the anterior abdominal wall in a tension-free manner through which the abdominal contents could be seen.

**Figure 2**



Edge-to-edge fascial closure with insertion of a 30 cm×30 cm Dexon mesh in the intraperitoneal space to support the anterior abdominal wall.

(2) Incidence of late postoperative complications, such as ventral hernia, detected clinically by the treating team during the follow-up visits in the outpatient clinic.

The statistical analysis of the data was done using the statistical package for the social sciences (SPSS version 25; SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were applied (frequency and percentage for categorical variables, mean and SD for quantitative variables). A statistically significant difference was considered at *P* values less than 0.05.

The research was approved by the Institutional Research Board of College of Medicine, Alexandria University (IRB 00007555), and precautions were taken to conceal the identity of patients. Items of the PROCESS checklist [16] were fulfilled.

## Results

The study included 74 patients, with a mean age of 37.9±13.7 years. Patients included 47 (63.5) males and 27 (37.5%) females. Demographic, clinical data and laboratory data of the patients are shown in Table 1.

All the patients were explored through a wide midline incision. The intraoperative findings during the operation and the operative procedure done are reported in Table 2.

The mean number of laparotomies among our patients was 3.2±0.8 (range: 2–5 laparotomies). The main indications to resort to TAC are shown in Table 3.

Regarding postoperative mortality, 10 patients died in the immediate follow-up period (mortality rate 13.51%). The mean duration between first operation and the death was 9.1±14.1 days (range: 5–32 days). Six patients died owing to multiorgan failure; two of them were initially operated for perforated duodenal injury, two patients were operated for infected necrotizing pancreatitis, one patient was operated for perforated duodenal ulcer, and one patient was operated for extensive bowel gangrene owing to mesenteric

**Table 1 Demographic, clinical data, and laboratory data of the patients**

| | Patients who died (*n*=10) | Patients who survived (*n*=64) | All patients (*n*=74) | *P* value |
|---|---|---|---|---|
| Age (mean±SD) (years) | 58.40±9.11 | 35.0±11.3 | 38.19±13.60 | <**0.001** |
| Sex [*n* (%)] | | | | |
| Male | 40 (85.1) | 7 (14.9) | 47 (63.5) | 0.647 |
| Female | 24 (88.9) | 3 (11.1) | 27 (36.5) | |
| BMI (mean±SD) (kg/m$^2$) | 32.10±5.7 | 32.1±5.7 | 32.51±6.86 | 0.257 |
| *Comorbidities [n (%)]* | | | | |
| Diabetes | | | | |
| Yes | 11 (78.6) | 3 (21.4) | 14 (18.9) | 0.336 |
| No | 53 (88.3) | 7 (11.7) | 60 (81.1) | |
| Cardiac problems | | | | |
| Yes | 4 (66.7) | 2 (33.3) | 6 (8.1) | 0.138 |
| No | 60 (88.2) | 8 (11.8) | 68 (91.9) | |
| Hypertension | | | | |
| Yes | 7 (70.0) | 3 (30.0) | 10 (13.5) | 0.101 |
| No | 57 (89.1) | 7 (10.9) | 64 (86.5) | |
| Others | | | | |
| Yes | 4 (66.7) | 2 (33.3) | 6 (8.1) | 0.138 |
| No | 60 (88.2) | 8 (11.8) | 68 (91.9) | |
| Etiology [*n* (%)] | | | | |
| Traumatic | 20 (83.3) | 4 (16.7) | 24 (32.4) | 0.583 |
| Medical | 44 (88.0) | 6 (12.0) | 50 (67.6) | |
| Leukocytic count (×1000) (mean±SD) | 28.3±5.0 | 15.4±4.3 | 17.13±6.23 | <**0.001** |

Bold values indicate statistical significance ($P<0.05$).

**Table 2 Intraoperative findings and the operative procedure for the patients**

| | *N*=74 [*n* (%)] |
|---|---|
| Intraoperative findings | |
| Perforated malignant colorectal disease | 10 (13.5) |
| Perforated peptic ulcer | 4 (5.4) |
| Infected necrotic pancreatitis | 8 (10.8) |
| Gangrenous small bowel (mesenteric vascular occlusion) | 20 (27.0) |
| Strangulated para-umbilical hernia | 8 (10.8) |
| Intra-abdominal hemorrhage due to liver tear(s) | 10 (13.5) |
| Retroperitoneal hemorrhage and splenic injury(s) | 4 (5.4) |
| Retroperitoneal hemorrhage and traumatic intestinal perforation(s) | 4 (5.4) |
| Retroperitoneal hemorrhage and duodenal perforation | 6 (8.1) |
| Operative procedure | |
| Just drainage with Bogota bag insertion | 8 (10.8) |
| Resection of a bowel segment and re-anastomosis with Bogota bag insertion | 20 (27.0) |
| Resection of a bowel segment with creation of stoma with Bogota bag insertion | 18 (24.3) |
| Direct repair of intestinal tear(s) or perforated gut after refreshment of the edges and omental patch placement with Bogota bag insertion | 8 (10.8) |
| Packing of liver tear(s) with Bogota bag insertion | 10 (13.5) |
| Splenectomy with Bogota bag insertion | 4 (5.4) |
| Doudenal exclusion and feeding jejunostomy | 6 (8.1) |

vascular occlusion. The other four patients died owing to pulmonary embolism after being operated for bowel ischemia due to mesenteric vascular occlusion.

