

# Laparostomy in patients with severe secondary peritonitis

## Ağır sekonder peritonitli hastalarda laparostomi

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### BACKGROUND

The aim of this study was to evaluate the effectiveness of laparostomy with the Bogota bag for the management of patients with severe secondary peritonitis and the risk factors for survival.

### METHODS

Thirty-seven patients (22 males, 15 females; mean age 63.5; range 44 to 83 years) with secondary peritonitis were treated by laparostomy and temporary closure with Bogota bag. APACHE II scores and Mannheim Peritonitis Index (MPI) were used to calculate the disease severity. The outcomes and effectiveness of APACHE II and MPI values were analyzed retrospectively.

### RESULTS

The mortality rate was 43.2%. Significant differences were noted between survivors and non-survivors according to initial APACHE II and MPI scores and the number of operations. The non-survivors had higher APACHE II ( $r=0.81$ ,  $p=0.001$ ) and MPI ( $r=0.39$ ,  $p=0.02$ ) scores. The patients who survived were re-operated 1.6 times and those who died were re-operated 4.7 times. In five patients, laparostomy was closed primarily, while in the others, the wound was left open to heal secondarily.

### CONCLUSION

Patients with higher APACHE II and MPI scores and number of operations had higher rates of mortality due to their major risk factors. Temporary abdominal closure using the Bogota bag in patients with secondary peritonitis is an inexpensive-simple method, permitting evaluation of underlying viscera and recognition of infection.

**Key Words:** APACHE II; Bogota bag; intraabdominal morbidity; Mannheim Peritonitis Index; mortality; secondary peritonitis; temporary abdominal closure.

### AMAÇ

Bu çalışmada, sekonder peritonitli hastaların tedavisinde, Bogota bag ile geçici karın kapatmanın etkinliği ve sağ kalımdaki risk faktörleri değerlendirildi.

### GEREÇ VE YÖNTEM

Sekonder peritonit nedeniyle Bogota bag kullanılarak geçici olarak karın kapatılması uygulanan 37 hasta (22 erkek, 15 kadın; ort. yaş 63,5; dağılım 44-83) ele alındı. Hastalığın şiddetinin belirlenmesinde Acute Physiology and Chronic Health Evaluation II (APACHE II) ve Mannheim Peritonit İndeksi (MPI) skorları kullanıldı. APACHE II'nin sonuçları ve etkinliği ve MPI değerleri, geriye dönük olarak değerlendirildi.

### BULGULAR

Mortalite oranı %43,2 olarak belirlendi. Yaşayan ve hayatını kaybeden hastaların, başvuru APACHE II ( $r=0,81$ ,  $p=0,001$ ) ve MPI ( $r=0,39$ ,  $p=0,02$ ) skorları ve ameliyat sayıları (1,6'ya karşın 4,7 ameliyat) arasında yaşayanların lehine anlamlı fark saptandı. Beş hastada laparostomi primer olarak kapatılırken, yaşayan diğer hastalar sekonder iyileşmeye bırakıldı.

### SONUÇ

Sekonder peritonitli hastalarda Bogota bag ile geçici karın kapatılması, ucuz ve basit bir yöntem olup, şeffaflığıyla altındaki organların ve enfeksiyonun gözlenmesine olanak sağlar. Yüksek APACHE II ve MPI skorları ve fazla sayıda relaparotomi uygulanması, daha yüksek mortalite oranı ile sonuçlanmaktadır.

**Anahtar Sözcükler:** APACHE II; Bogota bag; karın içi morbidite; Mannheim Peritonit İndeksi; mortalite; sekonder peritonit; geçici abdominal kapatma.

