MEDICAL UNIVERSITY

"PROF. DR. PARASKEV STANOV" - VARNA

FACULTY OF MEDICINE

DEPARTMENT OF SURGICAL DISEASES

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Intraabdominal Abscesses

Abstract

Of the dissertation for the award of a scientific degree

"DOCTOR OF MEDICAL SCIENCES"

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The dissertation is written in 372 standard pages, of which 42 pages present the references used. The bibliographic reference includes 362 titles, of which 18 in Cyrillic and 344 in Latin.

The material is illustrated with 113 tables and 77 figures.

The dissertation was discussed, accepted and directed for defense by the Departmental Council of the Department of Surgical Diseases, Medical University - Varna.

The dissertant works as a surgeon-assistant professor in the Second Department of Surgery at the University Hospital "St. Marina" and Department of Surgical Diseases, Medical University - Varna.

The public defense of the dissertation will take place on 12.01.2024 at .....hours at the University Hospital "St. Marina" at a scientific jury:

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The defense materials are available in the Scientific Department and are published on the website of MU - Varna

Note: The numbers of tables and figures in the abstract do not correspond to those in the thesis.

Contents

Abbreviations used

- CT - computed tomography
- MRI - magnetic resonance imaging
- US - ultrasound
- PTH - percutaneous transhepatic cholangiography
- PTD - percutaneous transhepatic drainage
- ERCP - endoscopic retrograde cholangiopancreatography
- GEA - gastroenteroanastomosis
- MRCP - magnetic resonance cholangiopancreatography
- PCA - procoagulant activity
- PAI - 1 - tissue plasminogen activator
- TNF - tumour necrosis factor
- ASA - American Society of Anesthesiologists
- CHD - chronic heart disease
- MSD - cerebrovascular disease
- CHF - chronic heart failure
- DM - diabetes mellitus
- COPD - chronic obstructive pulmonary disease
- CKD - chronic renal failure
- CKD - chronic vertebrobasilar vascular insufficiency
- BPH - benign prostatic hyperplasia
- NHL - Non-Hodgkin lymphoma
- DVT - deep vein thrombosis
- CKD - renal stone disease

- AKI - acute renal failure

- GERD - gastro-oesophageal reflux disease

- CKD - chronic arterial insufficiency of the extremities

- CDA - choledocho-duodenal anastomosis

- CHA - choledocho-jejunoanastomosis

Introduction

Intraabdominal abscesses are an important cause of morbidity and mortality. They are common surgical emergencies and have been reported as a major contributor to non-traumatic deaths in emergency departments worldwide. Early clinical diagnosis, adequate control of the source of infection to halt ongoing intoxication, appropriate antimicrobial therapy, assessment of risk factors for infection and immediate resuscitation of critically ill patients are the cornerstones in the management of this abdominal pathology. However, there are still critical controversies in the management of these patients.

Complicated intra-abdominal abscesses are an important cause of morbidity and mortality. In a recent multicenter observational study conducted in 132 medical institutions worldwide during a 4-month period (October 2014-February 2015) involving 4553 patients with intra-abdominal abscesses, a mortality rate of 9.2% was found.

Over the past century, intra-abdominal abscess has evolved from a disease with extreme mortality even with surgical intervention to a medical condition with a sometimes quite insidious presentation, thanks in part to the widespread use of antibiotics, especially in the postoperative period.

Intra-abdominal abscesses continue to be important and serious problems in the practice of clinical surgery. They occur frequently as complications of injuries, diseases and operations of the digestive system and less frequently as a result of lesions of the female and male genitourinary organs. Not infrequently their diagnosis and localization is difficult. These characteristics can create serious problems in the surgical strategy of patients with such abscesses. Moreover, their pathophysiological effects may become life-threatening or lead to prolonged periods of morbidity, prolonged hospitalization, and one or several operations. In addition, various X-ray and other diagnostic tests, increasing care and intensive treatment, or the use of isolation techniques further increase the cost of these infections to patients, hospitals, and society.

The social and economic significance of intra-abdominal abscesses is measured by the significant health resource burden they require in terms of the need for emergency care, hospital admission, imaging and laboratory diagnostics, surgery (both initial and repeat interventions). In addition, ineffective initial empiric antimicrobial therapy can lead to significant increases in

treatment costs. Tremendous advances have been made in the treatment of intra-abdominal infections in the past, as mortality rates have fallen from approximately 90% in 1900 to 23% in 2002. However, mortality rates can still vary widely depending on the source of infection, ranging from 0.25% for appendicitis, to much higher rates for stomach/duodenum (21%), pancreas (33%), small bowel (38%), colon (45%) and bile duct (50%). There is little or no evidence that antibiotic therapy has reduced the overall incidence of intra-abdominal abscesses, but increasing evidence that it can be used more effectively than at present. Although this pathology continues to be relatively common in clinical practice there are a small number of studies of patients with this problem.

Intra-abdominal abscesses are still associated with a high mortality rate due to organ dysfunction in critically ill surgical patients. As a result, these infections require a combination of appropriate and timely surgical source control and broad-spectrum antimicrobials for optimal outcomes. The goals are to avoid sepsis/bacteremia, local destructive effects of infection, and death.

Aim and objectives

AIM

To investigate, analyze and standardize the diagnosis, preoperative approach and treatment of patients with intra-abdominal abscesses in order to optimize treatment outcome, reduce complications and achieve a better quality of life.

OBJECTIVES

1. Retrospective analysis of patients with intra-abdominal abscesses hospitalized in the Second Department of Surgery for the period 2011 - 2020.

2. Comparative analysis between diagnostic and therapeutic modalities in terms of risks, benefits and cost.

3. Assessment of risk factors and comorbidities on outcome

4. Analysis of postoperative complications and patient survival

5. Creation of a diagnostic and treatment algorithm

MATERIALS AND METHODS

During the period 2011 - 2020, 555 patients with intra-abdominal abscess were hospitalized in the Second Department of Surgery. Of these:

- 207 patients with liver abscess and perivesical abscess;
- 142 patients with periapendicular abscess;
- 65 patients with pancreatic abscess;
- 21 patients with abscess due to colonic diverticulitis
- 51 patients with abscess due to small or large bowel perforation, without diverticulitis
- 41 patients with postoperative abscess
- 13 patients with abscess of gynaecological origin
- 7 patients with splenic abscess
- 8 patients with abscess due to ulcer perforation

The distribution of patients by nosological cause is shown in Fig. 1.

A total of 8666 surgical interventions were performed during the same period, of which 564 surgical interventions were due to intra-abdominal abscess - 6.5% (Fig. 2).

Observed trend:

- 2011 - 2013 - 4.7 - 5.0% of interventions were for intra-abdominal abscess.

- 2018 - 2019г - 7,4 - 8,1 %

- 2020 - 10.1% (reduced number of elective)

