

## ORIGINAL RESEARCH

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## Risk factors in the development of acute appendicitis complications

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### Abstract

**Background:** To study the risk factors of the development of acute appendicitis (AA) complications in adults in order to improve the results of surgical treatment.

**Material and methods:** The research included 449 patients with AA treated surgically during the years 2015-2017 divided into 2 groups: 117 patients who were admitted with complicated appendicitis (intra- and extraabdominal complications) and 332 patients with non-complicated AA were randomly selected from the same period. The rate and characteristic of the complications evolved during the pre- and postoperative period in these two groups were specified and analyzed.

**Results:** In the acute complicated appendicitis group (CAA), there was a predominance of women with a ratio of 1.60 versus 1.26 in the uncomplicated acute appendicitis group (NAA). The proportion of people aged > 60 years was significantly higher in the case of CAA-23.1% (n=27), while in uncomplicated AA it was only 3.9% (n=13). In the case of AA complications, there was an emphasis on late addressing, the debut-addressing term being higher compared to uncomplicated AA. The low socio-economic status has a significant negative impact on the evolution of AA and its complications, as well as on the results of appendectomy. Thus, uninsured patients (n=59, 49.6%) formed almost half of CAA group. Associated comorbidities were established in 76 or 16.9% of cases, respectively in CAA-21.4% vs 15.4% in NAA group. In summary we note that the presence of associated uncorrected comorbidities has an obvious negative impact on the development of AA.

**Conclusions:** Our findings suggest that clinical assessment is most important for identifying individuals at risk of developing complications of AA and the above-mentioned risk factors are useful for emergency surgical decisions.

**Key words:** Complications of acute appendicitis, risk factors.

### Introduction

Acute appendicitis (AA) is the most common surgical abdominal emergency and its lifetime risk is 8.6% for men and 6.7% for women, yet the risk of undergoing appendectomy is higher for women (12 vs. 23%) [1-3]. In developed countries the incidence of AA is 400-520 cases per 100000 population, while in poorly developed countries it is 100-320 cases per 100000 population [4, 5]. In the Republic of Moldova the AA frequency denotes 220 cases per 100000 inhabitants [6].

Apparently simple as a pathology, AA does not always find an easy solution, and by its complications it can sometimes generate situations requiring complex therapeutic features. Although surgical treatment is well tolerated by most patients, it is associated with a risk of postoperative complications in 2%- 23% of cases [7, 8]. In addition, notwithstanding the implementation of miniinvasive techniques, it is noted that about 3% of patients who underwent an appendectomy with or without laparoscopy [9] were repeatedly admitted to hospital with a diagnosis of intestinal occlusion, cataloged as a tardive post-operative complication, often a long time after primary surgery [10].

AA complications may evolve either as a natural stage in the pathophysiological process of vermicular appendicitis with plastron formation or depending on wall integrity with its perforation and triggering of generalized or localized appendicular peritonitis [11,12]. This type of complications can be called intraabdominal complications, according to the literature; they have an incidence of about 5-7% cases in the developed countries and up to 30% in the case of countries with poor socio-economic status [13]. Notwithstanding the general decrease in the morbidity rate through AA, an impressive number of studies demonstrate the stability of these rates over the past decades [14-16].

Another group of complications are caused by the purulent processes in the postoperative wound (suppuration, abscess, ligature fistula) at a rate of 18-20%, they do not have a certain tendency to diminish [17,18]. Even despite the frequent and prolonged use of antibacterial drugs for prophylaxis of postoperative wound complications, the frequency of appearance remains at a constant level [19]. In general, post-appendectomy complications rates are usually within 10%-19% range for acute AA without perforation and reaches to 12%-30% for perforated AA [20-24]. Perforation

increases the AA mortality rate from 0.0002% to 3% and causes an increase in morbidity from 3% to 47% [25-27].

Thus, we can see that, despite all the surgical progress achieved, the AA complications remain a problem that still requires increased attention. This determines the need to specify risk and prognostic factors in the development of AA complications for their prophylaxis and improvement of surgical treatment results.

The purpose of the paper: to study the risk factors of the development of acute appendicitis complications in adults in order to improve the results of surgical treatment.

