Source Control in Abdominal Sepsis

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Massimo Sartelli

18.1 Introduction

Intra-abdominal infections (IAIs) include several different pathological conditions and are usually classified into uncomplicated and complicated [1]. In uncomplicated IAIs, the infectious process only involves a single organ and does not proceed to the peritoneum. Patients with these infections can be managed with either surgical source control or with antibiotics alone. In complicated IAIs, the infectious process extends beyond the organ and causes either localized or diffuse peritonitis.

IAIs are an important cause of morbidity and mortality [1].

Treatment of patients with complicated IAIs has been usually described to achieve satisfactory results if adequate management is established [2]. However, results from published clinical trials may not be representative of the true morbidity and mortality rates of these severe infections. First of all, patients who have perforated appendicitis are usually over-represented in clinical trials. Furthermore, patients with IAIs enrolled in clinical trials often have an increased likelihood of cure and survival. In fact, the trial eligibility criteria usually restrict the inclusion of patients with comorbid diseases that would increase the death rate of patients with IAIs [1]. In the WISS study enrolling all the patients older than 18 years old with complicated IAIs worldwide, the overall mortality rate was 9.2% (416/4533) [2].

Early clinical diagnosis, adequate source control to stop ongoing contamination, appropriate antimicrobial therapy dictated by patient and infection risk factors, and prompt resuscitation in critically ill patients are the cornerstones of the management of IAIs.

The timing and adequacy of source control are currently among the most important issues in the management of IAIs because inadequate and late operation may have a negative effect on outcome [2].

M. Sartelli (✉)
Department of General Surgery, Macerata Hospital, Macerata, Italy
e-mail: massimosartelli@gmail.com

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18.2 Source Control

Source control encompasses all measures undertaken to eliminate the source of infection, reduce the bacterial inoculum and correct or control anatomic derangements to restore normal physiologic function [3, 4].

IAIs are the sites where source control is more feasible and more impactful. In these settings appropriate source control can improve patient outcomes and reduce antibiotic pressure by allowing a short course of antibiotic therapy [1].

The timing and adequacy of source control are currently important issues in the management of IAIs because, when inadequate and delayed, they may have a negative effect on outcome. The optimal timing of source control has not been rigorously investigated [5, 6]. However, source control should be performed as soon as possible in patients with diffuse peritonitis, but it can be delayed for logistical reasons in stable patients with a localized infection, if appropriate antibiotic therapy is given and careful clinical monitoring is provided [7].

The level of urgency of treatment is determined by the affected organ(s), the relative speed at which clinical symptoms progress and worsen, and the underlying physiological stability of the patient. The Surviving Sepsis Campaign guidelines suggest that a specific anatomic diagnosis of infection requiring emergent source control should be identified or excluded as rapidly as possible in patients with sepsis or septic shock [8].

Control of the source of infection in patients with IAIs can be achieved using both operative and non-operative techniques. An operative intervention remains the most viable therapeutic strategy for managing surgical infections in critical ill patients.

Non-operative interventional procedures include percutaneous drainages of abscesses. Well-localized fluid collections of appropriate density and consistency (i.e., lack of extensive loculations) may be drained percutaneously with acceptable outcomes. Percutaneous drainage of abdominal and extraperitoneal abscesses performed under ultrasound or computed tomography guidance in selected patients are safe and effective [9, 10]. The principal cause for failure of percutaneous drainage is misdiagnosis of the magnitude, extent, complexity, location of the abscess.

Surgery is the most important therapeutic measure to control surgical infections. In the setting of IAIs, the primary objectives of surgical intervention include (a) determining the cause of peritonitis, (b) draining fluid collections, (c) controlling the origin of peritonitis. In patients with IAIs, surgical source control entails resection or suture of a diseased or perforated viscus (e.g., diverticular perforation, gastroduodenal perforation), removal of the infected organ (e.g., appendix, gallbladder), debridement of necrotic tissue, resection of ischemic bowel and repair/resection of traumatic perforations with primary anastomosis or exteriorization of the bowel [11].

Table 18.1 summarizes the sources of infection in the international WISS Study [2].