Methods used

1. Preoperative diagnosis and staging:

1.1. History of disease and physical examinations.

1.2. Laboratory tests

1.3. Diagnostic ultrasound

1.4. Computed tomography

1.5. Magnetic resonance imaging

1.6 Magnetic cholangiopancreatography

1.7. Percutaneous transhepatic drainage

1.8. Fibrogastroduodenoscopy

1.9. Fibrocolonoscopy

2. Methods of intraoperative diagnostics:

2.1. Examination, palpation

2.2. Laparoscopy

2.3. Intraoperative cholangioscopy

3. Postoperative methods:

3.1. Postoperative observation

3.2. Postoperative abdominal ultrasonography

3.3. Postoperative CT

4. Methods of clinical analysis and observation:

4.1. Retrospective analysis of medical records and prospective observation of treated patients

4.2 Retrospective observation of procedures used and their outcomes

5. Statistical methods

5.1 Descriptive

5.2 Correlational

5.3 Hypothesis testing

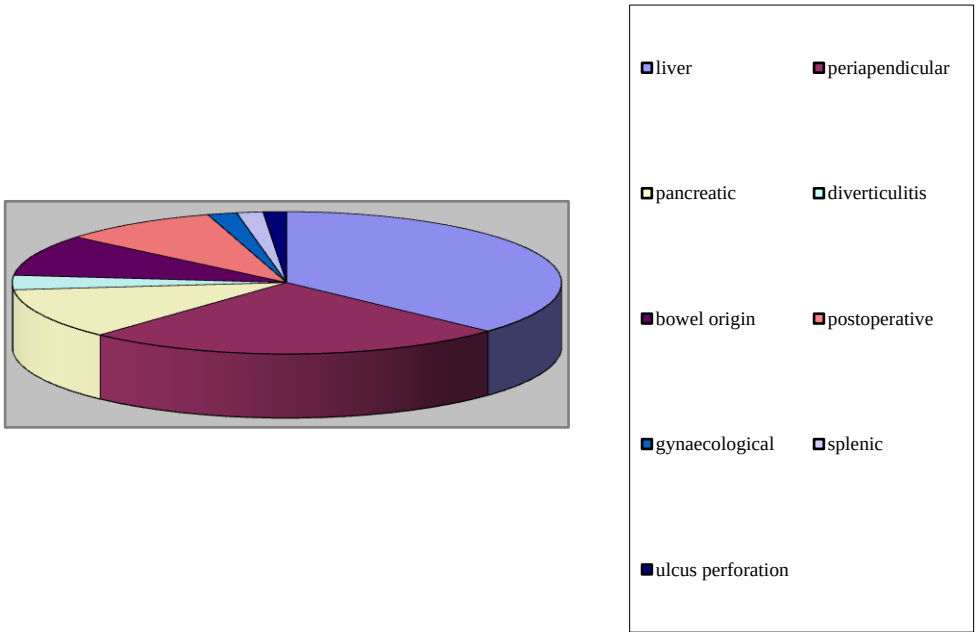


Fig. 1: distribution of patients by nosological origin

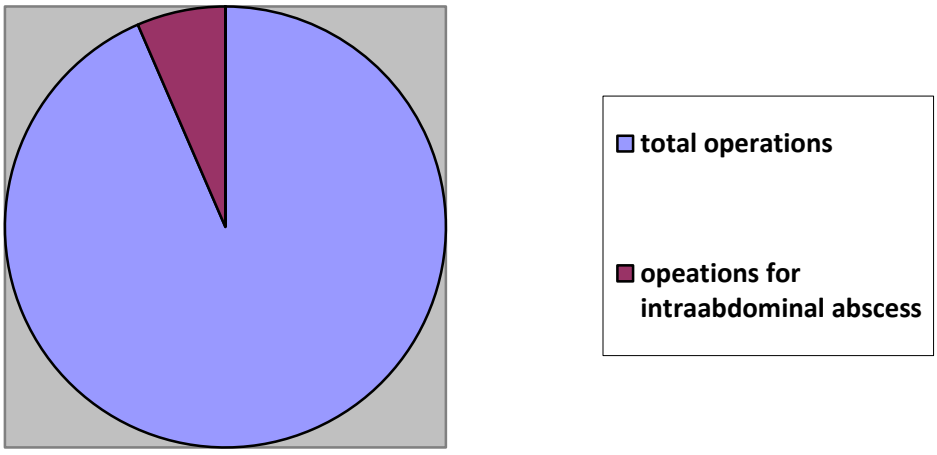


Fig. 2: ratio of operations for intra-abdominal abscess to total number of operations

Age of patients

N	Valid	555
	Missing	0
Mean		57,51
Median		60,50
Mode		67
Std. Deviation		16,848
Skewness		-,393
Std. Error of Skewness		,110
Kurtosis		-,588
Std. Error of Kurtosis		,220
Minimum		16
Maximum		89

Table. 1: age distribution

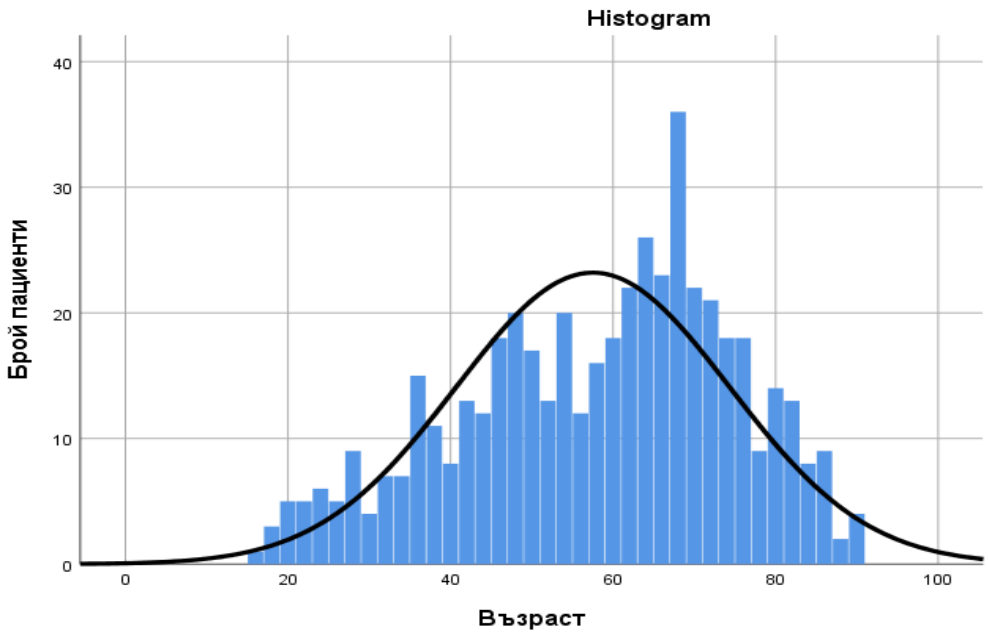


Fig. 3:Distribution of patients by age

N Valid - number of study units - 555 patients

Mean-average age of patients in the study was 57.51 years, approximately 58 years

Mode-most common occurrence of units by a given trait-most common age was 67 years

Std. deviation-mean squared standard deviation-measures the differences between units on a given trait-patients differ on the trait "age" by an average of 16.848 years, approximately 17 years

Skewness-coefficient of asymmetry

-0.393 as a value indicates moderate asymmetry with a right drawn distribution curve /shown in the histogram below/

Kurtosis-coefficient of skewness-has a relationship with the peak pull of the distribution curve

Minimum - smallest value of the attribute by which the units are considered - in this case the attribute is "Age" and the youngest patient is 16 years old

Maximum - the oldest patient is 89 years old

Age intervals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	up to years	61	11,0	11,0	11,0
	31-60 years	231	41,6	41,6	52,6
	over 61 years	263	47,4	47,4	100,0
	Total	555	100,0	100,0	

Table. 2: age ranges

Distribution by sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	310	55,9	55,9	55,7
	female	245	44,1	44,1	100,0
	total	555	100,0	100,0	

Table. 3: gender distribution

Diagnosis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lower colon tumor	1	,2	,2	,2
	Small bowel abscess	11	2,2	2,2	2,4
	Postoperative small bowel lower GIT	2	,2	,2	2,7
	Appendicitis	142	24,3	24,3	26,9
	Crohn's disease	7	1,4	1,4	28,4
	Postoperative upper git stomach duodenum	3	,6	,6	29,0
	Diverticulitis colon lower GIT	21	3,7	3,7	32,7
	Postoperative colonic lower GIT	7	,8	,8	33,5
	Hepatic or perihepatic abscess and cholecystitis	139	28,0	28,0	61,4
	Cholecystitis	64	13,1	13,1	74,5
	Splenic abscess	7	1,0	1,0	75,5
	Pancreatic abscess	65	12,9	12,9	88,4
	Ileus	14	2,9	2,9	91,2
	Stomach ulcer	3	,2	,2	91,4
	Ulcer of duodenum	5	,6	,6	92,0
	Fistula entero et colocutanea	4	,4	,4	92,4
	Perforation small intestine	12	2,4	2,4	94,9
	Perforation colon tumor	12	2,2	2,2	97,1
	Perforation colon	6	1,2	1,2	98,4
	Gynaecological abscess	2	,2	,2	98,6
	Insufficiency anastomosis	4	,6	,6	99,2
	Echinococcosis	4	,2	,2	99,4
	Gastrostomy, peritoneal catheter	2	,2	,2	99,6