### Material and methods

**Study Design.** The study includes a retrospective analysis of clinical material focused on the estimation of the incidence, character and risk factors of the development of AA complications. We designed a case-control study to compare different perceived risk factors among patients with complicated or uncomplicated AA. The point of reference was the analysis and evaluation of the anamnestic disease, the clinical picture, the laboratory and instrumental data established preoperatively in connection with the morphological changes of the vermicular appendix performed by morphopathological examination of the operative piece. The rate and characteristic of the complications evolved during the pre- and postoperative period in the analyzed patients were specified. For the purpose of assessing the microbial etiological factor, the patients of the study group were subjected to the bacteriological examination which included seeding on aerobic culture media as a source of collected material for samples collected during diagnostic laparoscopy, surgical intervention, pathological leakage from the safety drains or postoperative wound.

**Participants and data collection.** The research included 449 AA patients treated surgically by classical approach during the years 2015-2017 at Surgical Clinic Nr. 2 and Nr. 3 of Surgery Department Nr. 2 of Nicolae Testemitsanu State University of Medicine and Pharmacy. The analyzed data were extracted from: clinical observation sheets, operative protocols, histopathological examination bulletins and electronic database Sfinta Treime Municipal Hospital (code K35.0-3, K35.9). An individual clinical research file was complemented for each patient. The terms of evolution of the disease were analyzed, the studied cases being classified in 3 time intervals: addressing up to 6 hours after the onset of clinical manifestations, 7-24 hours; more than 24 hours. At the same time, attention was drawn to the socio-economic status of the patient (insured or uninsured).

The Charlson co-morbidity index (CCI) was used in order to establish the aggressive synergistic action of chronic co-morbidities on AA evolution and its complications (tab. 1).

This score was evaluated in each patient with the consecutive specification in the following groups according to the stage of compensation of the associated condition:  $\sqrt{\text{CCI}} - \text{I}$  (lack of co-morbidity) – 0 points;  $\sqrt{\text{CCI}} - \text{II}$  (compensated co-morbidity) – 1 point,  $\sqrt{\text{CCI}} - \text{III}$  (uncompensated co-mor-

bidity) 2-3 points,  $\sqrt{\text{CCI}} - \text{IV}$  (decompensated co-morbidity) >4 points,  $\sqrt{\text{CCI}} - \text{V}$  (decompensated co-morbidity refractory to any treatment).

**Table 1**

#### The value and conditions considered in the Charlson co-morbidity index

Value	Conditions
1	Myocardial infarction, congestive heart failure, peripheral vascular pathology, cerebrovascular disease, dementia, chronic pulmonary pathology, connective tissue pathologies, ulcerative disease, non-severe compensated hepatopathy.
2	Diabetes, hemiplegia, moderate or severe kidney pathologies, complicated diabetes with internal organ damage, leukemia, lymphoma.
3	Moderate or severe hepatopathy.
6	Non-metastatic solid tumors, Metastatic tumors, AIDS.

**Definitions.** In order to standardize the results we divided all patients into 2 groups: Non-complicated acute appendicitis (NAA) group, consisting of patients without the progression of complications of cataract and phlegmonous AA without perforation; and complicated acute appendicitis (CAA) group, consisting of patients with complications of acute appendicitis. It included phlegmonous with perforation AA, gangrenous AA, appendicular infiltration or peri-appendicular abscess, local, diffuse or generalized peritonitis; septic complications of postoperative wound. The same group included 4 patients who were previously operated for AA, who at distant point had acute adherent intestinal occlusion, treated surgically, 1 patient with external intestinal fistula, 6 patients with ligature fistula, and 5 with post-appendectomy hernias.

**Statistical analysis.** For the purpose of processing quantitative summaries, statistical software was used. Pearson's chi-square and independent sample t tests were used to compare categorical and continuous variables as indicated. A p -value  $\leq 0.05$  was considered statistically significant.

### Results and discussion

AA complications have evolved in 117 out of 449 cases or 26.1%, index compatible with literature data [28-30]. So the control group included 332 patients without complications (NAA), and the CAA group included 117, respectively. Tables 2 and 3 show the structure of AA complications in pre- and postoperative periods.

