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REVIEW

Medical complications following splenectomy

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Summary Splenectomy is attended by medical complications, principally infectious and thromboembolic; the frequency of complications varies with the conditions that led to splenectomy (hematologic splenectomy, trauma, presence of portal hypertension). Most infectious complications are caused by encapsulated bacteria (*Meningococcus*, *Pneumococcus*, *Hemophilus*). These occur mainly in children and somewhat less commonly in adults within the first two years following splenectomy. Post-splenectomy infections are potentially severe with overwhelming post-splenectomy infection (OPSI) and this justifies preventive measures (prophylactic antibiotics, appropriate immunizations, patient education) and demands prompt antibiotic management with third-generation cephalosporins for any post-splenectomy fever. Thromboembolic complications can involve both the caval system (deep-vein thrombophlebitis, pulmonary embolism) and the portal system. Portal vein thrombosis occurs more commonly in patients with myeloproliferative disease and cirrhosis. No thromboembolic prophylaxis is recommended apart from perioperative low molecular weight heparin. However, some authors choose to prescribe a short course of anti-platelet medication if the post-splenectomy patient develops significant thrombocytosis. Thrombosis of the portal or caval venous system requires prolonged warfarin anticoagulation for 3 to 6 months. Finally, some studies have suggested an increase in the long-term incidence of cancer in splenectomized patients.

Introduction

Although the indications for splenectomy have decreased in current trauma management and cancer surgery, splenectomy remains a frequently performed surgical procedure; the surgeon must be familiar with both surgical complications (hematoma, sub-phrenic

Abbreviations: ISS, Injury Severity Score; OPSI, overwhelming post-splenectomy infection; PMN, polymorphonuclear leukocyte; SIRS, systemic inflammatory response syndrome; SFAR, Société française d'anesthésie réanimation (French Society of Anesthesia and Reanimation).

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collection, pancreatic fistula due to pancreatic tail injury) as well as medical complications. Medical morbidity after splenectomy consists mainly of infectious complications and thromboembolic complications; their prevalence is sufficient to warrant the implementation of preventive measures. Other complications have been mentioned, particularly an increased risk of subsequent cancer [1—3]. This update aims to focus on the medical complications of splenectomy and on prophylactic measures that should be adopted for patients who undergo splenectomy.

Infectious complications

The most frequent complications of splenectomy are infectious. In addition to acute postoperative complications (in 40% of cases), severe infections such as overwhelming post-splenectomy infection (OPSI) may occur in from 3—5% of patients over the long-term [4—6]. Although the interval to infection following splenectomy is quite variable, most occur on average within two years. Because its prognosis can be extremely severe, the possible occurrence of OPSI should be considered when weighing the indications for splenectomy and warrants implementation of both short- and long-term preventive measures.

Pathophysiology

The spleen is a lymphoid organ that plays an important role in both innate and acquired immunity [7]. Its role is particularly crucial for the elimination of encapsulated bacteria, the clearance of intra-erythrocytic parasites, and for potentiating the immune response to vaccines against polysaccharide antigens.

The spleen is composed of three anatomical and functional structures:

- the red pulp is a network of capillary sinuses whose fenestrated epithelium allows contact between circulating blood elements and the extravascular environment. The red pulp's rich supply of macrophages, opsonins and properdines plays a crucial role in innate immunity. It also plays the role of a phagocytic filter, allowing the culling and destruction of senescent erythrocytes and platelets and the selective elimination of intra-cytoplasmic elements (pitting). This ''cleansing'' of red blood cells (RBC) also allows the clearance of intra-erythrocyte pathogens such as Plasmodium and Babesia. With the loss of this culling function, the post-splenectomy patient often develops transient thrombocytosis (600—800,000/mm^3). Elevated counts of polymorphonuclear leukocytes (PMN) also typical occur early after splenectomy and an elevated WBC count > 15,000/mm^3 may lead to the erroneous suspicion of an infectious complication [8]. The failure to remove intra-erythrocytic nuclear fragments (pitting) results in the typical finding of Howell—Jolly bodies on review of blood smear or by simple phase-contrasted microscopy (basophilic stippling of RBC's);
- the white pulp consists of a network of arterioles with peri-arteriolar distribution of lymphocytes forming an organized secondary lymphoid organ that is involved in the adaptive immune response. This involves the collaboration of phagocytic cells and T and B lymphocytes;
- the marginal zone is a region that contains a population of specific B lymphocytes called IgM memory B cells that play a major role in the opsonization and eradication of encapsulated bacteria. This specific population of lymphocytes is present almost exclusively in the spleen, which largely explains why there is an excess risk of serious infection by encapsulated bacteria following splenectomy [9].

Functional asplenia

In addition to splenectomy, many other diseases can result in functional asplenia. Sickle cell disease in the most common, but celiac disease, inflammatory bowel disease, acquired immunodeficiency syndrome (AIDS), active autoimmune diseases, cirrhosis with Felty's syndrome, or chronic hematologic diseases (including stem cell bone marrow transplant with graft versus host reaction). In such cases or after splenectomy, evidence of splenic dysfunction may be manifested by RBC morphologic abnormalities; immunological dysfunction seems to be correlated to the number of pitted erythrocytes seen on electron microscopy and the presence of Howell—Jolly bodies on peripheral blood smear [7]. Other methods that may help to evaluate splenic function or dysfunction require specific tools that are uncommonly used in practice, such as phase-contrast microscopy to detect RBC pitting or scintigraphy to detect accessory spleens [7].

Infectious risk

Pathogens and risk factors

Due to decreased response to encapsulated bacteria, the principal bacteria involved in post-splenectomy sepsis are primarily *Streptococcus pneumoniae* (50% to 70%), and *Neisseria meningitidis* and *Haemophilus influenzae* B (15—25% each), although the epidemiology of post-splenectomy infection has not been reassessed since the advent of vaccines against *Pneumococcus*, *Meningococcus* and *Hemophilus*. There is also an increased risk of serious infection due to *Capnocytophaga canimorsus* after animal bites, *Bordetella holmesii*, *Ehrlichia* species and intra-erythrocytic parasites such as *Babesia* after tick bites, and *Plasmodium* species in malaria-endemic areas [10—12]. No excess risk of infection by other pathogens such as *Escherichia coli*, or *Staphylococcus aureus* has been established.

The infectious risk varies with associated co-morbidities and the time interval following splenectomy [10]. The risk of OPSI is higher in children, in patients beyond the age of 60, in patients who undergo splenectomy for hematological malignancies or thalassemia, for patients with associated immunosuppression, a previous history of serious post-splenectomy infection, or failure to respond to pneumococcal vaccination [13]. The incidence of infection is highest in the first two years after splenectomy, but the risk persists throughout life [14,15]. In longitudinal studies, 50—75% of post-splenectomy infections occurred within the first two years, at an average interval of 22.6 months [4]. The average interval to infection after splenectomy is shorter when splenectomy was performed for hematological disease vs. posttraumatic splenectomy (20 months vs. 50 months) [16].

The risk is possibly lower when partial splenectomy is performed, but no specific study encourages the same recommendations as after total splenectomy [7]. Furthermore, the risk of infection also seems to be just as high for functional asplenia as for splenectomy.