	Postoperative cholecystectomy, pancreas, spleen	6	,2	,2	99,8
	Subphrenic abscess	12	,2	,2	100,0
	Total	555	100,0	100,0	

Table 4: distribution by diagnosis

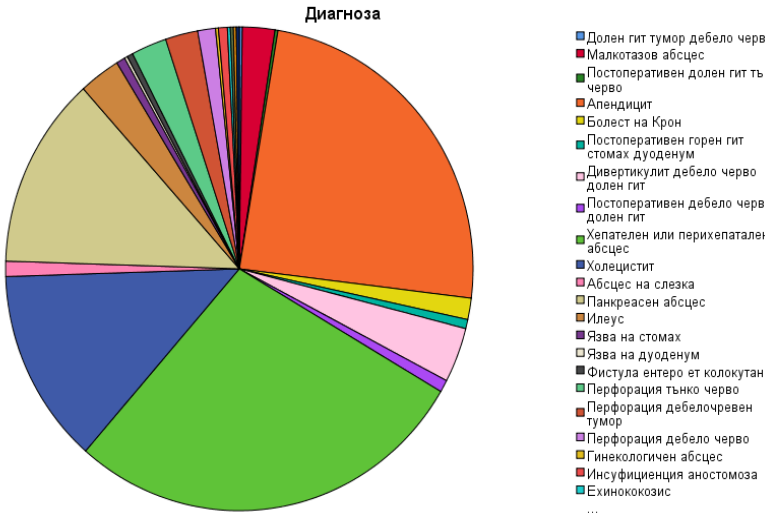


Fig. 4: distribution of patients by diagnosis

In order to provide an overview of diagnoses among all 555 patients, the 5 most common diagnoses were isolated, described and visualized.

Most common diagnoses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Appendicitis	142	24,3	24,3	24,3
	Diverticulitis colon lower git	21	3,7	3,7	28,0
	Hepatic or perihepatic abscess	139	28,0	28,0	55,9
	Cholecystitis	64	13,1	13,1	69,0
	Pancreatic abscess	65	12,9	12,9	81,8
	Other	124	18,2	18,2	100,0
	Total	555	100,0	100,0	

Table 5: most common diagnoses

Treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Surgery without drainage	42	6,3	6,3	6,3
	Drainage (CT, USV)	58	7,8	7,8	14,1
	Conservative	6	1,2	1,2	15,3
	Refused operative treatment	2	,4	,4	15,7
	Surgery+drainage	447	84,3	84,3	100,0
	Total	555	100,0	100,0	

Tabl. 6: treatment

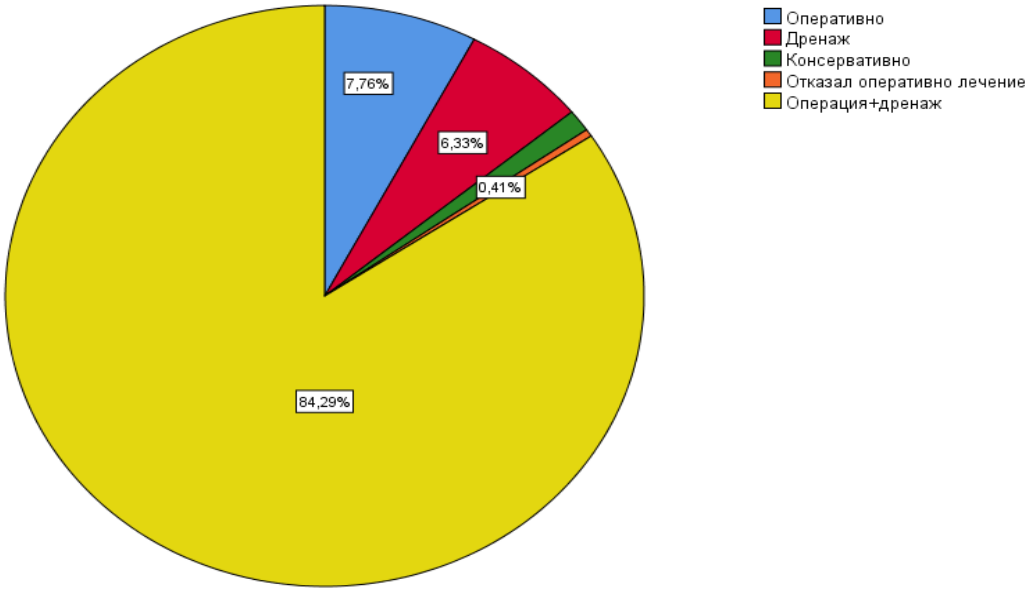


Fig. 5: distribution of patients by type of treatment

Microbiology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	E.coli	123	24,6	24,6	24,6
	Staphylococcus aureus	8	1,6	1,6	26,2
	Sterile seedings	189	37,8	37,8	64,0
	Acinetobacter baumannii	6	1,2	1,2	65,2
	Klebsiella oxytoca	6	1,2	1,2	66,4

	Bacteroides fragilis	1	,2	,2	66,6
	Enterococcus faecium	18	3.6	3.6	70,2
	Proteus vulgaris	2	,4	,4	70,6
	Klebsiella pneumoniae	45	7,0	7,0	77,6
	Enterobacter aerogenes	3	,6	,6	78,2
	Citrobacter freundii	7	1,4	1,4	79,6
	Enterococcus faecalis	29	4,4	4,4	84,0
	Pseudomonas sp	5	1,0	1,0	85,0
	Streptococcus alpha	4	,8	,8	85,8
	Providencia rettgeri	1	,2	,2	86,0
	Candida albicans	7	,4	,4	86,4
	Staphylococcus coagulase negative	10	1,6	1,6	88,0
	Morganella morganii	2	,4	,4	88,4
	Enterococcus avium	1	,2	,2	89,6
	Pseudomonas aeruginosa	27	2,7	2,7	89,8
	Enterobacter cloacae	28	1,6	1,6	92,5
	Pseudomonas stutzeri	2	,4	,4	94,1
	Enteroccocus gallinarum	1	,2	,2	94,5
	Citrobacter braakii	1	,2	,2	94,7
	Proteus mirabilis	9	1,0	1,0	95,7
	Staphylococcus epidermidis	8	1,6	1,6	96,7
	Micrococcus sp	2	,4	,4	98,0
	Salmonella Enteritidis	1	,2	,2	98,4
	Staphylococcus haemolyticus	3	,6	,6	98,6
	Gram negative rods	1	,2	,2	99,2
	Serratia marcescens	1	,2	,2	99,4
	Streptococcus haemoliticus	2	,4	,4	99,6
	Acinetobacter lwoffi	1	,2	,2	99,8
	Corynebacterium striatum	1	,2	,2	100,0
	Total	555	100,0	100,0	