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Severe secondary peritonitis is a life-threatening condition; the patient's survival mainly depends on supportive care, rational and intense antibiotherapy and effective operative procedures to control the source of infection. Operative management consists of effective debridement, source control, and laparostomy following planned or on-demand relaparotomies.<sup>[1,2]</sup> Benefits of laparostomy 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.<sup>[3]</sup> Several techniques have been published, but no clear consensus on the best technique or device exists.<sup>[3]</sup>

Despite the above, the mortality rate is 59%,<sup>[4]</sup> and morbidity associated with severe complications (abscess, fistulas, bleeding, wound infection, dehiscence, ventral hernias)<sup>[5,6]</sup> is followed by re-operations and months of convalescence.

Temporary closure of the abdominal wall with Bogota bag (BB) in these patients is a simple and inexpensive method, and this transparent bag permits evaluation of the intraabdominal space.<sup>[7]</sup>

Our aim was to present our experiences in temporary closure technique with BB in severe secondary peritonitis and to discuss our results in light of the recent literature. In addition, the differences between survivor and non-survivor cases are discussed.

## MATERIALS AND METHODS

Thirty-seven serious secondary peritonitis patients who underwent temporary closure with BB between 2000 and 2006 were included in this retrospective study. Acute abdomen was the initial diagnosis in all of the operated patients; preoperative computed tomography and conventional radiographs were performed as needed. In the resuscitative phase, we followed the surviving sepsis guidelines in order to deliver standard therapy to every patient, which included intravenous fluid hydration with isotonic crystalloid solutions, oxygen support, broad spectrum antibiotherapy and warming of the patients.

After a duodenal feeding tube placement, nutrition was initiated progressively within 12-36 hours of surgery; when it was not possible, the patients were submitted to total parenteral nutrition. The indications for surgery are listed in Table 1.

We used the temporary closure methods in patients with generalized peritonitis in whom it was difficult to control the infection and/or in cases with increased intra-abdominal pressure.<sup>[8]</sup> The decision criterias to perform a laparostomy in patients with generalized peritonitis and without the intra-abdominal hypertension is not well-defined.<sup>[9]</sup>

The relaparotomy decision was based on patients' clinical findings and observations through BB by the same surgical team: presence of a gastrointestinal leakage and increase in intra-abdominal pressure and APACHE II/Mannheim Peritonitis Index (MPI) scores during the intensive therapy in the intensive care unit (ICU) (relaparotomy on-demand).

Use of the BB technique for abdominal closure has been reported primarily in the management of trauma;<sup>[10,11]</sup> we used a bag of intravenous fluids or 3L urologic irrigation fluid, spreading over the intestinal loops and sutured to the skin part of the wound edge. At a later stage, if the intraabdominal sepsis was resolved, the abdominal wall was reconstructed.

Age, sex, preoperative APACHE II and MPI scores, number of operations, duration in ICU, intra-abdominal complications, mortality rate, morbidity, and modality of abdominal closure were evaluated in all patients.

The results of survivors and non-survivors according to several parameters were compared by using Student's t, Pearson correlation, and Mann-Whitney U tests. Probability values less than 0.05 were considered statistically significant.

## RESULTS

Thirty-seven patients were included in this research (22 M, 59.4%; 15 F, 40.5%). Average age

**Table 1.** Indications in initial operations

Etiology	Patients (n) (%)
Perforated malignant colorectal disease	14 (37.8)
Infected pancreatic necrosis	10 (27.0)
Multiple small bowel perforations	4 (10.8)
Gangrenous small bowel	4 (10.8)
Peptic ulcer perforation	2 (5.4)
Anastomotic leakage from urologic ileal conduit	2 (5.4)
Perforated splenic abscess	1 (2.7)
Total	37 (100)

was 63.5 (44-83) years. Postoperatively, all the patients were admitted to the surgical ICU (18 patients) (48.6%) or the general ICU (19 patients) (51.4%) for close follow up and monitoring. Mechanical ventilatory support was necessary in 19 patients (51.4%) in the ICU. The overall mortality rate was 43.2% (16/37).