In recent years, laparoscopy has been gaining wider acceptance in the diagnosis and treatment of IAIs. The laparoscopic approach in the treatment of peritonitis is

Table 18.1 Source of infection in 4553 patients from 132 hospitals worldwide (15 October 2014–15 February 2015)

Source of infection	Number	%
Appendicitis	1553	34.2
Cholecystitis	837	18.5
Gastroduodenal perforations	498	11.0
Postoperative	387	8.5
Colonic non-diverticular perforation	269	5.9
Small bowel perforation	243	5.4
Diverticulitis	234	5.2
Post-traumatic perforation	114	2.5
Pelvic inflammatory disease	50	1.1
Other	348	7.7
Total	4553	100.0

Modified from [2]

feasible for many emergency conditions. It has the advantage of allowing, at the same time, an adequate diagnosis and appropriate treatment with a less invasive abdominal approach. However, because of the increase of intra-abdominal pressure resulting from pneumoperitoneum, laparoscopy may have a negative effect in critically ill patients, leading to acid–base balance disturbances, as well as changes in cardiovascular and pulmonary physiology [12].

18.3 Relaparotomy Strategies

In certain circumstances, infection not completely controlled may trigger an excessive immune response and local infection may progressively evolve into sepsis, septic shock, and organ failure. These patients can benefit from immediate and aggressive surgical reoperations with subsequent relaparotomy strategies to curb the spread of organ dysfunctions caused by ongoing peritonitis. Surgical strategies following an initial emergency laparotomy include subsequent "relaparotomy on demand" (when required by the patient's clinical condition) as well as planned relaparotomy in the 36–48-h postoperative period.

On-demand laparotomy should be performed only when absolutely necessary and only for those patients who would clearly benefit from additional surgery. Planned relaparotomies, on the other hand, are performed every 36–48 h for purposes of inspection, drainage, and peritoneal lavage of the abdominal cavity. The concept of a planned relaparotomy for severe peritonitis has been debated for over 30 years. Reoperations are performed every 48 h to reassess the peritoneal inflammatory process until the abdomen is free of ongoing peritonitis; then the abdomen is closed. The advantages of the planned relaparotomy approach are optimization of resource utilization and reduction of the potential risk for gastrointestinal fistulas and delayed hernias. The results of a clinical trial published in 2007 by Van Ruler et al. investigating the differences between on-demand and planned relaparotomy strategies in patients with severe peritonitis found few advantages for the planned relaparotomy strategy; however, the study mentioned that this latter group exhibited a reduced need for additional relaparotomies, decreased patient dependency on subsequent health care services, and decreased overall medical costs [13].

An open abdomen (OA) procedure is the best way of implementing relaparotomies. The role of the OA in the management of severe peritonitis has been a controversial issue [14].

Although guidelines recommend not to routinely utilize the OA approach for patients with severe intraperitoneal contamination undergoing emergency laparotomy for intra-abdominal sepsis, OA has now been accepted as a strategy in treating physiologically deranged patients with acute peritonitis [15].

The OA concept, which is closely linked to damage control surgery, may be easily adapted to patients with advanced sepsis and can incorporate the principles of the Surviving Sepsis Campaign. The term “damage control surgery” (DCS) for trauma patients was introduced in 1993 [16].

It was defined as initial control of hemorrhage and contamination, allowing for resuscitation to normal physiology in the intensive care unit and subsequent definitive re-exploration. Similarly to the trauma patient with the lethal triad of acidosis, hypothermia and coagulopathy, many patients with sepsis or septic shock may present in a similar fashion. For those patients, DCS can truly be life-saving. Patients progressing from sepsis with organ dysfunction into septic shock can present with vasodilation, hypotension, and myocardial depression, combined with coagulopathy. These patients are profoundly hemodynamically unstable and are clearly not optimal candidates for complex operative interventions. Abdominal closure should be temporary, and the patient is rapidly taken to the intensive care unit for physiologic optimization. This includes optimization of volume resuscitation and mechanical ventilation, correction of coagulopathy and hypothermia, and monitoring for the possible development of abdominal compartment syndrome. Over the following 24–48 h, when abnormal physiology is corrected, the patient can be safely taken back to the operating room for reoperation. Following stabilization of the patient, the goal is the early and definitive closure of the abdomen, in order to reduce the complications associated with an OA. Primary fascial closure can be achieved in many cases within few days from the initial operation. It would not be successful if early surgical source control failed.

Sequential fascial closure can immediately be started once the abdominal sepsis is well controlled. In these cases, surgeons should perform a progressive closure, where the abdomen is incrementally closed each time the patient undergoes a reoperation. Within 10–14 days the fascia retracts laterally and becomes adherent to the overlying fat; this makes primary closure impossible. Therefore, it is important to prevent retraction of the myofascial unit [17, 18].

