Acute Appendicitis in Obese Patients

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8.1 Introduction

Acute appendicitis (AA) is definitely one of the most common surgical emergencies, with a worldwide incidence of about 16 million cases in 2013 [1]. The male to female ratio is 1.4 to 1, with an overall lifetime risk estimated at 8.6% for men and 6.7% for women [2]. Appendicitis is most common between the ages of 10 and 30 years, but all age groups may be affected. Different distributions in incidence for AA are also determined by variations in ethnicity, season of the year and nutritional patient-related factors such as obesity [3–5]. Obesity represents a widespread condition in Western countries. In Italy the number of obese people in 2015 was about six million, equivalent to 9.8% of the population, with an incidence that grows with increasing age and is more prevalent among men than women. Another aspect to be considered is the close association between obesity and diabetes, which today in Italy affects 5.3% of the population, with a substantially doubled incidence compared to 30 years ago [6], while the total number of people with diabetes worldwide is projected to rise from 171 million in 2000–366 million in 2030. One of the main pathophysiological features of diabetes is the alteration of the microcirculation, also at the splanchnic level, resulting in an augmented risk of developing AA in this group of patients, together with an increased resistance to antibiotic therapy. A retrospective analysis using the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP) database from 2004 to 2010 in over 300 US hospitals concluded that patients with diabetes and no other significant comorbidities had a higher risk of developing surgical site infections with longer hospital stay after appendectomy than patients without diabetes [7].

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In cases of AA, all these elements are amplified by the context of surgical emergency. It must then be noted that if these issues are usually well addressed in dedicated bariatric surgery divisions, this is often not so true in common general and emergency surgery units, where most AA cases are actually treated [8].

The current concept is that there are two types of AA, an uncomplicated appendicitis and a complicated appendicitis. An uncomplicated appendicitis is defined as an inflamed appendix without any sign of gangrene, perforation, periappendicular contained phlegmon, free purulent fluid or intra-abdominal abscesses, whereas the presence of one or more of these features distinguishes a complicated appendicitis [9]. Conditions such as obesity increase the risk of evolution from an uncomplicated to a complicated form, thus increasing the incidence of postoperative morbidity.

8.2 Diagnostic Work-Up

The objectives of the diagnostic process in suspected AA are both to provide a correct diagnosis—and thus minimize the risk of negative appendectomies—and to stratify the severity of AA by discriminating between uncomplicated and complicated forms. Despite the efforts, the rate of negative appendectomies is still reported to be up to 27% [10].

Classically, the diagnosis was made by combining clinical and anamnestic data with the biochemical findings of increased blood inflammation markers. However, the clinical presentation of AA may vary from mild symptoms to a pattern of generalized peritonitis and sepsis, making the diagnosis of AA a challenge. Over the years, several score systems have been proposed. The purpose of these classification systems is to guide the clinical decision-making process, in order to optimize the need for diagnostic imaging, reduce admissions, and prevent negative surgical explorations. In high-risk patients such as the obese, the Appendicitis Inflammatory Response (AIR) score showed specificity (97% versus 76%) and positive predictive values (88% versus 65%) statistically better than the Alvarado score [11].

Ultrasound (US) represents a useful, non-invasive and readily available diagnostic tool, with a sensitivity and specificity of 58% and 76%, respectively [12]. However, it must be remembered that US diagnostics is highly operator-dependent and that negativity, especially in the case of an unseen appendix, does not rule out the diagnosis of AA but suggests proceeding with further investigations [13].

Abdominal computed tomography (CT) is superior to US in terms of accuracy, but the radiation exposure of abdominal CT is a concern in children and during pregnancy. If required, a low-dose CT scan is preferred in patients with suspected AA [14]. A CT scan is indicated in elderly patients who may have a neoplasia, in atypical or delayed clinical presentations, in the suspicion of an appendicular mass, and in patients who may underestimate the clinical data such as obese patients.

In obese patients, the diagnostic accuracy of US is diminished due to an increase of the subcutaneous and intra-abdominal fat. Anderson et al. demonstrated that the body mass index (BMI) does not alter the diagnostic accuracy of a CT scan. CT appears therefore more reliable than US in obese patients with the exception of children and pregnancy [15]. If there are diagnostic doubts in children and pregnant women magnetic resonance imaging (MRI) can be successfully used, having demonstrated both sensitivity and specificity comparable to those of CT, although it represents an expensive examination that is not always available [16].