Among all the different variables in this study, only age and preoperative white blood cell level were found to be significantly affecting the mortality rate in our patients ($P\leq0.001$ and $\leq0.001$, respectively).

Regarding postoperative complications, two patients developed intestinal fistulas that were missed in the primary operation and were treated successfully by repair with simple sutures and insertion of the repaired bowel loop deep in the abdomen away from the Bogota bag. Reapplication of the Bogota bag was required in six patients. The reason of reapplication was inability to make definitive closure after 15 days of

**Table 3 The distribution of patients according to the indication of open abdomen with temporary abdominal closure**

| | Patients who died (*n*=10) | Patients who survived (*n*=64) | All patients (*n*=74) | *P* value |
|---|---|---|---|---|
| Number of laparotomies (mean±SD) | 3.20±0.92 | 3.16±0.78 | 3.16±0.79 | 0.557 |
| Indication [*n* (%)] | | | | |
| Massive visceral edema | 5 (15.2) | 28 (84.8) | 33 (44.6) | 0.610 |
| Large retroperitoneal hematoma | 1 (16.7) | 5 (83.3) | 6 (8.1) | |
| Second look after packing of liver tears | 0 | 10 (100.0) | 10 (13.5) | |
| Hypertension, Hypothermia, etc. | 4 (16.0) | 21 (84.0) | 25 (33.8) | |

**Table 4 Outcomes after open abdomen and temporary abdominal closure using Bogota bag**

| | *n* (%) |
|---|---|
| Mortality (*n*=10) | |
| Multiorgan failure | 6 (60.0) |
| Pulmonary embolism | 4 (40.0) |
| Postoperative complications (*n*=74) | |
| Fistula | 2 (2.7) |
| Wound infection | 9 (12.2) |
| Evisceration | 1 (1.4) |
| Abdominal compartment | 0 |
| Reapplication of Bogota bag | 6 (8.1) |
| Incisional hernia | 24 (32.4) |

**Table 5 The distribution of methods of delayed primary fascial closure among the patients**

| Method of delayed primary fascial closure | *N*=64 [*n* (%)] |
|---|---|
| Edge-to-edge closure | 20 (31.25) |
| Edge-to-edge closure+intraperitoneal Dexon mesh | 28 (43.75) |
| Approximation of the edges, intraperitoneal Dexon mesh, and filling the gap by Dexon mesh | 16 (25) |

application of the Bogota bag for the first time in three patients, to manage missed intestinal fistulas in two patients and to manage evisceration that occurred in one patient and necessitated reapplication of the Bogota bag. Details about complications after OA and TAC using the Bogota bag are shown in Table 4.

All 64 surviving patients were operated for definite abdominal closure where edge-to-edge approximation of abdominal fascia was successful in 48 (75%) of them. In 16 (25%) patients, approximation of the edges to the nearest available distance without tension was performed after insertion of a 25 cm×25 cm Dexon mesh intraperitoneally, and filling the gap by another part of a Dexon mesh sutured to the free edges of the fascia. Details of abdominal closure are shown in Table 5.

The surviving 64 patients were reevaluated clinically at 3, 6, 12, 24, and 36 months for detection of late complications. Twenty-four (32.4%) patients developed incisional hernia during the follow-up period. The time at which incisional hernia was diagnosed ranged from 2 to 26 months, with a mean of 7.3±7.2 months. It was noticed that most of the incisional hernia occurred during the first 6 months postoperatively (16 patients) especially for patients where edge-to-edge fascial closure was not successful.

## Discussion

Although DC principles were first applied to patients who have multiple severe traumatic injuries [17], it is now applied to all patients presented to emergency unit with severe tissue damage even owing to medical nontraumatic cause, as in case of extensive bowel ischemia or acute hemorrhagic pancreatitis [6]. Accordingly, during our study that extended for more than 10 years, two-thirds of the patients who were admitted to emergency unit and required TAC as a part of DC procedure were presented with acute abdomen owing to an underlying nontraumatic cause, whereas only one-third presented after blunt abdominal trauma.

