Commentary

DOI: 10.14235/bas.galenos.94695
Bezmialem Science 2023;11(3):242-6

Peritonitis-an Overview

Peritonitlere Genel Bakış

Adem AKÇAKAYA

Bezmialem Vakıf University Faculty of Medicine, Department of General Surgery, İstanbul, Turkey

Dear Readers,

In this issue, I will make an overview of peritonitis and its classification, which is a common issue in emergency services and causes mortality if the diagnosis is delayed.

Peritonitis is inflammation of the peritoneal cavity caused by a variety of pathogens, including bacteria, fungi, viruses, chemical irritants, and foreign substances.

To understand peritonitis, it is important to know the anatomy and histopathological structures. As is known, the peritoneum surrounds the abdominal cavity and consists of a thin endothelial layer. There are two separate structures here; the visceral peritoneum, which covers the intra-abdominal organs, and the parietal peritoneum, which covers the intra-abdominal wall. The peritoneal surface is equal to the skin surface, which is approximately 2 m^2 in a 70 kg person. During embryonic development, the peritoneum covers the abdominal organs and consists of certain compartments. The small peritoneal cavity lies behind the stomach and the lesser omentum (gastroenteric ligament) and opens into the main peritoneal cavity by the foramen epiploicum (Winslow). The visceral and parietal layers consist of a single layer of mesothelial cells. While both layers are present in the abdominal walls and omentum, only the visceral layer is located above the internal organs. The endothelial surface of the peritoneum is slippery and smooth, with a small amount of fluid in the peritoneal cavity. In its deeper layers, there is a rich capillary and lymphatic network. Mesothelial cells make little secretion. Some of this secretion (about 50 mL) is between both peritoneal layers and some is in the peritoneal cavity. It is this secretion that allows the layers to slide over each other and provides peritoneal moistness. Approximately half of the peritoneal surface (≈ 1 m^2) carries fluid-electrolyte transport. This area is also used in peritoneal dialysis. The other half cannot transport due to various reasons (anatomical folds, etc.). Peritoneal absorption is very important. So much so that the fluid-electrolyte imbalance that occurs in diffuse peritonitis is the same as in a 50% skin burn. One mm thickening of the peritoneum causes an average of 15 liters of fluid to accumulate. There are abundant plasminogen activators in mesothelial cells. The blood in the peritoneum therefore does not clot. Peritoneal damage (laparotomy trauma, peritonitis, etc.) reduces this secretion and causes adhesions. The only area in the abdominal cavity walls without the parietal peritoneum is the periumbilical region. Therefore, this region is the part of the abdominal wall where there is no parietal pain and the least pain is felt in traumas.

Normally, the peritoneum is quite resistant to infections. Bacteria injected into the peritoneal cavity are rapidly eliminated by phagocytosis. If the same amount of bacteria is injected into the subcutaneous or retroperitoneal region, abscess or diffuse cellulitis will develop. Bacterial peritonitis results from prolonged contamination or contact with highly virulent bacterial strains. Foreign bodies greatly reduce the resistance of the peritoneum to infections. The omentum is the bifold fatty tissue-rich peritoneum extending from the stomach to the transverse colon and covers the small intestine. It is a highly mobile and highly specialized tissue and plays an important role in the control of infections in the peritoneal cavity.

After this general introduction, let's briefly touch on the classification of peritonitis and the characteristics of each. Despite advances in better understanding of the pathophysiology, diagnosis, surgery, antimicrobial therapy, and intensive care support, peritonitis remains a potentially fatal condition. According to the source and nature of microbial contamination, peritonitis can be classified as primary, secondary and tertiary. **Primary peritonitis** is a frequent monomicrobial infection of the peritoneal fluid

Address for Correspondence: Adem AKÇAKAYA, Bezmialem Vakıf University Faculty of Medicine, Department of General Surgery, İstanbul, Turkey
E-mail: drakcakaya@yahoo.com **ORCID ID:** orcid.org/0000-0003-3116-7033

Received: 19.07.2023
Accepted: 20.07.2023

Cite this article as: Akçakaya A. Peritonitis-an Overview. Bezmialem Science 2023;11(3):242-6

without visceral perforation. **Secondary peritonitis** occurs after loss of integrity of a hollow internal organ and is the most common form of peritonitis encountered. **Tertiary peritonitis** develops due to the failure of the host inflammatory response or superinfection following treatment of secondary peritonitis. Therefore, contamination of the peritoneal cavity can lead to a number of infections, sepsis, and multi-system organ failure and is fatal if not treated in a timely manner (1,2). Peritonitis describes the inflammatory process of the peritoneum, which is usually due to infection, but peritonitis can also be a sterile process (2).