AA had a higher incidence in women – 257, or 57.2% observations, men representing 41.8% respectively. Specialized literature [14, 31-33] indicates a prevalence of AA in men, the dominance of women in our research was probably determined by a hyperdiagnosis in patients with benign gynecological disorders (tubo-ovarian infections, gynecologic peritonitis). This fact was mirrored in the rate of the so-called negative appendices (catarrhal) which had an incidence of 15.6% in women (n = 40), compared with 3.6% in men (n=7) (P<0.001). In the general group of patients

Table 2

**Intra-abdominal pre- and postoperative complications of acute appendicitis in CAA group (n=117)**

INTRABDOMINAL COMPLICATIONS	N=	%
Perforated appendicitis	21	17,9
Appendicular infiltration	11	9,4
Appendicular infiltration with abscessing	7	5,9
Periappendicular abscess	19	16,2
Interintestinal abscess	1	0,9
Typhlitis	9	7,7
Local and diffuse peritonitis	73	62,4
Generalized peritonitis	1	0,9
Acute dynamic intestinal occlusion	31	26,5
Intestinal occlusion by post-appendectomy adhesion	4	3,4
External intestinal fistula	1	0,9

Table 3

**Pre-and postoperative extra-abdominal complications of acute appendicitis in the CAA group (n=117)**

WOUND COMPLICATIONS	N=	%
Suppuration	15	12,8
Abscess	7	5,9
Infiltration	12	10,2
Seroma	14	11,9
Ligature fistula	6	5,1
Hernia post-appendectomy	5	4,3

undergoing appendectomy catarrhal rate was 10.5%. We found a higher incidence of postoperative complications of AA in this group compared to phlegmonous appendicitis and a lower incidence of complications compared to gangrenous appendicitis (tab. 4).

Figure 2 shows the stratification of patients with AA according to age groups and sex.

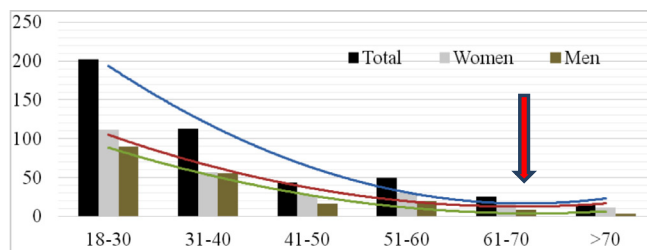


Fig. 2. The incidence of acute appendicitis according to age and sex (n=449).

Data analysis denotes the highest incidence of AA in the age group of 18-30 years, – 202 patients (45%), therefore, practically half of the total number of patients. The decrease in morbidity through AA over the next 3 decades of life (age 31-60 years) is noted, while in patients > 60 years old we have confirmed changes in the epidemiological trend, namely: the trend of AA growth in the general group, especially in women (marked with a red arrow on fig. 3.3). We consider this remark to be important because elderly patients with associated comorbidities are at risk of developing AA complications either on the basis of delayed referral to a physician or because of difficulties or mistakes in establishing the diagnosis and respectively the withdrawal of surgical treatment.

In the complicated acute appendicitis group there was a predominance of women with a ratio of 1.60 (F/B=72/45) comparing to 1.26 (F/B=185/147) in the non-complicated acute appendicitis. The comparative analysis also recorded statistical differences in age, which was 33.5 ± 13.4 years in the NAA group compared to 39.4 ± 16.1 years in the CAA group (P<0.001). Moreover, the share of persons >60 years old was higher in the case of complications of AA – 23.1% (n=27), while in uncomplicated AA it only constituted 3.9% (n=13). Table 5 shows the patients' profile by age and gender.

Table 4

**The structure of postoperative complications according to the morpho-pathological form of AA**

Complications Catarrhal (n=47, 10.5%)	The morpho-pathological form of acute appendicitis (N=449)		
	Phlegmonous (n=330, 73.5%)	Gangrenous (n=72, 16.0%)	
Complications of the postoperative wound	5 (10.6%)	17 (5.2%)	26 (36.1%)
Intestinal fistula	-	1 (0.3%)	-
Ligature fistula	1 (2.2%)	2 (0.6%)	3 (4.2%)
Postappendectomy hernia		1 (0.3%)	4 (5.6%)
Intestinal occlusion by postappendectomy adhesion	1 (2.2%)	2 (0.6%)	1 (1.4%)
Interintestinal abscess			1 (1.4%)
Total	7 (14.9%)*	23 (7.0%)	35 (48.6%)**

\*- significant statistic difference between catarrhal and phlegmonous AA ; P<0.05

\*\* - significant statistic difference between catarrhal and gangrenous AA; P<0.001

Table 5

**Distribution of complications (CAA) and absence of complications (NAA) of acute appendicitis by age group and sex**

INDEX	18-30	31-40	41-50	51-60	>60	Total
AAC M	8	14	7	8	8	45
W	19	10	13	11	19	72
AAN M	82	42	9	11	3	147
W	93	47	15	20	10	185

In this context we can conclude that advanced age is a risk factor in the development of complications of acute appendicitis.