As a part of DC and OA procedure, many techniques are available for TAC aiming at preventing the abdominal contents from being exposed or abdominal compartment syndrome to develop [13,14]. We preferred to use the Bogota bag, as we believe it is simple, easily available, safe, and inexpensive. In addition, it has the advantage of being transparent and abdominal contents could be monitored through it. Similar opinions were reported by some authors [3,18]. Furthermore, other techniques may have the limitations of availability, the need for local available tissue, the need for expertise, and the cost [3,11,19].

Regarding postoperative mortality, in this study, 10 patients died in the immediate follow-up period (mortality rate 13.51%). All patients who died in our study were owing to the underlying diseases leading to open abdominal technique and not directly to the Bogota bag technique itself. In the literature, studies that used the Bogota bag for TAC, and included mixed types of patients, traumatic and medical nontraumatic cases, showed comparable results, with mortality rates ranging from 11.6 to 31% [20–23]. They reported also that the mortality in most of their patients were owing

to progression of the original pathology and not related to the OA and TAC technique. Furthermore, we think that the OA and TAC may play an important role in reducing the mortality rate by preventing the compartment syndrome and its terrifying complications.

In this study, many variables (Tables 1 and 3) were studied to detect factors affecting mortality. Only old age and high leukocytic count were found to be significant.

Old age was reported as a significant factor for mortality in hospitalized patients in many studies [24–26]. We think that inclusion of medical nontraumatic patients in our study that represented two-thirds of the studied group may be the main factor in the elevation of the mean age of our patients. Variables affecting the high mortality rate in elderly patients were studied by many authors [27–29] and revealed possible risk factors to be significant such as functional impairment, medical condition-related disability, cerebrovascular disease, cancer, delirium, immobility, low albumin levels, elevated creatinine levels, and history of heart failure. We believe that the high mortality in the elder people in our study may be related to the limited ability of the old people to cope with stress in emergency situations. We agree with Lavretsky [30] who reported that physiological aging can modify response to stress because of reduced resilience.High leukocyte count was found to be a significant factor affecting mortality in our patients. However, it is not an unusual finding as high leukocyte count is a poor prognostic factor in many scores for evaluation of the prognosis, like Ranson score and APACHE score [31]. The high leukocyte count usually reflects the severity of the pathological condition and/or the inflammatory response and consequently it is associated with poorer prognosis compared with patients with normal or slightly elevated leukocyte count [32].

## Conclusion

Bogota bag for TAC after OA is an easy and efficient technique for management of abdominal catastrophes by which serious complications of either exposure or closure under tension could be prevented. It is associated with 13.5% mortality rate. Old age and high leukocyte count were found to be significant risk factors affecting mortality.

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**Conflicts of interest**
There are no conflicts of interest.

## References

1 Maddah G, Shabahang H, Abdollahi A, Zehi V, Abdollahi M. Temporary abdominal closure in the critically ill patients with an open abdomen. Acta Med Iran 2014; 52:375–380.

2 Tremblay LN, Feliciano DV, Schmidt J, Cava RA, Tchorz KM, Ingram WL, *et al.* Skin only or silo closure in the critically ill patient with an open abdomen. Am J Surg 2001; 182:670–675.

3 Muhammad Y, Gondal KM, Khan UA. Use of the 'Bogota bag' for closure of open abdominal wound after exploratory laparotomy – our experience at Mayo Hospital Lahore. J Pak Med Assoc 2016; 66:980–983.

4 Coccolini F, Roberts D, Ansaloni L, Ivatury R, Gamberini E, Kluger Y, *et al.* The open abdomen in trauma and non-trauma patients: WSES guidelines. World J Emerg Surg 2018; 13:7.

5 Sartelli M, Abu-Zidan FM, Ansaloni L, Bala M, Beltran MA, Biffl WL, *et al.* The role of the open abdomen procedure in managing severe abdominal sepsis: WSES position paper. World J Emerg Surg 2015; 10:35.

6 Shapiro MB, Jenkins DH, Schwab CW, Rotondo MF. Damage control: collective review. J Trauma Acute Care Surg 2000; 49:969–978.

7 Kääriäinen M, Kuuskeri M, Helminen M, Kuokkanen H. Greater success of primary fascial closure of the open abdomen: a retrospective study analyzing applied surgical techniques, success of fascial closure, and variables affecting the results. Scand J Surg 2017; 106:145–151.

8 Beckman M, Paul J, Neideen T, Weigelt JA. Role of the open abdomen in critically ill patients. Crit Care Clin 2016; 32:255–264.

9 Chiara O, Cimbanassi S, Biffl W, Leppaniemi A, Henry S, Scalea TM, *et al.*, editors. International consensus conference on open abdomen in trauma. In Journal of Trauma and Acute Care Surgery. LWW; 2016; 80:173–183.

10 Campbell A, Kuhn W, Barker P. Vacuum-assisted closure of the open abdomen in a resource-limited setting. S Afr J Surg 2010; 48:114–115.