Primary (Spontaneous) Peritonitis

Spontaneous bacterial peritonitis is considered a bacterial infection of ascitic fluid without an intra-abdominal, surgically treatable source of infection. Over the past decade, multiple variants of this infection have been described, with a different clinical setting and outcome. Bacterial translocation from the gut to the mesenteric lymph nodes, decreased activity of the reticuloendothelial phagocytic system, and decreased antimicrobial capacity of ascitic fluid appear to be major steps in the pathogenesis of ascitic fluid infection. Diagnosis of ascitic fluid infection is based on clinical suspicion and analysis of ascitic fluid, particularly white cell count and culture in blood culture bottles.

There is no source in the peritoneal cavity to cause peritonitis. It is believed that the infectious agent enters the peritoneum through the blood. Examples are; all kinds of bacteremias (most commonly streptococcal, pneumococcal bacteremias in children), peritonitis in patients with ascites, peritonitis in patients undergoing peritoneal dialysis, pelvic peritonitis in women, etc. (3,4).

Primary peritonitis is inflammation of the peritoneum, often secondary to hematogenous spread from an extraperitoneal source. It is common in both children and adults. It is more common in women than in men because the fallopian tubes provide a clear relationship between the vagina and the peritoneal cavity.

Spontaneous Peritonitis in Childhood: The causative agents of primary peritonitis in childhood are beta hemolytic streptococci and pneumococci. The incidence is highest in the newborn period and 4-5 years of age. Patients have acute abdominal tenderness, fever and leukocytosis. A previous history of ear or upper respiratory tract infection may be detected. The incidence is higher in children with nephrotic syndrome and systemic lupus erythematosus. Gram staining in peritoneal fluid obtained with paracentesis makes the diagnosis. In the differential diagnosis, cystitis and pneumonia should be excluded.

Spontaneous peritonitis in adults is most common in patients with ascites secondary to cirrhosis. In the last decade, the spectrum of causative organisms has changed and coliform bacteria have begun to be seen more frequently. Therefore, it has become more difficult to distinguish between primary and secondary peritonitis. There are no significant differences between signs and symptoms. However, symptoms develop more slowly in primary peritonitis.

Peritonitis in peritoneal dialysis is an important complication of peritoneal dialysis applied to patients with end-stage kidney disease. The incidence in these patients may differ according to the centers. An average incidence of 1.3% is reported for each year. Gram-positive microorganisms are the most common agents. Pseudomonas aeruginosa has been reported in 3.4% of the patients, and it is usually not possible to recover with medical treatment alone. Turbidity of the dialysis fluid is the first symptom and is seen in 1/4 of the patients. If this is accompanied by abdominal pain or fever, diagnostic laboratory studies should be performed and treatment should be initiated. Intrapertioneal and intravenous antibiotics have been used in the treatment. Although many treatment schemes have been suggested, no one scheme has been found to be superior. Removal of the catheter is often necessary, but it is essential in infections secondary to Pseudomas aeruginosa (5).

Tuberculosis peritonitis is an infection caused by *Mycobacterium tuberculosis*. Patients with extrapulmonary tuberculosis constitute 15% of all patients with tuberculosis and the abdomen is involved in 11% of patients. It can be confused with cirrhosis and peritoneal carcinomatosis, resulting in increased mortality and morbidity. Although there has been a decrease in the incidence of tuberculous peritonitis recently, it has started to be seen frequently in Europe and North America secondary to the increase in AIDS prevalence due to HIV infections. It is still a major problem in India, Southeast Asia, Africa and Latin America. Tuberculosis bacillus probably enters the peritoneum transmurally via the diseased bowel wall, tuberculous salpingitis and nephritis or by hematogenous spread from other organs. Although no obvious source can be identified in most patients clinically, a source is almost always found at autopsy. Generally, the tuberculin skin test is positive in patients. It has two clinical forms. In the first form, there are fever, ascites, abdominal pain and malaise. Acid is progressive and can be massive. In the second form, there is no acid. Diagnosis is best made by open or closed peritoneal biopsy. Lymphocytes predominate in the peritoneal fluid obtained in abdominal paracentesis; acid-fast bacilli may rarely be demonstrated and the culture is positive in less than 50% of patients. In recent studies, ascitic fluid adenosine deaminase (ADA) level above 36 U/L is used in differential diagnosis (6). Anti-tuberculosis agents are used in the treatment. Surgical interventions are only used for diagnosis in patients in whom needle biopsy is insufficient or for treatment in the presence of complications such as fecal fistula.