The analysis of the onset-address terms in the all patients found a predominance of the term more than 24 hours after the onset of the disease. To standardize clinical manifestations of AA onset, the time when the patient started to feel nausea, vomiting, dyspepsia or any abdominal pain was defined as the time of onset of the symptoms of the disorder. Of the total of 449 patients only 67 (14.9%) addressed before 6 hours have passed, 131 addressed in 7-24 hours (29.2%), while in over 24 hours – 251 (55.9%) patients. In the case of AA complications there was an emphasis on late referral, the debut-addressing term being higher than uncomplicated AA (fig. 3).

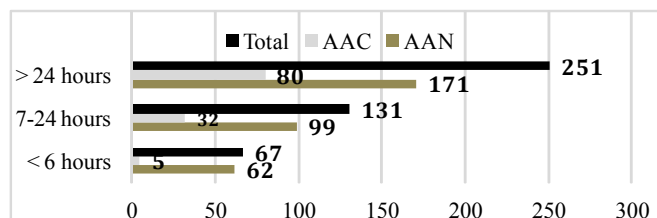


Fig. 3. Distribution of patients according to terms onset-address.

Thus, in the group of patients with complications of AA only 5 (4.3%) patients were addressed in terms of up to 6 hours, 32 (27.3%) – 7-24 hours, and 80 (68.4%) were addressed over 24 hours. In the group of patients without complications these parameters were respectively 18.7%, 29.8% and 51.5% of cases:

Table 6

**Division of patients with (CAA) and without complications (NAA) of acute appendicitis depending of the time of address**

Variable	< 6 hours	7-24 hours	>24 hours
CAA n (%)	5 (4.3%)	32 (27.3%)	80 (68.4%)
UAA n (%)	62 (18.7%)	99 (29.8%)	171 (51.5%)
P	< 0.001	> 0.05	< 0.05

In this context, the data obtained is consistent with the results of other studies, which have shown that delayed appendectomy is associated with weaker results, so early diagnosis with surgical treatment plays a decisive role in improving outcomes [25,31,34,35]. Busch M. [36] reported

that an in-hospital delayed term of more than 12 hours prior to surgery was an independent risk factor for perforation. Kim M. [37] has determined that delayed appendectomy, 24 hours after the onset of clinical manifestations, significantly increases the rate of complications of acute appendicitis. Papandria D. [22] notes that the delay of admission is associated with a higher perforation rate. In contrast, other authors have not recorded a connection between the appendectomy's terms and its perforation rate [20,21,38,39]. For example, Teixeira P. reported that the delay of appendectomy did not increase the risk of perforation [40]. Thus, the ideal or opportune terms for performing appendectomy are currently a controversial problem; the results obtained by various authors are not univocal.

Probably, the different results are determined by what was analyzed – just the terms of the patient in the ward, or the onset – surgical treatment terms. Of course, considering the pathophysiology of AA and its complications, it is rational to study general, complex terms, not just the time when the patient is in custody of the surgeon. On the other hand, it is required to note that the initial symptoms of AA are known to be vague and nonspecific, making it difficult to accurately determine the time of initiation of the pathology. Moreover, the symptoms are subjective, because they depend on the sensations of the patients; the surgeons rely only on their claims. For these reasons, the time at which any known symptom, such as nausea, vomiting, anorexia or abdominal pain are reported by the patient, is to be considered as the first occurrence of AA symptoms.

To conclude on this subject, analyzing our own results, we consider that late referral is a major risk factor for the evolution of AA complications. We believe that the moment symptoms of appendicitis are triggered is important for deciding when to perform emergency surgery. The delayed operation (from the onset of symptoms) is associated with more severe results in the progression of pathology and the risk of developing complications of the disease.