In 5 patients (23.8%), laparotomies were closed in one stage. The diagnosis was perforated malignant colorectal disease in 2 cases (APACHE II scores: 18 and 21; MPI scores: 21 and 22, respectively), peptic ulcer perforation in 2 cases (APACHE II scores: 15 and 19; MPI scores: 16 and 17, respectively) and perforated splenic abscess in 1 case (APACHE II score: 17; MPI score: 18).

In the other 32 cases, relaparotomies were needed. In relaparotomy cases, laparotomy intervals varied between 12-96 hours according to operative and laparotomy observation findings, and the mean number of re-operations was  $2.9 \pm 1.8$ . The patients who survived were re-operated 1.6 times and those who died were re-operated 4.7 times. There was a statistically significant difference between survivors and non-survivors, with the survivors undergoing fewer operations (Table 2).

Twelve (32.4%) of the relaparotomy cases had major complications. Four patients had (10.8%) intra-abdominal abscesses (abscesses were drained), 4 patients (10.8%) had intra-abdominal abscess and fistula (abscesses were drained; 2 intestinal fistulas were exteriorized, 2 pancreatic fistulas were drained), 2 patients had bleeding (5.4%, packed), and 2 patients (5.4%) had intestinal obstructions (1 detorsion, 1 adhesiolysis were performed). It is important to mention that all patients with intra-abdominal complications died, except one who had

intestinal obstruction (secondary to operation of peptic ulcer perforation).

Among the 5 patients who died without major intra-abdominal complications, 4 died due to multi-organ failure (MOF) affecting at least five systems and 1 due to pulmonary embolus.

Multi-organ failure was the cause of death in 2 patients with perforated malignant colorectal disease and in 2 patients with multiple small bowel perforations. A pulmonary embolus occurred in 1 patient with perforated malignant colorectal disease and it progressed to death.

The etiologies in 16 patients who died were: 6 perforated colorectal cancer, 5 pancreatic necrosis, 3 multiple intestinal perforation (2 non-specific vasculitis, 1 typhoid lesion) and 2 intestinal necrosis (Table 3).

When comparing survivors and non-survivors, there was no significant difference between sex and ages of the patients (Table 2).

The APACHE II scores calculated at admission and MPI scores based on operative findings between survivors and non-survivors were significantly different (Table 2 and Fig. 1). Patients with higher APACHE II and MPI scores demonstrated significantly higher mortality rate ( $p=0.001$  and  $p=0.02$ , respectively). The APACHE II scores  $\geq 30$  were correlated with very high mortality rates ( $r=0.95$ ,  $p=0.001$ ).

Duration of ICU or surgical ICU hospitalization was 8.2 days for patients who survived and 22.4 days for non-survivors. There was a significant difference in ICU/surgical ICU hospitalization times between survivors and non-survivors (Table 2).

**Table 2.** Statistical analysis of sex, age, APACHE II and MPI scores, number of operations, and ICU hospitalization duration between survivors and non-survivors

	Mean ( $\pm$ SD)		p	95% Confidence Interval
	Survivors	Non-survivors		
Sex (male/female)	13 / 8	9 / 7	0.77	NS
Age	63.3 $\pm$ 9.8	67.9 $\pm$ 7.6	0.13	NS
APACHE II	22.4 $\pm$ 4.3	34.9 $\pm$ 5.0	0.001	(-9.3)-(-15.6)
MPI	29.4 $\pm$ 7.1	35.4 $\pm$ 7.7	0.02	(-1.0)-(-11.1)
Number of operations	1.6 $\pm$ 0.8	4.7 $\pm$ 1.1	0.001	(-2.5)-(-3.7)
ICU	8.2 $\pm$ 2.1	22.4 $\pm$ 9.1	0.001	(-10.1)-(-18.4)

MPI: Mannheim Peritonitis Index; ICU: ICU hospitalization duration.