Table 7: microbiological agents

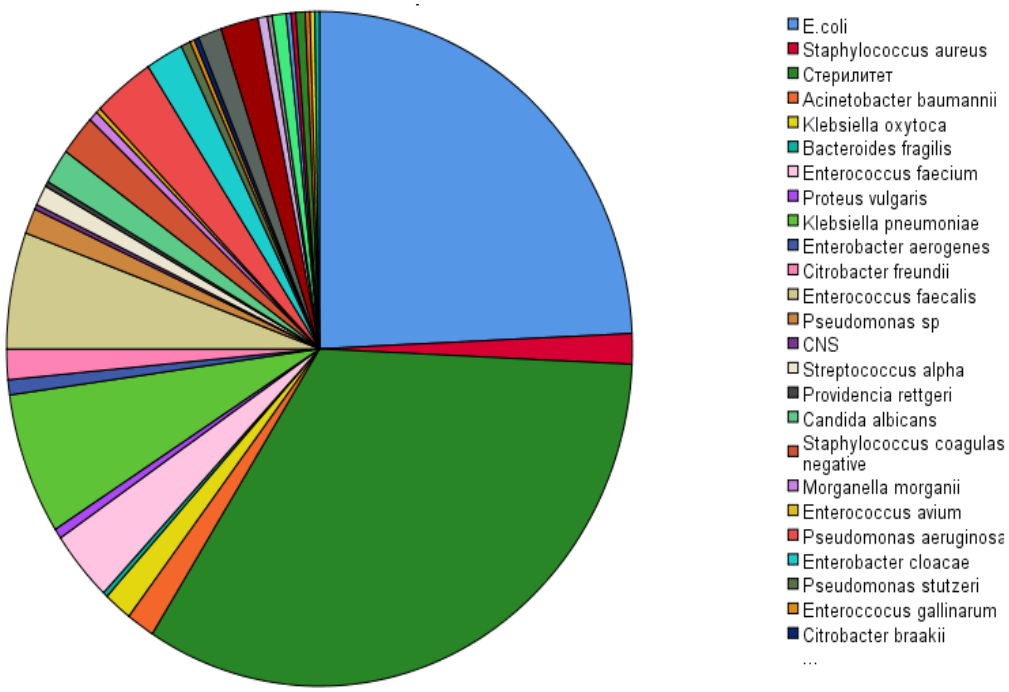


Fig. 6: distribution by number of microbiological agents

In order to have an overview in describing the microbiology among all 490 patients, the 5 most common bacteria were isolated, described and visualized.

Microbiology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	E.coli	123	20,4	20,4	20,4
	Sterile seedings	189	28,0	28,0	48,4
	Enterococcus cloacae	28	2,9	2,9	51,2
	Klebsiella pneumoniae	45	5,7	5,7	56,9
	Enterococcus faecalis	29	4,7	4,7	61,6
	Други	141	38,4	38,4	100,0
	total	555	100,0	100,0	

Table 8: most common microbiological agents

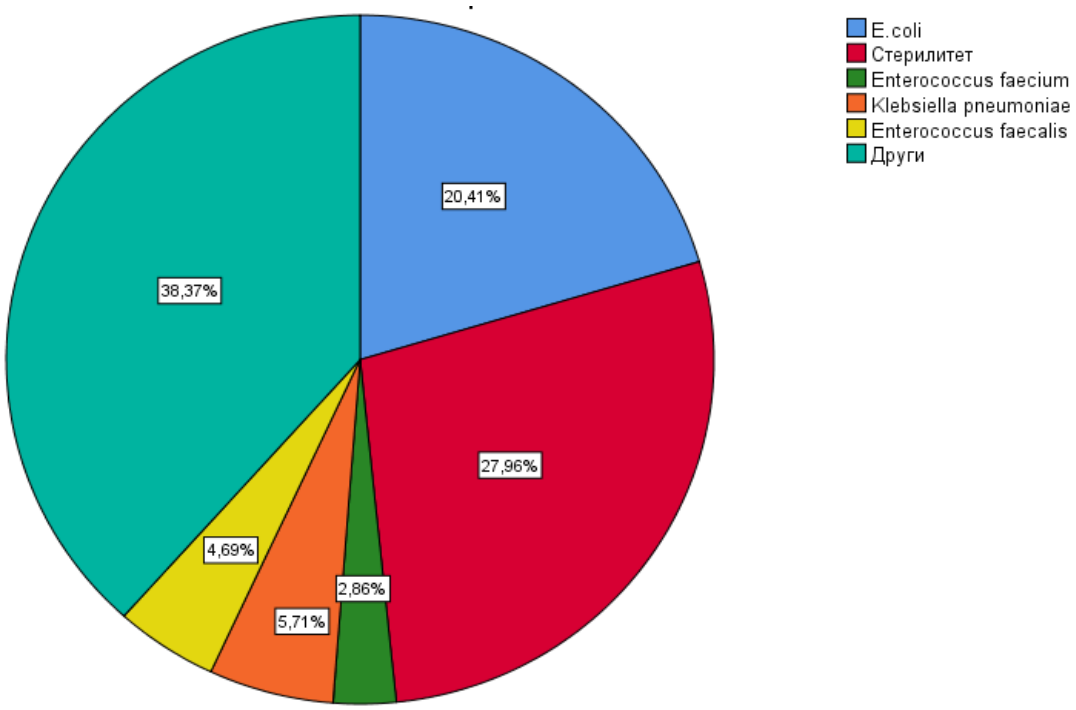


Fig.7: most common microbiological agents

Clinical symptoms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	485	87,4	87,4	87,4
	No	70	12,6	12,6	100,0
	Total	555	100,0	100,0	

Table 9: abdominal pain

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	108	19,5	19,5	19,5
	no	447	80,5	80,5	100,0
	Total	555	100,0	100,0	

Table 10: symptom abnormal passage (ileus or diarrhea)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	179	32,3	32,3	32,3
	No	376	67,7	67,7	100,0
	Total	555	100,0	100,0	

Table 12: symptom febrility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	242	43,6	43,6	43,6
	No	313	56,4	56,4	100,0
	Total	555	100,0	100,0	

Table 12: symptom nausea with/without vomiting

Symptoms frequency

		Responses		Percent of Cases
		N	Percent	
Symptoms[a]	Symptom abdominal pain	485	40,9%	87,4%
	Symptom nausea and vomiting	242	20,4%	43,6%
	Symptom abnormal passage	108	9,1%	19,5%
	Symptom febrility	179	15,1%	32,3%
	Other	172	14,5%	14,5 %
Total		1186	100,0%	197,3%

a. Dichotomy group tabulated at value 0.

Table 13: most common symptoms

There were 1186 symptoms recorded in all 555 patients. The most frequent symptom was "abdominal pain", which occurred in 485 patients or 40.2% of all clinical symptoms. With the least manifestation of the main symptoms was "abnormal passage" occurring in 108 patients or 9.1% of the units studied.

Imaging studies

	N	Percent	Percent of Cases
Ultrasound	460	40,2	82,9
CT of abdomen and pelvis	337	29,5	60,7
Abdominal X-ray	120	10,5	21,6
Chest X-ray	108	9,4	19,5
MRI	20	1,7	3,6
Other	99	8,7	17,8
Total	1144	100,0%	206,1 %

Table 14: most frequently performed imaging tests

There were 1144 imaging studies recorded in all 555 patients. Ultrasound was the most frequently used imaging modality in 460 patients and CT of the pelvis and abdomen in 337 patients.