Studying the causes of late referral of patients, we paid attention to their socio-economic status, taking as a criterion the estimation of the presence or absence of medical insurance. The vast majority of patients in our study were insured – 364, or 81.1% of cases. Of the 85 uninsured patients 61 (71.%) went to hospital late, over 24 hours after the first clinical symptoms of acute appendicitis manifested. Figure 4 shows the distribution of patients according to the socio-economic status and the onset-addressing terms.

A direct link was established between the socio-economic state and the terms of addressing for medical care. Probably the absence of medical insurance determines the delay of addressing, the initiation of a self-treatment, which in turn reflects on the evolution of the disease. Thus, namely uninsured patients (n=59,49.6%) formed virtually half of the group of patients with AA complications. Similar results have been obtained by Lin K. [13] who finds a substantially higher incidence of perforated AA in low-income patients compared to normal population, – 37.28% and respectively 26.1%, and the so-called perforation rate constituted 1.34/1.



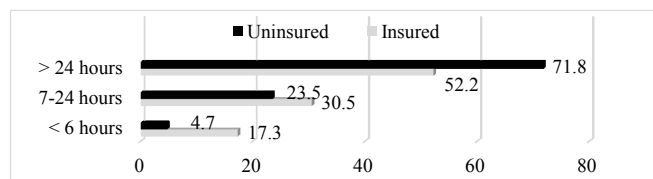


Fig. 4. The distribution of the patients (%) according to the onset-addressing and the socio-economic status.

This study, as well as the results of our research, confirmed that low socio-economic status has a significant negative impact on the evolution of acute appendicitis and its complications, as well as on appendectomy results.

As regards the influence of associated co-morbidities on the natural evolution of the disease, some connections have been noted, namely: with the increase of the co-morbidity score increases the rate of complications as well as the general ones, as well as the abdominal or post-appendectomy wound. This is probably due to the difference in the biological conditions on the background of which the inflammation process occurs in patients with associated co-morbidities, as well as the inflammatory response of the macro-organism itself to the pathogen. Thus, these suggestions are in favor of alternative theories in the field of AA pathophysiology which place the local immunological response made by the vermiform appendix (favored by the richness of lymphoid tissue in the appendix submucosa) and the general release of pro- and anti-inflammatory cytokines in response to the pathogenic microbial agent.

Associated co-morbidities were established in 76 or 16.9% of cases, most frequently – cardiovascular (hypertension, ischemic heart disease, angina pectoris, atherosclerotic or postinfarct cardiosclerosis, paroxysmal arrhythmia) – 26 (34.2%) cases. Digestive tract disorders (chronic cholecystitis, chronic gastroduodenitis, chronic viral hepatitis B and C, chronic gastro-duodenal disease in remission) was marked in 12 (15.8%) patients. Type II diabetes was present in 15 (19.7%) patients, and respiratory tract disorders (bronchial asthma, pneumonia, chronic bronchitis) were noted in 6 (7.9%). Urogenital diseases (salpingitis, salpingoophoritis, ovarian cyst, urolithiasis, chronic renal failure) were diagnosed in 7 (9.2%) cases. In 10 (13.2%) patients, co-morbidities were represented by various causes of cerebral infarction, dysmetabolic or atherosclerotic encephalopathy, feripritis anemia, narcotics, varicose veins, chest cancer chemotherapy.

In case of co-morbid score «0» we noticed significant differences, 84.6% of patients being in the NAA group compared to 78.6% of the patients in the CAA group ( $P < 0.001$ ). In other words, the majority of patients who had a favorable affection did not show associated co-morbidities. The association of compensated co-morbidity did not show a severe impact on disease progression, at 13.3% with NAA, compared with 15.4% of patients with CAA ( $P > 0.05$ ). In the case of undercompensated or decompensated associated diseases, or the presence of more co-morbidities, the picture was radically different: 1.5% compared to 3.4% in CCI = 2; and 0.6% vs. 2.6% in CCI  $\geq 3$  in the respective groups.

Table 7

Characteristics of patients with complications (CAA) and without complications (NAA) of acute appendicitis depending on Charlson Co-morbidity Index (CCI)

Parameter	Total (N= 449)	CAA (n= 117)	NAA (n= 332)	P
CCI "0" (%)	83.1	78.6	84.6	<0.001
CCI "1" (%)	13.8	15.4	13.3	>0.05
CCI "2" (%)	2.0	3.4	1.5	<0.01
CCI "≥3" (%)	1.1	2.6	0.6	<0.001

In brief, we note that the presence of associated co-morbidities has a clear negative impact on AA evolution. The failure to diagnose secondary pathologies or to perform surgical treatment in a patient with insufficiently corrected subcompensated or decompensated co-morbidity and the associations of several co-morbid pathologies are significant risk factors for the development of AA complications.