**Table 3.** The survival and intra-abdominal complications according to the sources of infection

Etiology	n	Mortality (n)	Causes of mortality (n)	Intra-abdominal complications (n)
Perforated malignant colorectal disease	14	6	Intra-abdominal complications: 3 MOF: 2 PE: 1	Abscess: 3
Infected pancreatic necrosis	10	5	Intra-abdominal complications: 5	Bleeding: 2 Fistula and abscess: 2 Abscess (recurrence): 1
Multiple small bowel perforations	4	3	Intra-abdominal complications: 3	Fistula and abscess: 2 MIO: 1
Gangrenous small bowel	4	2	MOF: 2	0
Peptic ulcer perforation	2	0	0	MIO: 1
Anastomotic leakage from urologic ileal conduit	2	0	0	0
Perforated splenic abscess	1	0	0	0
Total	37	16	16	12

MOF: Multiple organ failure; PE: Pulmonary embolism; MIO: Mechanic intestinal obstruction.

In the 16 surviving patients, the wound was left open to heal secondarily. Ten (47.6%) of them were unable to be followed and did not inform us regarding incisional hernia.

In 1 (4.8%) of the remaining 6 patients (28.6%), skin grafting was used for abdominal wall closure. Skin graft was preferred because we were not able to dissect through the abdominal planes.

In 2 patients (9.6%), incisional hernias were repaired with on-lay polypropylene mesh and in 3 patients (14.3%) with intraperitoneal polyglactin 910-polypropylene dual mesh. In these cases, a polypropylene mesh was placed into the preperitoneal space. These operations were done within the first year of the incisional hernia development.

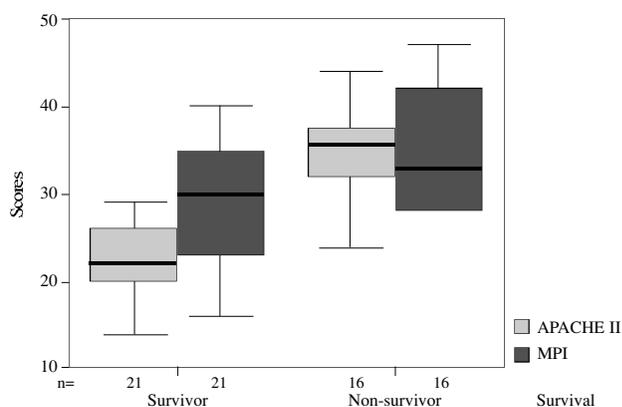
## DISCUSSION

The key steps in the management of severe secondary peritonitis are early detection and care of these patients with adequate antimicrobials and removal or drainage of all septic sources. Postoperative ICU support and balanced volume should be applied with careful monitoring of intra-abdominal pressure, especially in patients where ventilation support is needed.<sup>[5]</sup>

Elimination of the septic focus and contents is mandatory for successful treatment. If it is not achieved in one stage, planned re-laparotomy, planned re-laparotomy via laparostomy (STAR procedure), relaparotomy on-demand, and open treat-

ment with laparostomy are accepted as the surgical treatment alternatives.<sup>[2,4,10]</sup> Although there are some disadvantages such as evisceration, fistulization and development of difficult incisional hernias, the laparostomy technique has been generally accepted for the management of severe intra-abdominal infections; the laparostomy could be covered with BB simply and cheaply.<sup>[7,10]</sup> In a few studies, some authors have found planned re-laparotomy to be more advantageous than relaparotomy on-demand,<sup>[12]</sup> while others found the opposite.<sup>[13,14]</sup> However, the majority of studies, including one meta-analysis,<sup>[15]</sup> state that there is no significant difference between these two methods.<sup>[16-18]</sup>

Our patients were managed with temporary laparostomy with BB and relaparotomy on-demand after observing the patient's condition and abdomi-



**Fig. 1.** APACHE II and MPI scores for survivors and non-survivors.

nal contents through the bag. Among the few heterogeneous and mostly retrospective studies, the lowest mortality rate was reported as 23%<sup>[19]</sup> for severe intra-abdominal infection patients. Our mortality rate of 43% for these patients might be considered as acceptable when compared with mortality rates as high as 59% reported in the literature.<sup>[4]</sup>

Clinical follow-up of the patients in the ICU according to specific parameters has been used frequently. APACHE II and MPI scores were used in our cases; these parameters were also used as predictors for higher mortality. Their use was significantly effective in our study: patients with higher APACHE II and MPI scores demonstrated higher rates of mortality ( $r=0.81$  and  $r=0.39$ , respectively), and the differences were statistically significant. Furthermore, the  $r=0.95$  value found for APACHE II scores  $\geq 30$  was notable.