8.3 Management

Surgery remains the therapy of choice with 95.92% of AA treated by appendectomy, showing a crude rate of mortality and postoperative complications of 0.1% and 3.5%, respectively [17]. Surgery can be performed by open appendectomy (OA), first described by Fitz in 1886 [18] and then codified by McBurney in 1894 [19], or by laparoscopic appendectomy (LA) introduced by Semm in 1983 [20]. However, the paradigm of treatment is increasingly shifting from OA to LA, for both adults and children.

Non-operative management (NOM) for AA in adult patients was recently investigated and represents a topic under debate. Outcomes were discordant, reporting an efficacy between 45% and 81% at 1-year follow-up [21, 22], but globally demonstrated a lower effectiveness of NOM compared to the surgical approach.

Timing of appendectomy after a hospital admission is another topic of discussion. The real question is whether a delay in appendectomy could increase the risk of a progression from uncomplicated to complicated appendicitis and consequently increase the postoperative morbidity rate [23]. A retrospective analysis from ACS-NSQIP on 32,782 patients undergoing appendectomy did not reveal statistically significant differences in terms of morbidity and short-term outcomes between patients operated within 6 h, between 6 and 12 h, and over 12 h from the admission [24]. These results were partially confirmed by the UK study of Banghu et al. according to which the risk of surgical site infections and adverse events would increase only after 48 h [25]. Vice versa, according to Busch et al., an appendectomy delayed more than 12 h in a frail patient should be avoided, as an in-hospital delay represents an independent risk factor for perforation, similar to an age over 65 years old and the presence of significant comorbidity such as obesity, hepatopathy and heart diseases [26]. A recent meta-analysis from Cheng et al. concluded that there are currently no elements of superiority either for early or for delayed appendectomy in AA [27].

To date, LA represents with grade A of recommendation the approach of choice for the treatment of AA, as it demonstrated clear advantages in terms of lower incidence of surgical site infections, less pain, shorter hospital stay and earlier return to daily activities [19, 28]. LA is specifically indicated in obese patients and in frail or high-risk patients and allows better short-term outcomes even in pediatric patients. A recent Cochrane meta-analysis, analyzing 85 studies, 10 of which on children, showed better outcomes of LA over OA in terms of control of pain, wound infection rate, length of hospital stay and return to normal life, while a worse performance was highlighted regarding the incidence of intra-abdominal abscesses (IAAs) [29]. Some other trials tended to reconsider this last conclusion in view of the fact that an increased IAA rate for LA characterized its early days of diffusion and was therefore related to surgical expertise [30]. A systematic review of nine meta-analyses from Jaschinski et al. confirmed the findings regarding better short-term outcomes following LA versus OA [31]. Data from the analysis of the US Nationwide Inpatient Sample in the period 2003–2011 showed the trend in diffusion of LA, which increased from 41.7% to 80.1%, with greater penetrance to patients over 65 years old (from 9.4 to 11.6%), obese (from 3.8 to 8.9%) and with more comorbidities according to the Elixhauser score (from 4.7 to 9.8%) [17].

These results emerged in both elective [33] and emergency surgery like appendectomy [34], even for increased-risk patients [35]. In patients with BMI over 30 kg/m^2, LA was more effective than OA in terms of overall morbidity and mortality rates [32, 36]. The laparoscopic approach showed reduced operative time and length of hospital stay, as well as a statistically lower incidence of wound infections and IAAs, substantially confirming what has emerged for non-obese patients in recent years [37–39]. Ciarrocchi et al. carried out a meta-analysis of five papers comparing OA versus LA in obese patients, concluding that the laparoscopic approach offered significant advantages in terms of lower intra-abdominal abscesses, wound infection and overall postoperative complication rate, as well as a shorter operative time and hospital stay [40]. Dasari et al. proposed a systematic review of the literature by analyzing eight studies on the role of laparoscopic appendectomy in the obese patient, including one prospective randomized trial and seven retrospective papers, without any intention-to-treat analysis. There were no statistically significant differences in outcomes between obese and non-obese patients undergoing LA, confirming the effectiveness and safety of the minimally invasive technique even in patients with a BMI higher than 30 kg/m^2 [8].

Single-incision laparoscopic surgery (SILS) appendectomy was first proposed by Pelosi in the early 1990s [41] with a view to further minimizing the surgical trauma, and then resumed a few years ago. Randomized clinical trials that compared appendectomy by SILS and conventional laparoscopic approach showed a comparable postoperative morbidity rate, while the outcomes in terms of operative time and conversion rate were detrimental to SILS [42, 43]. SILS was associated with a higher risk of port-site hernias than conventional laparoscopic surgery. There has been evidence that obesity was a risk factor for developing port-site hernias after SILS [28, 44].

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