One of the cardinal problems discussed in the literature is the specification of the pathophysiological mechanisms that underlie the pre- and postoperative complications of AA. It is considered that all septic complications after appendectomy evolved within the surgical wards are due to nosocomial infection. However, the presence of an exogenous source is necessary for its appearance, or otherwise the patient who underwent the operation must contact either a supposed wound of another patient or with contaminated dressing material, instrumentation and so on. The most frequent phenomenon occurs when a septic department is absent in the clinic and the patients with septic complications are not isolated. Another reason could be due to the non-observance of the profile of the hospitalized surgical patients. Such situations may result in outbreaks of in-hospital infection.

In the group of CAA patients, bacteriological cultures were culled intraoperatively in order to analyze whether there is a correlation between the bacterial species normally present in the digestive tract and those isolated from the peritoneal fluid in the appendicular peritonitis. Another objective was the comparative analysis of microbial germs in the case of postoperative wound complications and isolated germs in the peritoneal cavity.

Although peritoneal fluid response was noted in all cases, only 78 patients (66.7%) identified microbes. Constantly, the germs were present in all observations accompanied by diffuse peritonitis and partly in AA with localized peritonitis. In 33.3% observations, the bacteriological laboratory response was negative, probably due to the impossibility of determining the anaerobic flora. This moment is a weak point of the bacteriological research analyzed in our study, because the absence of flora identification does not necessarily signify its absence. The aforementioned increases its importance, because the microbial flora is decisive in the evolution of the disease in the etiopathogenesis of AA, most of the postoperative complications are septic. The aggressiveness of microbial flora in AA is due to the colon, which

in the healthy individual contains anaerobic flora with the predominance of gram negative bacteria Bacterioidis. On the other hand, it is known that the most commonly found in the colon is E.Coli, which is an aerobic germ, and is also an anaerobic microbe (optional) and therefore can also develop under anaerobiosis conditions. These considerations are probably the explanations of a large number of negative bacteriological outcomes in our research.

Analysis of positive crop results (n = 78) revealed the identification of 1 single germ in 6 (7.7%) cases; at least 72 germs were identified in the remaining 72 patients (92.3%). Primary bacteriological research confirmed the prevalence of Gram-negative flora – 57 or 73.1% cases, represented by E. coli – 43 (55.1%), Klebsiella and Enterobacter – 7 (9.0%), Pseudomonas aeruginosae – 4 cases (5,1%), Proteus mirabilis – 3 (3.8%). Of gram-positive microorganisms the following were discovered: (n= 21) Staphylococcus (aureus, epydermidis and heamolyticus) were identified in 9 (11.5%) cases and Enterococcus in 7 (9.0%) observations. Other microbial agents were established in 5 (6.4%) cases.

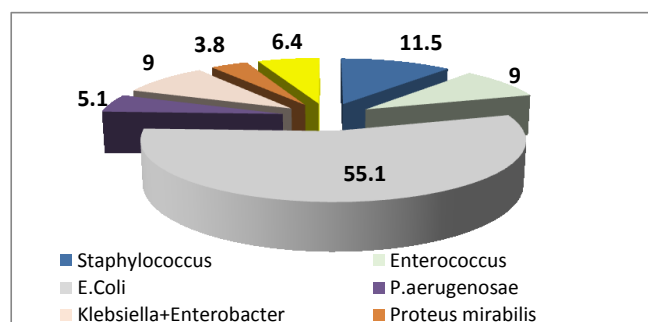


Fig. 5. Microbial germs identified in the study group.

Penicillins possessed a high antimicrobial activity in regards to *E. coli* with a cumulative rate of 29.5% of cases and aminoglycosides in 35% of observations. *Pseudomonas aeruginosa* noted sensitivity to azlocillin – 27.3% and cefazidime in 31.8% of cases. *Klebsiella and Enterobacter* were sensitive to ciprofloxacin and cyprinol at a cumulative rate of 21.3%. *Proteus mirabilis* was susceptible to cefotaxime and carbapenicillin in 34.6% of cases. Concerning gram-positive flora, cefuroxime (41.7%), ciprofloxacin and oxacillin – 50%; lincomycin – 47.4%, enterococci, vancomycin (26.7%) and netilmicin (20.0%) were effective against Staphylococcus.