The mean number of re-operations was  $2.9 \pm 1.8$  in our series, but this rate was higher in non-survivors than in survivors. Our results are similar to those of Kirshtein.<sup>[7]</sup> Higher APACHE and MPI scores during the management period could be accepted as poor prognostic predictors. In addition, patients requiring more re-operations and with a longer ICU period could present a poor outcome.

The high rate of intra-abdominal complications (32.4%) in our cases was in correlation with the available literature; furthermore, the results were better than in some studies.<sup>[6]</sup>

The literature reported high incidences of intra-abdominal complications, e.g. 24% (5) for abscess, 2-25% (5,6) for fistulas, and 24% (6) for bleeding.

Towel clip closure, BB, polyglycolic acid mesh, polyglactin 910 mesh, zipper and vacuum-assisted closure (VAC) systems are available options in the temporary abdominal closure procedures.<sup>[5]</sup> BB was used in our cases. It was an inexpensive material, and it usually permitted us to observe severe intra-abdominal infections, leakages and soft tissue necrosis through it.<sup>[7]</sup>

For repairing the full-thickness abdominal wall soft-tissue defect developing after the BB procedures, there are several alternative techniques and materials, such as polypropylene, polytetrafluorethylene (PTFE) graft, composite materials, plastic surgery techniques, biologic materials, and primary fascial closure.<sup>[2,7,19,20]</sup>

Primary closure was the preferred form of definitive closure, but its use quite various in the literature, between 8-10% (8,16) and 70%.<sup>[11]</sup> Only 5/21 (23.8%) patients in our study underwent primary fascial closure; the others required delayed closure. As shown in our study, in accordance with the literature, the limited number of re-operations could increase the chance of primary closure;<sup>[19,21]</sup> all five cases with primary closure were re-operated only once.

As mentioned in Bailey's study as well,<sup>[22]</sup> 16 (76.4%) of our cases had secondary healing and needed delayed closure. The period before delayed closure was four weeks in different studies;<sup>[4]</sup> however, for most of the cases this period could be longer.<sup>[7]</sup> In our study, 6 patients with ventral hernia (28.6%) underwent hernia repair within 3-12 month periods (1 patient with skin graft; the other 5 patients with mesh repair). Mesh repair was performed easily in the late period.

In conclusion, in the initial period of severe intraabdominal sepsis, the laparostomy procedure with temporary closure using BB could be sufficient and permits observation of abdominal content and further on-demand explorations. These patients can be followed with MPI and APACHE II scores in the ICU. Limited number of re-operations, decreased APACHE II and MPI scores and shorter periods in the ICU unit were associated with decreased mortality rates and intra-abdominal complications in our series.

## REFERENCES

1. Kriwanek S, Armbruster C, Dittrich K, Beckerhinn P, Schwarzmaier A, Redl E. Long-term outcome after open treatment of severe intra-abdominal infection and pancreatic necrosis. *Arch Surg* 1998;133:140-4.
2. Wittmann DH, Schein M, Condon RE. Management of secondary peritonitis. *Ann Surg* 1996;224:10-8.
3. Kaplan M, Banwell P, Orgill DP, Ivatury RR, Demetriades D, Moore FA, et al. Guidelines for the management of the open abdomen. *Wounds* 2005(17 Suppl):1-24.
4. Rakic M, Popovic D, Rakic M, Druzijanic N, Lojpur M, Hall BA, et al. Comparison of on-demand vs planned relaparotomy for treatment of severe intra-abdominal infections. *Croat Med J* 2005;46:957-63.
5. Rutherford EJ, Skeete DA, Brasel KJ. Management of the patient with an open abdomen: techniques in temporary and definitive closure. *Curr Probl Surg* 2004;41:815-76.
6. Bosscha K, Hulstaert PF, Visser MR, van Vroonhoven TJ, van der Werken C. Open management of the abdomen and planned reoperations in severe bacterial peritonitis. *Eur J Surg* 2000;166:44-9.