Anaesthetic risk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I	48	8,6	8,6	8,6
	II	147	26,5	26,5	35,1
	III	246	44,3	44,3	79,4
	IV	107	19,4	19,4	98,8
	V	7	1,2	1,2	100,0
	Total	555	100,0	100,0	

Table 15: number of patients according to ASA

Antimicrobial therapy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Amoxiclav	26	4,2	4,2	4,2
	Metronidazole	201	37,6	37,6	41,8
	Ceftriaxone	28	4,6	4,6	46,4
	Cefazolin	237	42,3	42,3	88,7
	Lifurox	33	6,1	6,1	94,8
	Piperacillin	30	5,2	5,2	100,0
	Total	555	100,0	100,0	

Table 16: most commonly used antibiotics

Intensive care unit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	164	29,4	29,4	29,4
	No	391	70,6	70,6	100,0
	Total	555	100,0	100,0	

Table 17: number of patients in intensive care unit

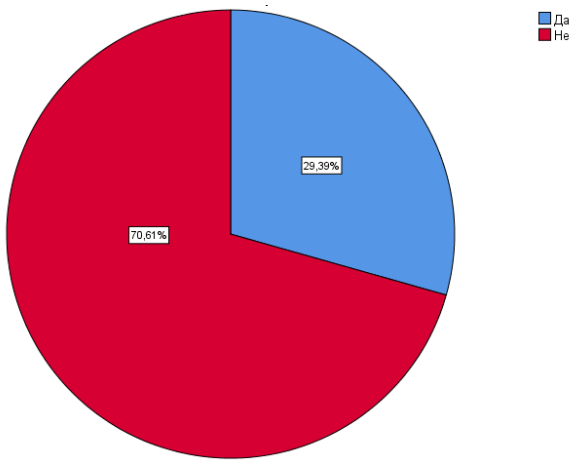


Fig. 8: number of patients in intensive care unit

Wound healing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	512	92,2	92,2	92,2
	Secondary	43	7,8	7,8	100,0
	Total	555	100,0	100,0	

Table 18: number of patients according to wound healing

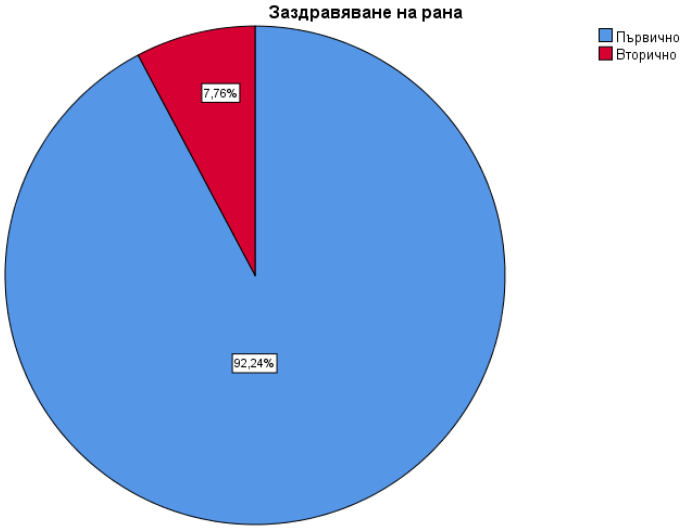


Fig. 9: number of patients according to wound healing

Mortality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	71	12,8	12,8	12,8
	No	484	87,2	87,2	100,0
	Total	555	100,0	100,0	

Table 19: mortality

Comorbidities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No comorbidities	158	26,1	26,1	26,1
	1	139	25,7	25,7	51,8
	2	111	20,2	20,2	72,0
	3 and more	147	28,0	28,0	100,0
	Total	555	100,0	100,0	

Table 20: Patients with a number of concomitant diseases

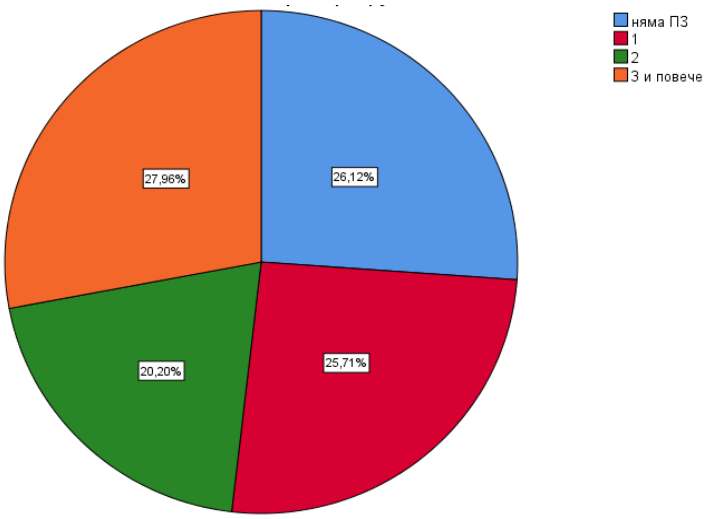


Fig. 10: distribution of patients by number of comorbidities

Incidence of comorbidities

		Responses N	Responses Percent	Percent of Cases
IC[a]	IHD	83	10,0%	15,5%
	CVD	43	5,4%	7,7%
	CHF	33	4,0%	5,9%
	Crohn's disease	3	0,3%	0,5%
	Left-sided hemiparesis	1	0,1%	0,1%
	Hypertensive disease	273	33,8%	49,2%
	Mitral and aortic insufficiency	3	0,3%	0,5%

Chronic pyelonephritis	7	0,8%	1,2%
Rhythm disturbances	22	2,6%	4,0%
Gout	7	0,8%	1,2%
Liver cirrhosis	8	1,0%	1,4%
Cholelithiasis	7	0,8%	1,2%
Steatosis hepatis	14	1,7%	2,5%
Arthritis	3	0,3%	0,5%
Dilated cardiomyopathy	1	0,1%	0,1%
Hypothyroidism	3	0,1%	0,3%
Chronic myelogenous leukemia	2	0,2%	0,4%
Hepatitis B	8	1,0%	1,4%
DM	89	11,7%	16,0%
GERD	5	0,6%	0,9%
Rheumatoid arthritis	3	0,3%	0,5%
Hepatitis C	5	0,6%	0,9%
Organic personality disorder	2	0,2%	0,4%
Parkinson's disease	2	0,2%	0,4%
Chronic gastritis	25	3,0%	4,5%
Behavioural disorder	1	0,1%	0,1%
Epilepsy	5	0,6%	0,9%
Bronchial asthma	11	1,3%	2,0%
CKD	17	2,0%	3,1%
BPH	9	1,1%	1,6%
NHL	4	0,5%	0,7%
Lung carcinoma	1	0,1%	0,1%
BCL	1	0,1%	0,1%
Pneumonia	1	0,1%	0,1%
Diverticulosis of colon	3	0,3%	0,5%
Pleural effusion	7	0,8%	1,2%
Splenomegaly	1	0,1%	0,1%
Carcinoma of mammary gland	1	0,1%	0,1%
COPD	21	2,5%	3,8%
Osteoporosis	2	0,2%	0,4%
Disc herniation	2	0,2%	0,4%
Vasomotor rhinitis	1	0,1%	0,1%
Gonarthrosis	8	1,0%	1,4%
Gastric carcinoma	1	0,1%	0,1%
Baseda disease	3	0,3%	0,5%
Psoriasis	3	0,3%	0,5%

	Thalassemia minor	1	0,1%	0,1%
	Chronic venous insufficiency	1	0,1%	0,1%
	Postoperative hernia	1	0,1%	0,1%
	Discoordination syndrome	1	0,1%	0,1%
	Hydronephrosis	2	0,2%	0,4%
	Raynaud's syndrome	1	0,1%	0,1%
	HANC	2	0,2%	0,4%
	Idiopathic thrombocytopenic purpura	2	0,2%	0,4%
	Sleep apnoea	1	0,1%	0,1%
	Ao stenosis	2	0,2%	0,4%
	Hernia umbilicalis	3	0,3%	0,5%
	Depressive disorder	5	0,6%	0,9%
	Hiatal hernia	8	1,0 %	1,4 %
	Pancreatic carcinoma	1	0,1%	0,1%
	Carcinoma of rectum	1	0,1%	0,1%
	Bipolar affective disorder	1	0,1%	0,1%
	Autoimmune anemia	1	0,1%	0,1%
	HBSS	10	1,2 %	1,8%
	Paranoid schizophrenia	2	0,2%	0,4%
	Cataracts	1	0,1%	0,1%
	Tuberculosis	1	0,1%	0,1%
	DVT	1	0,1%	1,1%
	Splenic infarction	1	0,1%	0,1%
	Lupus erythematosus	1	0,1%	0,1%
	AA in PM	2	0,2%	0,4%
	Aortic aneurysm	1	0,1%	0,1%
	Chronic bronchitis	1	0,1%	0,1%
	Deafness	1	0,1%	0,1%
	Hashimoto's thyroiditis	2	0,2%	0,4%
	Rheumatoid arthritis	3	0,3%	0,5%
	Alcoholic encephalopathy	1	0,1%	0,1%
	Chronic colitis	1	0,1%	0,1%
	Essential tremor	1	0,1%	0,1%
	Struma	1	0,1%	0,1%
	Leiomyoma uteri	1	0,1%	0,1%
	Nerve root damage	1	0,1%	0,1%
	Chronic respiratory failure	1	0,1%	0,1%
	Conjunctivitis	1	0,1%	0,1%
	Glaucoma	1	0,1%	0,1%