Repeated microbiological studies were performed in 48 patients with wound complications. The microflora isolated from wounds usually coincided with seeding taken during abdominal cavity surgery. A total of 53 microbiological tests were performed with positive results in 88.3% of cases. Gram-negative flora observations were found in 67.1%, and gram positive in 32.9% of cases. Microbial associations were noted in 71.2% of cases were represented by 2 microorganisms; in 10.7% – 3 and in 6.4% of cases we confirmed the presence of 4 species of bacteria.

The isolated strains of microbes in repeated bacteriological tests were susceptible to cephalosporins and aminoglycosides. It is known, however, that in-hospital infection is mainly caused by multi-resistant, gram-negative bacteria

that produce beta-lactamases and are resistant to cephalosporins, penicillins and aminoglycosides (antibiotic groups commonly used). Specification of microbial flora and its sensitivity to antibiotics allows us to consider flora, which circulates in the abdominal cavity prior to surgery, as the main cause of the suppuration of postoperative wounds. From this point of view, the septic processes of post-appendectomy wounds appear to be essentially a continuation of the purulent-inflammatory process already existing at the point when the patient was hospitalized and treated surgically. In some cases, the lack of identity of the microbial flora may be a consequence of the so-called bacterial translocation in the intestine. These circumstances are important in interpreting the causes of post-operative parietal complications, which by definition are attributed to in-hospital infection, but de facto are a continuation or outcome of the purulent-inflammatory process with which the patient was hospitalized.

Of course, the given deductions do not deny and do not question the importance of nosocomial infection in the evolution of septic-purulent processes in the surgical patient, but we believe that every case of parietal complication of the postoperative wound requires individualized analysis that would allow more accurate determination of the source of the infection (endogenous or intra-hospital). An accurate understanding of this pathophysiological process influences the choice of ways to prevent and treat postoperative complications, including postoperative antibiotic therapy.

Summarizing the data of the bacteriological research of the patients with AA complications we can observe the following trends: 1) an essential predominance of the gram-negative flora was found in the studied patients – 73.1% of cases part of this study; 2) secondary non-hospital peritonitis with autochthonous flora with a high sensitivity to standard antibiotic therapy usually evolved in patients with CAA; 3) microbial species with high resistance or polyantibiotic resistance are present in case of association of nosocomial infection; 4) when it comes to the general structure of the in-hospital microbial landscape, it is represented by a higher rate of gram-positive flora, represented primarily by staphylococcus aureus and subpopulations of staphylococcus (epydermidis and heamolyticus); 5) the identified gram-positive in-hospital flora possesses a high resistance to the penicillin group antibiotics, hence the productive beta-lactamase-producing species are also resistant to cephalosporins.

## Conclusions

1. In our study complications of acute intra-and extra-abdominal appendicitis had an incidence of 26.1%, a value compatible with existing literature data.

2. Risk factors for the evolution of complications were the late referral from the onset of the first clinical manifestations, age > 60 years, and the presence of insufficiently corrected co-morbidity or the association of several co-morbid pathologies. Low socioeconomic status also has a negative impact on the evolution of acute appendicitis and its complications.

3. There was a higher incidence of AA parietal postoperative complications in catarrhal appendicitis compared to phlegmonous appendicitis and a lower incidence of complications compared to gangrenous appendicitis. Thus, more extensive application of diagnostic laparoscopy is necessary in uncertain clinical situations.

4. Specification of microbial flora and its susceptibility to antibiotics allows us to consider the main cause of postoperative wound sedation of native flora susceptible to the usual antibiotic therapy. From this point of view, the septic processes of the post-appendectomy wound appear to be essentially a continuation of the purulent-inflammatory process with which the patient was hospitalized and surgically treated. Any suspicion of postoperative complication through nosocomial infection requires wide-spectrum desiccation antibiotic therapy, including one covering the anaerobic flora.

5. Our findings suggest that clinical assessment is most important for identifying individuals at risk of developing complications of acute appendicitis and the above-mentioned risk factors are useful for emergency surgical decisions.

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