7. 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;73:249-52.
8. Lenz S, Doll D, Harder K, Lieber A, Müller U, Düsel W, et al. Procedures of temporary wall closure in abdominal trauma and sepsis. [Article in German] *Chirurg* 2006;77:580-5. [Abstract]
9. Schein M. Surgical management of intra-abdominal infection: is there any evidence? *Langenbecks Arch Surg* 2002;387:1-7.
10. Taviloglu K. Staged abdominal re-operation for abdominal trauma. *Ulus Travma Acil Cerrahi Derg* 2003;9:149-53.
11. Guloglu R. Abdominal compartment syndrome. *Ulus Travma Derg* 2002;8:133-6.
12. Jiffry BA, Sebastian MW, Amin T, Isbister WH. Multiple laparotomies for severe intra-abdominal infection. *Aust N Z J Surg* 1998;68:139-42.
13. Robledo FA, Luque-de-León E, Suárez R, Sánchez P, de-la-Fuente M, Vargas A, et al. Open versus closed management of the abdomen in the surgical treatment of severe secondary peritonitis: a randomized clinical trial. *Surg Infect (Larchmt)* 2007;8:63-72.
14. van Ruler O, Mahler CW, Boer KR, Reuland EA, Gooszen HG, Opmeer BC, et al. Comparison of on-demand vs planned relaparotomy strategy in patients with severe peritonitis: a randomized trial. *JAMA* 2007;298:865-72.
15. Lamme B, Boermeester MA, Reitsma JB, Mahler CW, Obertop H, Gouma DJ. Meta-analysis of relaparotomy for secondary peritonitis. *Br J Surg* 2002;89:1516-24.
16. Lamme B, Boermeester MA, Belt EJ, van Till JW, Gouma DJ, Obertop H. Mortality and morbidity of planned relaparotomy versus relaparotomy on demand for secondary peritonitis. *Br J Surg* 2004;91:1046-54.
17. Koperna T, Schulz F. Relaparotomy in peritonitis: prognosis and treatment of patients with persisting intraabdominal infection. *World J Surg* 2000;24:32-7.
18. Hau T, Ohmann C, Wolmershäuser A, Wacha H, Yang Q. Planned relaparotomy vs relaparotomy on demand in the treatment of intra-abdominal infections. The Peritonitis Study Group of the Surgical Infection Society-Europe. *Arch Surg* 1995;130:1193-6.
19. Barker DE, Green JM, Maxwell RA, Smith PW, Mejia VA, Dart BW, et al. Experience with vacuum-pack temporary abdominal wound closure in 258 trauma and general and vascular surgical patients. *J Am Coll Surg* 2007;204:784-92.
20. Bosscha K, Reijnders K, Jacobs MH, Post MW, Algra A, van der Werken C. Quality of life after severe bacterial peritonitis and infected necrotizing pancreatitis treated with open management of the abdomen and planned re-operations. *Crit Care Med* 2001;29:1539-43.
21. van Goor H, Hulsebos RG, Bleichrodt RP. Complications of planned relaparotomy in patients with severe general peritonitis. *Eur J Surg* 1997;163:61-6.
22. Bailey CM, Thompson-Fawcett MW, Kettlewell MG, Garrard C, Mortensen NJ. Laparostomy for severe intra-abdominal infection complicating colorectal disease. *Dis Colon Rectum* 2000;43:25-30.