11 Panel OAA, Vargo D, Richardson JD, Panel A, Campbell A, Chang M, *et al.* Management of the open abdomen: from initial operation to definitive closure. Am Surg 2009; 75:S1–S22.

12 Leppäniemi AK. Laparostomy: why and when? Crit Care 2010; 14:216.

13 Danilo C, Leanza S. Systematic review of laparostomy/open abdomen to prevent acute compartimental syndrome (ACS). Maedica (Buchar) 2018; 13:179.

14 De Laet I, Malbrain M. Current insights in intra-abdominal hypertension and abdominal compartment syndrome. Med Intensiva 2007; 31:88–99.

15 Rutherford EJ, Skeete DA, Brasel KJ. Management of the patient with an open abdomen: techniques in temporary and definitive closure. Curr Probl Surg 2004; 41:815–876.

16 Agha R, Fowler A, Rammohan S, Barai I, Orgill D. The PROCESS statement: preferred reporting of case series in surgery. Int J Surg 2016; 36:319–323.

17 Johnson JW, Gracias VH, Schwab CW, Reilly PM, Kauder DR, Shapiro MB, *et al.* Evolution in damage control for exsanguinating penetrating abdominal injury. J Trauma Acute Care Surg 2001; 51:261–271.

18 Kirshtein B, Roy-Shapira A, Lantsberg L, Mizrahi S. Use of the 'Bogota bag' for temporary abdominal closure in patients with secondary peritonitis. Am Surg 2007; 73:249–252.

19 Shestak KC, Edington HJ, Johnson RR. The separation of anatomic components technique for the reconstruction of massive midline abdominal wall defects: anatomy, surgical technique, applications, and limitations revisited. Plast Reconstr Surg 2000; 105:731–739.

20 Doyon A, Devroede G, Viens D, Saito S, Rioux A, Echavé V, *et al.* A simple, inexpensive, life-saving way to perform iterative laparotomy in patients with severe intra-abdominal sepsis. Colorectal Dis 2001; 3:115–121.

21 Howdieshell TR, Proctor CD, Sternberg E, Cué JI, Mondy JS, Hawkins ML. Temporary abdominal closure followed by definitive abdominal wall reconstruction of the open abdomen. Am J Surg 2004; 188:301–306.

22 Kushimoto S, Yamamoto Y, Aiboshi J, Ogawa F, Koido Y, Yoshida R, *et al.* Usefulness of the bilateral anterior rectus abdominis sheath turnover flap method for early fascial closure in patients requiring open abdominal management. World J Surg 2007; 31:2–8.

23 Manterola C, Moraga J, Urrutia S. Contained laparostomy with a Bogota bag. Results of case series. Cir Esp 2011; 89:379–385.

**24** Ayaz T, Sahin SB, Sahin OZ, Bilir O, Rakıcı H. Factors affecting mortality in elderly patients hospitalized for nonmalignant reasons. J Aging Res 2014; 2014:584315.

**25** Joseph B, Zangbar B, Pandit V, Fain M, Mohler MJ, Kulvatunyou N, *et al.* Emergency general surgery in the elderly: too old or too frail? J Am Coll Surg 2016; 222:805–813.

**26** Morales AE, Cardona DA. Prognostic factors of early 30-day mortality in elderly patients admitted to an emergency department. Rev Esp Geriatr Gerontol 2017; 52:257–260.

**27** Ponzetto M, Maero B, Maina P, Rosato R, Ciccone G, Merletti F, *et al.* Risk factors for early and late mortality in hospitalized older patients: the continuing importance of functional status. J Gerontol A Biol Sci Med Sci 2003; 58:M1049–M1054.

**28** Silva TJ, Jerussalmy CS, Farfel JM, Curiati JA, Jacob-Filho W. Predictors of in-hospital mortality among older patients. Clinics 2009; 64:613–618.

**29** Sousa S, Moraes M, Beato V, Corredoura A, Rodrigues G, Soares M, *et al.* Predictive in-hospital and 6-month morbidity and mortality factors in elderly hospitalized patients. Acta Med Port 2002; 15:177–184.

**30** Lavretsky HNP. Stress, inflammation, and aging. Am J Geriatr Psychiatry 2012; 20:729–733.

**31** Chatzicostas C, Roussomoustakaki M, Vlachonikolis IG, Notas G, Mouzas I, Samonakis D, *et al.* Comparison of Ranson, APACHE II and APACHE III scoring systems in acute pancreatitis. Pancreas 2002; 25:331–335.

**32** Platon A, Frund C, Meijers L, Perneger T, Andereggen E, Becker M, *et al.* Concomitant leukocytosis and lymphopenia predict significant pathology at CT of acute abdomen: a case-control study. BMC Emerg Med 2019; 19:10.