Several materials can be used to achieve temporary closure of the abdomen: gauze, mesh, impermeable self-adhesive membrane dressings, zippers and negative pressure wound therapy (NPWT) techniques. The surgical options for management of the OA are now more diverse and sophisticated, but there is a lack of prospective randomized controlled trials demonstrating the superiority of any particular method. At present, NPWT techniques have become the most extensively used methods for temporary abdominal wall closure. NPWT actively drains toxin or bacteria-rich intraperitoneal fluid and has resulted in a high rate of fascial and abdominal wall closure.

18.4 Conclusion

IAIs are the sites where a source control is more feasible and more impactful. In these settings appropriate source control can improve patient outcomes and reduce antibiotic pressure by allowing a short course of antibiotic therapy.

Surgery is the most important therapeutic measure to control surgical infections. In the setting of intra-abdominal infections, the primary objectives of surgical intervention include (a) determining the cause of peritonitis, (b) draining fluid collections, (c) controlling the origin of peritonitis.

In certain circumstances, infection not completely controlled may trigger an excessive immune response and local infection may progressively evolve into sepsis, septic shock, and organ failure. Such patients can benefit from immediate and aggressive surgical reoperations with subsequent relaparotomy strategies, to curb the spread of organ dysfunctions caused by ongoing peritonitis.

References

1. Sartelli M, Chichom-Mefire A, Labricciosa FM, et al. The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines for management of intra-abdominal infections. World J Emerg Surg. 2017;12:29. https://doi.org/10.1186/s13017-017-0141-6.
2. Sartelli M, Abu-Zidan FM, Catena F, et al. Global validation of the WSES Sepsis Severity Score for patients with complicated intra-abdominal infections: a prospective multicentre study (WISS study). World J Emerg Surg. 2015;10:61. https://doi.org/10.1186/s13017-015-0055-0.
3. Marshall JC. Principles of source control in the early management of sepsis. Curr Infect Dis Rev. 2010;12:345–53.
4. Marshall JC, al Naqbi A. Principles of source control in the management of sepsis. Crit Care Clin. 2009;25(4):753–68.
5. Schneider CP, Seyboth C, Vilsmaier M, et al. Prognostic factors in critically ill patients suffering from secondary peritonitis: a retrospective, observational, survival time analysis. World J Surg. 2009;33(1):34–43.
6. Tellor B, Skrupky LP, Symons W, et al. Inadequate source control and inappropriate antibiotics are key determinants of mortality in patients with intra-abdominal sepsis and associated bacteremia. Surg Infect. 2015;16(6):785–93.
7. Solomkin JS, Mazuski JE, Bradley JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. Surg Infect. 2010;11(1):79–109.
8. Rhodes A, Evans LE, Alhazzani W, et al. Surviving Sepsis Campaign: international guidelines for management of sepsis and septic shock: 2016. Intensive Care Med. 2017;43(3):304–77.
9. Azzarello G, Lanteri R, Rapisarda C, et al. Ultrasound-guided percutaneous treatment of abdominal collections. Chir Ital. 2009;61(3):337–40.
10. Gazelle GS, Mueller PR. Abdominal abscess. Imaging and intervention. Radiol Clin N Am. 1994;32(5):913–32.
11. Sartelli M. A focus on intra-abdominal infections. World J Emerg Surg. 2010;5:9. https://doi.org/10.1186/1749-7922-5-9.

12. Sartelli M, Catena F, Di Saverio S, et al. Current concept of abdominal sepsis: WSES position paper. World J Emerg Surg. 2014;9(1):22. https://doi.org/10.1186/1749-7922-9-22.
13. van Ruler O, Mahler CW, Boer KR, et al. Comparison of on-demand vs planned relaparotomy strategy in patients with severe peritonitis: a randomized trial. JAMA. 2007;298(8):865–72.
14. Sartelli M, Abu-Zidan FM, Ansaloni L, et al. The role of the open abdomen procedure in managing severe abdominal sepsis: WSES position paper. World J Emerg Surg. 2015;10:35. https://doi.org/10.1186/s13017-015-0032-7.
15. Sartelli M, Catena F, Abu-Zidan FM, et al. Management of intra-abdominal infections: recommendations by the WSES 2016 consensus conference. World J Emerg Surg. 2017;12:22. https://doi.org/10.1186/s13017-017-0132-7.
16. Burch JM, Ortiz VB, Richardson RJ, et al. Abbreviated laparotomy and planned reoperation for critically injured patients. Ann Surg. 1992;215(5):476–83.
17. Demetriades D, Salim A. Management of the open abdomen. Surg Clin North Am. 2014;94(1):131–53.
18. Regner JL, Kobayashi L, Coimbra R. Surgical strategies for management of the open abdomen. World J Surg. 2012;36(3):497–510.