Secondary Peritonitis

Secondary peritonitis is caused by an intraperitoneal source, usually perforation of hollow internal organs. It is the most common peritonitis. Secondary peritonitis is a life-threatening surgical disease that is the most common emergency surgical procedure in most general surgery units worldwide. It generally

has high morbidity and mortality rates (9). Secondary peritonitis develops secondary to infection of any organ in the peritoneal cavity such as acute appendicitis, diverticulitis, pancreatitis etc.

Perforation peritonitis; is the most common form of acute intra-abdominal infections. While necrotic lesions of the gastrointestinal tract and other intra-abdominal organs are detected as the causative agent in 80% of patients, in 10-30% of patients peritonitis develops after intra-abdominal surgery (postoperative peritonitis).

Differential diagnosis is difficult in secondary peritonitis, which constitutes the part of peritonitis that requires surgical intervention. Differential diagnosis from primary peritonitis is required. With the widespread use of laparoscopic surgery, there have been important developments in differential diagnosis. Laparoscopy has become the preferred surgical approach in different pathologies, as it provides accurate diagnosis and treatment in one go. However, it is also stated that the laparoscopic approach can theoretically increase the risk of pneumoperitoneum and bacteremia and endotoxemia, albeit in small numbers (7). With the widespread use of laparoscopy, The World Society for Emergency Surgery recommends laparoscopic approach for laparoscopic peritoneal lavage and drainage in stable patients, patients with complicated perforated appendicitis with abscess and perforated peptic ulcer, and patients with generalized peritonitis due to perforated colonic diverticulitis (8).

Tertiary Peritonitis

Tertiary peritonitis occurs as a result of recurrence of primary or secondary peritonitis. It is a later stage of the disease, in which systemic manifestations of clinical peritonitis and sepsis persist after treatment for secondary peritonitis (9). It is usually seen in people who are immunocompromised. Tertiary peritonitis develops in patients with peritonitis and sepsis, who undergo surgical intervention and receive antibiotic therapy. There is a lack of host defense. The clinical picture is characterized by hyperdynamic cardiovascular findings, low-grade fever and general hypermetabolic period. These patients have the clinical features of sepsis without an identified focus of infection, and unnecessary laparotomy is often performed to drain recurrent or residual infected fluids. There is often no pathogen or there is a picture caused by low pathogenicity coagulase-negative staphylococci or fungi, that is incorrectly interpreted as septicemia or fungal sepsis. The lack of release of inhibitory autocoid substances may be a factor in this complex pathophysiological process. Cure can be provided by eliminating these deficiencies by using monoclonal technology (10).

Shimic Peritonitis

It develops as a result of direct contact of chemical substances with the peritoneum. The best-known example is barium peritonitis. Barium peritonitis is very severe and its mortality is 50% if it does not remain local and is widespread. Even if the patient does not die, the event results in copious peritoneal adhesions.

Abscesses

Abscesses are a subgroup of primary and especially secondary peritonitis, but are not seen in tertiary perthionitis. They are localized intra-abdominal infections and have a much better prognosis than diffuse peritonitis. Abscess formation is an indication of a successful peritoneal defense mechanism against infectious agents and prevents systemic infection, namely sepsis, by limiting bacteria. Sometimes these abscesses may perforate secondarily and cause diffuse infection. The term "intra-abdominal abscess" and the term "intra-abdominal infection" are sometimes used erroneously as if they were synonymous. Before computed tomography came into use, it was very difficult to distinguish between diffuse and localized peritonitis. The definitive diagnosis of intra-abdominal abscesses has become more important recently, because abscesses can be treated with non-surgical methods, computed tomography or ultrasound-guided needle aspiration.

Clinical Findings

Abdominal pain, nausea, vomiting and fever are present in almost all patients. The severity of the findings is directly related to the degree of contamination. Shock is always present in acute peritonitis, sometimes it can be severe. There is a widespread and marked tenderness in the abdomen, a hardness like wood. In acute diffuse peritonitis due to rupture of an intra-abdominal organ, the abdomen is initially silent. If peritonitis develops slowly, peristalsis may persist and may even be hyperactive in non-infected areas with peritoneal inflammation. If left untreated, ileus, distension and toxemia develop rapidly and progressive respiratory, renal and cardiac failure occurs.