	Prostate carcinoma	1	0,1%	0,1%
	Osteomyelitis	1	0,1%	0,1%
	Chronic cystitis	2	0,2%	0,4%
	Chronic sinusitis	1	0,1%	0,1%
	Ovarian carcinoma	1	0,1%	0,1%
	Secondary hyperparathyroidism	1	0,1%	0,1%
	Pancytopenia	1	0,1%	0,1%
Total		833	100,0%	147,9%

a. Group

Table 21: Incidence of comorbidities

For all 555 patients included in the study, a total of 833 comorbidities were recorded. As the most common concomitant disease, HD was found a total of 273 times or 33.8%. The next most common comorbidities were diabetes mellitus at 89 (11.7%) and IHD at 83 (10%).

Complications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No complications	383	72,0	72,0	72,0
	1	43	6,3	6,3	78,4
	2	41	6,1	6,1	84,5
	3 or more	88	15,5	15,5	100,0
	Total	555	100,0	100,0	

Table 22: patients complication rate

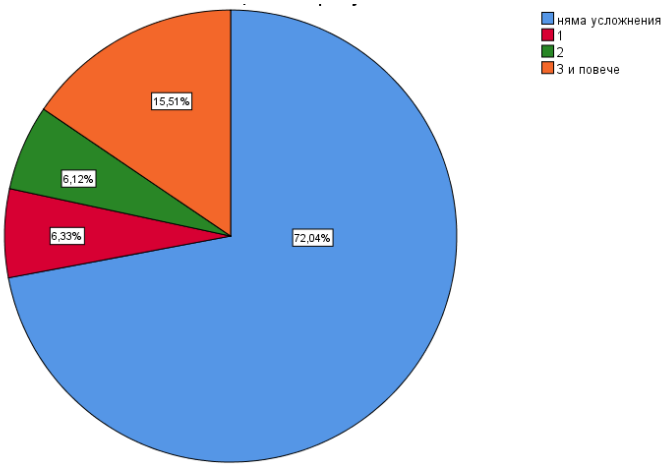


Fig.11: distribution of patients by number of complications

Complication rate

		Responses		Percent of Cases
		N	Percent	
Complications[a]	Dependence on auxiliary mechanisms, hemodynamic instability	96	24,8%	51,1%
	Somnolence	73	18,7%	48,9%
	Acute respiratory failure	49	12,4%	32,1%
	Rhythm disorders	45	11,4%	28,5%
	Septicemia and sepsis	11	2,8%	4,4%
	Stupor	29	7,6%	13,9%
	Hypotension	8	2,0%	1,5%
	Pulmonary thromboembolism	4	1,0%	1,5%
	Multiorgan failure	14	3,6%	5,8%
	DIC syndrome	2	0,5%	1,5%
	Endotoxic shock	3	0,7%	1,8%
	Acute heart failure	6	1,5%	2,2%
	Pneumonia	2	0,5%	2,9%
	Syncope and collapse	1	0,2%	0,7%
	Ventricular perforation	1	0,2%	0,7%
	Suppuratio vulneris	5	1,3 %	2,2%
	Pleural effusion	18	4,6%	5,1%
	Hepatorenal syndrome	1	0,2%	0,7%
	Asystole	1	0,2%	0,7 %

	Strangulation ileus	1	0,2%	0,7 %
	Evisceration	2	0,5%	1,5 %
	Acute nephritis	2	0,5%	1,5 %
	Abd. wall phlegmon	1	0,2%	0,7 %
	Haemorrhagic shock	1	0,2%	0,7 %
	Thrombosis of a.femor.	1	0,2%	0,7 %
	Cerebral edema	1	0,2%	0,7%
	Ischemic stroke	1	0,2%	0,7%
	Toxic shock syndrome	1	0,2%	0,7%
	Abdomeno-bronchial fistula	1	0,2%	0,7%
	Acidosis	1	0,2%	0,7%
	Coma	2	0,5%	1,5%
	Hemoperitoneum	2	0,5%	1,5%
	Posthemorrhagic anemia	2	0,5%	1,5%
	Alkalosis	1	0,2%	0,7%
	Phlebothrombosis	1	0,2%	0,7%
	Insufficiency of duodenum	1	0,2%	0,7%
	AKF	3	0,7%	1,8%
	Consequences of malnutrition	1	0,2%	0,7%
Total		395	100,0%	225,3%

Table 23: complication rate

For all 555 patients included in the study, a total of 395 complications were recorded. The most common complication was found to be other life-threatening conditions/dependence on other auxiliary devices 96 times or 24.8%, followed by somnolence -73 times or 28.7%, as well as ARF - 49 (12.4%) and rhythm disturbances - 45 (11.4%).

Leukocytes on admission

N	Valid	546
	Missing	9
Mean		13,9871
Median		12,3500
Mode		11,40[a]
Std. Deviation		9,14399
Skewness		6,487

Std. Error of Skewness	,111
Kurtosis	78,051
Std. Error of Kurtosis	,222
Minimum	1,68
Maximum	140,40

a. Multiple modes exist. The smallest value is shown

Table 24: Leukocytes on admission

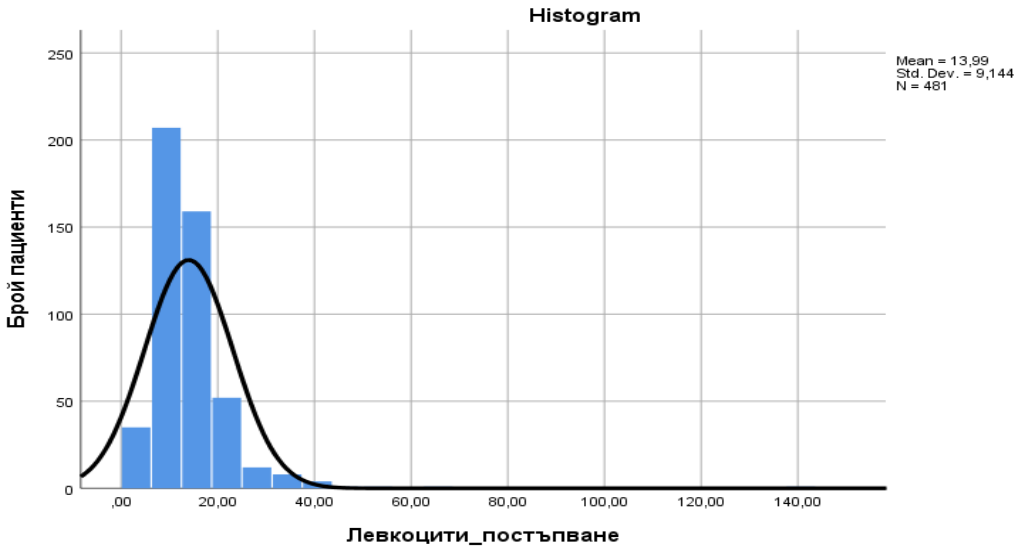


Fig.12: leukocyte values on admission

Leukocytes at discharge

N	Valid	405
	Missing	150
Mean		15,7298
Median		10,8650
Mode		8,19[a]
Std. Deviation		58,51752
Skewness		17,909
Std. Error of Skewness		,132
Kurtosis		326,729
Std. Error of Kurtosis		,264
Minimum		2,10
Maximum		1081,00