Whatever the cause, intra-abdominal infection affects the peritoneum and intestines, followed by a local and systemic response leading to endocrine, cardiac, respiratory, renal and metabolic events. This pathophysiological response explains the clinical signs and symptoms. Abdominal pain is almost always present unless masked by the administration of analgesics or the presence of a new surgical wound. Initially, the pain may be nonspecific due to autonomic nervous system irritation, or the very irritating pancreatic or gastric fluids commonly irritate the somatic nerve endings. A good example of the perception of pain in these two separate forms is the events that occur in acute appendicitis. Initially, pain secondary to appendiceal inflammation spreads to the region innervated by the solar plexus with the autonomic nervous system and manifests itself with epigastric pain, nausea, and sometimes vomiting. As the disease progresses, the patient's pain shifts from the epigastric region and the umbilicus to the right lower quadrant as somatic pain originating from the paraappendicular peritoneum and adjacent organs increases. In its later stages, it is in the form of continuous burning and increases with movement. Pain is usually in the area of greatest peritoneal inflammation. The decrease in pain intensity over time suggests that the inflammatory event is localized, and its increase suggests that widespread peritonitis has developed. Anorexia is almost always present. Nausea is common

and sometimes accompanied by vomiting. The patient often feels thirsty and has a fever with chills. The fever can be between 38-40 ℃. Tachycardia and attenuation of peripheral pulses indicate hypovolemia. As hypovolemia progresses, the initial vasoconstriction is hidden by rapidly developing hypovolemic shock. Respiration is typically rapid and superficial. The reason for the rapid respiration is the need for more oxygen in the tissue during this period and the attempt to correct the developing acidosis. The reason for shallow breathing is that deep breathing increases abdominal pain. There is distension in the abdomen, decreased bowel sounds, and tenderness on palpation. Tenderness exists on the entire surface where the peritoneum participates in inflammation, but this tenderness is the most around the organ where the inflammatory event begins. Direct percussion or indirect rebound tenderness indicates peritoneal inflammation. Percussion may be more appropriate than direct palpation to detect the point of greatest tenderness and the extent of peritoneal irritation. The rigidity of the abdominal muscles may initially be due to voluntary abdominal guarding. However, reflex muscular spasm occurs in the late period. The reflex spasm is sometimes so severe that it takes the form of a abdominal rigidity. Hyperresonance may be detected in percussion secondary to the collection of gas in the paralytic distended intestines. Bowel sounds may be heard in the early stages of intra-abdominal infections, but as the inflammation spreads, the paralytic ileus settles. Rectal and vaginal examinations are important in terms of showing the presence, tenderness and severity of pelvic mass. Examination of the cervix is also useful for detecting the source of the inflammatory event.

Laboratory Findings

There is marked leukocytosis and hemoconcentration. Serum electrolyte concentrations vary. Metabolic acidosis with respiratory alkalosis is characteristic for chemical and bacterial peritonitis. Hematocrit, peripheral leukocyte count, serum electrolytes, serum creatinine and arterial blood gases are the parameters routinely used in the follow-up of these patients. In the differential diagnosis, tests for the preliminary diagnosis should be requested.

X-ray Findings

Direct abdominal X-ray shows distention and air-fluid levels in both the small and large intestines. They appear thickened due to the presence of fluid between the intestinal loops. In cases of perforated gastric or duodenal ulcer, air may be seen under the diaphragm.

Specific Investigations

The diagnosis is mostly made with imaging methods such as ultrasonography, computed tomography and MRI. Abdominal paracentesis may be helpful in undiagnosed cases. This examination is especially valuable in the elderly whose symptoms and signs are suspicious and in whom anaesthesia is risky. For this purpose, the diagnosis can be made with peritoneal lavage by placing a cannula into the abdomen through a small median incision below the umbilicus. But today the gold standard for diagnosis is diagnostic laparoscopy. Since laparoscopy allows treatment as well as diagnosis, it should be performed on patients who cannot be diagnosed with imaging methods (7).

Differential Diagnosis

Many systemic diseases may present with signs of intestinal obstruction or *peritonitis*. *Pneumonia* can cause significant abdominal distension, especially in the elderly, suggesting a slowly developing peritonitis. It can cause abdominal pain resembling *diaphragmatic pleurisy*, acute cholecystitis and duodenal ulcer perforation. Uremia usually causes abdominal distention and ileus. If primary intraperitoneal disease such as appendicitis or ulcer perforation develops in cases of *chronic renal failure*, diagnosis may be very difficult. *Periodic peritonitis* (familial Mediterranean fever, paroxysmal familial polyserositis) is a rare disease of unknown cause that can show all the symptoms of acute peritonitis. Recurrent abdominal pain, tenderness, rebound phenomena, 38-38.5 ℃ fever and leukocytosis are seen. It is seen in Mediterranean people, especially Turks, Arabs, Greeks and Italians. Generally, laparotomy is performed in the first attack. Inflammation and free fluid may be seen in the peritoneum during surgery, but nothing is found in the smear and culture. In order to avoid confusion in diagnosis, appendectomy is performed, even if it is normal.