a. Multiple modes exist. The smallest value is shown

Table 25: Leukocytes at discharge

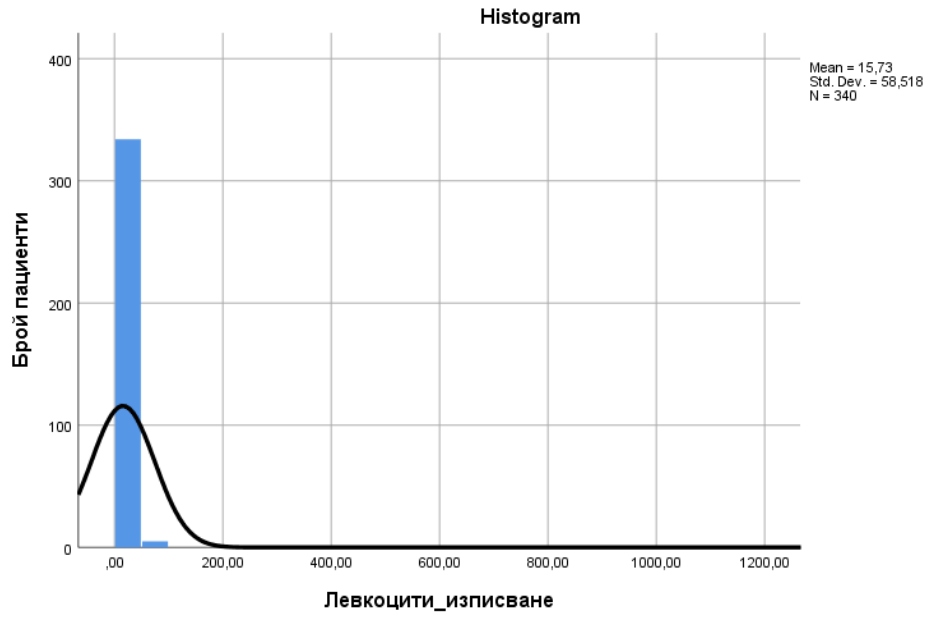


Fig. 13: leukocyte values at discharge

Discussion

Intra-abdominal abscesses continue to present important and serious problems in the practice of clinical surgery. They occur more frequently as complications of trauma, disease and surgery of the digestive tract and less frequently as a result of similar lesions of the female and male genitourinary organs. Their onset may be insidious, their presence obscure, and their diagnosis and localization difficult. These characteristics may in turn create serious problems in the surgical treatment of patients with such abscesses. In addition, their pathophysiological effects may become life-threatening or lead to prolonged periods of morbidity, prolonged hospitalization, and one or several operations. In addition, various imaging and other diagnostic tests, increased nursing and intensive care further increase the cost of this problem to patients, hospitals and society.

In recent years, significant advances have been made in our understanding of the pathogenesis and microbiology of intra-abdominal abscesses. In addition, there have been advances in various aspects of the diagnosis and treatment of these infections. Computed tomography and ultrasonography have simplified the diagnosis of intra-abdominal abscess, and percutaneous drainage of abscesses has become an acceptable alternative to surgery. Patients who would have died from this infection in a previous era now survive thanks to a range of supportive therapies.

Mortality is lower where an experienced team of anesthetists and surgeons and where patients have easy access to treatment in intensive care after surgery performs operations. "The 'surgeon factor', i.e. the decision to surgically manage the acute abdomen, is a critical determinant of outcome. “The 'patient factor' is also important, as most patients are over 65 with comorbidities. Perhaps the variation in surgical outcome can also be partly explained by the demographics and health of the local population. A better understanding of susceptibility to infection (patient factor) would explain why a patient with minimal bacterial contamination at surgery might develop postoperative abscess, whereas another patient with massive fecal contamination after stercoral perforation of the colon may not develop postoperative complications. Intra-abdominal infections are recognized by surgeons as among the most difficult infections to diagnose early and treat effectively. Mortality rates associated with intra-abdominal infection range from an average of 3.5 percent in patients with early infection after penetrating

abdominal trauma to more than 60 percent in patients with well-established intra-abdominal infection combined with subsequent multiorgan failure.

Of utmost importance for the treatment of intra-abdominal abscesses is the understanding of the pattern of their formation in the abdominal cavity. Thus, through treatment, we have tried to influence their rapid eradication and prevent complications. After initial peritoneal contamination, bacteria encounter three forms of host defense: lymphatic clearance, phagocytosis, and sequestration by fibrin. Bacteria are cleared rapidly within minutes via the lymph and are subsequently exposed to systemic protection. This clearance is so efficient that peritonitis or abscess formation will occur only when adjuvant substances such as hemoglobin or necrotic tissue are present. Adjuvants can stimulate bacterial proliferation by providing growth-promoting nutrients such as iron, by mechanically blocking lymphatic pathways, and by disrupting chemotaxis and killing bacteria. During the first 3 hours after bacterial contamination, resident macrophages are the predominant phagocytic cells, and they are also cleared from the lymphatic system. If bacterial proliferation predominates, polymorphonuclear leukocytes subsequently increase.

As widespread peritoneal inflammation develops, fibrin formation traps bacteria, limits their spread, and seals visceral leaks. There is an increase in splanchnic blood flow and capillary permeability, resulting in exudation of between 300 and 500 ml fluid/h, which can lead to hypovolemia and shock. It is unfortunate that these peritoneal defense mechanisms can have adverse effects. Ingestion of organisms into the lymphatic tract can lead to bacteremia, systemic sepsis, and secondary sites of infection. Exudation of fluid into the peritoneal cavity dilutes opsonins, thereby reducing opsonizing activity and phagocytosis. Fibrin deposition traps bacteria, which provides an isolated environment and impairs antimicrobial penetration and phagocytic migration. All of these events help control generalized peritonitis but promote the development of intra-abdominal abscesses.

Source Control

Intra-abdominal infection remains a serious problem worldwide. Hospital mortality associated with intra-abdominal abscesses varies between conditions and diseases, and can be as high as 23%-38%. Severe intra-abdominal infections are the second most common cause of

sepsis in critically ill patients. Achieving rapid and adequate control of the source of infection is a cornerstone in the management of this process.

The term "source control" originated in the environmental literature and referred to efforts to reduce the amount of waste from a particular source. More specifically, it referred to actions that prevented pollution through an effect on its origin. Similarly, source control in the medical context refers to any intervention aimed at the primary origin of an infectious process. This term was first used in medicine in the early twentieth century. Source control is a term that encompasses all physical actions taken in the course of treatment to control the focus of infection and subsequently reduce the favorable conditions that promote the growth of microorganisms, or that maintain the compromised host defenses.

Source control is the general term for all procedures used to control or eliminate the focus of intra-abdominal infection. Marshall describes this process as "drainage of abscesses or infected fluid, removal of necrotic infected tissue, and definitive measures to control the source of ongoing microbial contamination and restore anatomy and normal function."/John E. Mazuski et. Al, 2018/.

Successful management of intra-abdominal infection relies on the use of appropriate operative measures to manage peritonitis. Prospective clinical trials have also taught us the importance of the concept of 'source control'. Source control encompasses all measures that remove the focus of infection, prevent ongoing contamination, and correct anatomic abnormalities to restore normal physiologic function. This typically includes: /Mark A Malangoni et al,2006/

1) drainage of abscesses or infected fluids;
2) decompression of necrotic or infected tissues;
3) definitive measures to control the source of contamination and to restore anatomy and function.

Each individual aspect of this definition is important, but elimination of the source and control of ongoing contamination should receive primary attention as they determine early and long-term treatment success. Restoration of anatomy and full function can be accomplished at a later stage because prolonging surgical intervention may further impair the patient's condition at the first operation, which is often the case for critically ill patients.