Treatment

The aim of treatment is to reduce mortality. At the beginning of the century, the treatment of peritonitis was conservative and the mortality was 90%. Today, mortality rates have been reduced below 30%.

In the **treatment of primary peritonitis**, antibiotics are administered for the causative microorganism in patients whose diagnosis is confirmed. Until culture results are obtained, third generation cephalosporins or sulbactam-ampicillin can be used. Penicillin G should be administered intravenously in patients in whom pneumococcus is thought to be the causative agent. The combination of aminoglycoside and ampicillin may also be preferred in gram negative infections. Identification of the causative agent should be the main target and the treatment should be directed towards the causative agent. Diagnostic laparoscopy should not be avoided in patients in whom the possibility of secondary peritonitis cannot be excluded. When primary peritonitis is diagnosed in cirrhotic patients, peritoneal lavage with antibiotic fluids can be applied.

It should be known that the **treatment of secondary peritonitis** is surgical. Treatment can be grouped under 4 main headings:

1- Supportive treatment before and after surgery: All patients should be given supportive treatment according to the severity of the infection. Systemic clinical and laboratory evaluation should be repeated at frequent intervals. Today, blood pressure, arterial pulse, respiratory rate, central venous pressure, urine amount, hematocrit, peripheral leukocyte count, serum electrolytes, serum creatinine and arterial blood gases are the parameters routinely used in the follow-up of these patients.

2- Antibiotic therapy: Antibiotic therapy should preferably be started as soon as peritonitis is diagnosed. Before starting the treatment, aerobic and anaerobic culture samples should be collected separately.

3- Surgical treatment: The surgical method is chosen based on the localization of the pathology, and the agent.

4- Alternative treatment options: Some applications such as neutralization of microbial toxins, modulation of host mediators, fibronectin and immunoglobulin treatments are not common but may be preferred.

The goal in the *treatment of tertiary peritonitis* is to prevent multisystem organ failure. The first thing to do is to ensure that enough oxygen reaches the tissues. Enteral or parenteral hyperalimentation should be given importance to support the immune system. Fungal infections and occult focus should be investigated. Supportive treatment in tertiary peritonitis should be combined with antibiotic therapy and, if necessary, surgical treatment.

In conclusion, it should not be forgotten that early diagnosis of peritonitis is life-saving. Diagnosis will enable us to determine which type of peritonitis it is and ultimately plan the most effective treatment method.

References

1. Gupta S. Kaushık R. Peritonitis–the Eastern experience. World J Emerg Surg 2006;1: 1-6.
2. Simmen HP, Heinzelmann M, Largiader F. Peritonitis: Classification and causes. Dig Surg 1996;13:381-3.
3. Soriano G, Esparcia O, Montemayor M, Guarner-Argente C, Pericas R, Torras X, et al. Bacterial DNA in the diagnosis of spontaneous bacterial peritonitis. Aliment Pharmacol Ther 2011;33:275-84.
4. Guarner C, Soriano G. Spontaneous bacterial peritonitis. Semin Liver Dis 1997;17:203-17.
5. Hariharan Regunath KL, Khanna R. Peritoneal Infections in Peritoneal Dialysis (PD Peritonitis). Nolph and Gokal's Textbook of Peritoneal Dialysis 2023;431.
6. Mahajan M, Prasad ML, Kumar P, Kumar A, Chatterjee N, Singh S, et al. An Updated Systematic Review and Meta-Analysis for the Diagnostic Test Accuracy of Ascitic Fluid Adenosine Deaminase in Tuberculous Peritonitis. Infect Chemother 2023;55:264-77.
7. Agresta F, Ciardo LF, Mazzarolo G, Michelet I, Orsi G, Trentin G, et al. Peritonitis: laparoscopic approach. World Journal of Emergency Surgery 2006;1:1-5.
8. Elnabil-Mortada A, Albalkiny S, Elnagar M. Evaluation of the Role of Laparoscopy in Emergency Abdominal Surgery: Outcomes of 1740 Patients. Ain Shams Journal of Surgery 2023;16:156-62.
9. Arulselvan J, Manimekalai E. Effectiveness of the Mannheim Index in Predicting Morbidity and Mortality of Patients with Perforative Peritonitis. Int J Acad Med Pharm 2023;5:1210-4.
10. Mishra SP, Tiwary SK, Mishra M, Gupta SK. An introduction of Tertiary Peritonitis. J Emerg Trauma Shock 2014;7:121-3.