Mortality from intraperitoneal infection in the early twentieth century was nearly 90%. At that time, this problem was dealt with primarily nonoperatively until Kishner introduced the basic principles of surgery for intra-abdominal infections into clinical practice:

(1) elimination of septic foci;
(2) removal of necrotic tissue;
(3) drainage of purulent exudate

By the 1930s, mortality had been reduced to 50%. With the introduction of antibiotics, mortality continued to decrease slowly. The use of cephalosporins in the early 1970s was associated with a reduction in mortality to less than 40%. Subsequent advances in the understanding of physiology, monitoring and correction of cardiopulmonary abnormalities, rational use of new drugs, and intensive care unit care helped stabilize mortality to about 30%.

Surgical source control is the most important determinant of survival and should be placed at the top of the therapeutic priority list. There is no controversy regarding standard treatment, which includes source control and intra-abdominal lavage; however, in patients with advanced peritonitis, the source of infection may not be completely eradicated with a single surgical intervention. Thus, controversy arises, especially on issues such as timing and frequency of repeat laparotomies and treatment of the open wound/abdomen. Furthermore, the aggressive approach in these patients causes bowel and abdominal wall edema, which may be associated with increased intra-abdominal pressure exacerbated by premature closure of the abdominal wall. To date, it is clear that the reduction in mortality below 20% has been the result of a better understanding of the role of the source of infection, prevention of intra-abdominal compartment syndrome and improved antibiotics with newer broad-spectrum effects (Table 26). Despite these advances, control of the source of infection remains one of the most fundamental indicators determining patient survival.

Factors influencing mortality /St.Mulier et al, 2003/		
	Смъртност	
	–	+
Source control	100 %	23,9%
Cleansing the abdomen	100 %	17,3%
Hypotension	18,3%	64 %
Dyspnea	20,6%	53,6 %
Corticosteroid use	36,4%	5,3 %

Table 26: Factors influencing mortality

In the context of intra-abdominal infections, eradication of the source is often identified as a purely mechanical control of leakage of contents from the gastrointestinal tract. Surgeons often argue that source control is part of the surgical intervention, but rather the opposite is true: surgical intervention is part of the source control approach in a patient with intra-abdominal infection.

The goal of surgical treatment is to eradicate the source of infection - to remove the cause of the contamination. In the surgical approach, it is necessary to ensure adequate and complete examination of the abdominal cavity - thorough haemostasis and thorough examination are paramount. The other major goal in surgical management is to reduce the amount of bacterial load to prevent sepsis and recurrent re-accumulation of purulent material.

The decision to repeat laparotomy is made at the time of the initial operation. The patient may undergo repeat laparotomy every 48 hours until the septic focus is completely controlled, i.e. the source of infection completely eradicated.

Failure to obtain adequate source control during operation is due to:

- Inadequate or poor drainage
- Diffuse fecal peritonitis
- Hemodynamic instability
- Insufficiency of the anastomosis
- Intra-abdominal hypertension

Prompt identification and eradication of the source of infection is vital because delay leads to loss of physiological reserve, which together with comorbid systemic disease, particularly in the elderly, results in significantly worse outcomes. The pathophysiology of generalized peritonitis involves complex processes in each organ system, which deplete physiologic reserves and these inhibit the ability to localize, combat, and eradicate infection.

Source Control Principles

Principle 1 - Drainage

Drainage is the evacuation of the contents of an abscess or abdominal fluid collection. The effectiveness of the drainage used is very important: It must be adequately sized to allow complete evacuation of the exudate. If this is not fully accomplished, source control will fail. Drainage can be performed surgically or percutaneously, under ultrasound or CT scan control. The latter are preferred in situations where adequate drainage is possible and no anatomic structures are removed or restored. Especially in critically ill patients in whom surgical intervention may be difficult, this approach may be a valuable alternative and postpone definitive action until a later stage. Surgical drainage is indicated when percutaneous drainage cannot be performed or is not sufficient to control the source, (e.g. multiple abscesses).

Principle 2 – debridement

Debridement is the removal of necrotic tissue and foreign bodies from the patient. This can only be achieved surgically. The extent to which this should be done remains a controversial topic and strongly depends on the underlying condition. A minimalist approach consisting of removal of dead tissue and pus, or an aggressive approach with a large volume peritoneal lavage and meticulous removal of all fibrin adherent to the bowel or abdominal wall. The latter carries a higher risk for iatrogenic bowel injury and is also associated with a higher rate of postoperative abscesses. The anatomical relationships of the necrosis also play an important role. In the case of necrotization in pancreatitis, complete removal of all necrotic tissue may result in injury to organs or blood vessels.

Principle 3 - restoration of anatomy and function

Restoration of anatomy and function is the final step in the treatment of surgical infections. In most patients it can be done with the first operation, but in some patients it should be delayed until the patient's condition permits. Judgment is individual, but it is generally recommended not to prolong surgical intervention unnecessarily in patients who are in shock or have severe organ dysfunction.

Source control time

The best possible source control solution is complete control of the source of infection with the least delay. However, the evidence regarding the optimal time to perform the procedures remains weak, probably because of ethical constraints on clinical trials. Joint guidance issued by the Department of Health and the Royal College of Surgeons of England states that source control interventions should be performed as soon as possible, targeting a delay no longer than 7-22 h from diagnosis, without systemic inflammation. In severe intra-abdominal infection intervention should be carried out immediately. According to guidelines issued by the Surgical Infection Society (SIS), source control should be conducted within 24 h of diagnosis.

Adequacy of controls

Source control failure is a controversial topic in the multidisciplinary management of peritonitis that does not include clear definitions of diagnosis, surveillance index, or interventions. Various studies have recommended the use of biomarkers of systemic inflammation or organ system dysfunction to recognize patients with likely source control failure. But very often inflammatory markers such as C-reactive protein, leukocyte count and procalcitonin seem to be unpredictable in quite a few cases. Another indicator is the persistence of organ failure after the initial intervention, which correlates strongly with the ultimate failure of source control.

Antimicrobial therapy is also constantly evolving. But the appropriate duration of antimicrobial therapy after adequate source control remains unclear. Patients may be treated with antibiotics until resolution of fever and leukocytosis, resulting in therapy of 7 - 14 days. New

studies suggest that with adequate source control, a fixed duration of 4 days of antibiotic treatment is sufficient. It has been confirmed that the beneficial effects of systemic antimicrobial therapy are limited primarily in the first few days after surgical intervention. Shorter duration of antibiotic exposure may reduce the risk of bacterial resistance to antibiotics, which is particularly important in this era of spreading antimicrobial resistance.

Source control procedures

Operative intervention remains the most appropriate therapeutic strategy to control intra-abdominal infection. Source control can be achieved by operative intervention (laparotomy or laparoscopy) or nonoperatively (percutaneous drainage). Surgical source control includes resection or suture of an altered 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 bowel exteriorization. Rarely, in rigorously selected patients, an effect can be achieved without definitive source control if the patient responds satisfactorily to antimicrobial therapy.

Microbiological causative agents

The normal flora of the stomach, duodenum, and proximal small intestine is sparse, including small numbers of viridans streptococci, microaerophilic streptococci, Candida species, Lactobacillus species, Bacteroides species, and Fusobacterium species. Organisms of the Bacteroidesfragttis group are rare. The flora of the distal small intestine is composed of a progressively increasing number of Enterobacteriaceae, Enterococcus species and anaerobic organisms, which include the B group. fragilis. The large intestine has a rich flora with up to 1012 fecal organisms (anaerobes outnumber aerobes). The predominant anaerobic organisms are B. fragilis, Eubacterium species and Bifidobacteriuni species. The predominant facultative flora includes Enterobacteriaceae such as Escherichia coli, Klebsiella species, Proteus species, etc.

Anaerobic bacteria are 1000 times more prevalent than aerobes. With the exception of Bacteroides spp. most of the remaining anaerobic bacteria are the main barrier against colonization and infection by other pathogens.

A patient's medical history can also affect normal flora. In particular, hospitalized patients may be colonized by altered flora, including multidrug-resistant, nosocomial pathogens or Candida spp.

These infections usually occur after disruption of gastrointestinal continuity - from trauma, illness or surgery. Leakage of endogenous microflora into adjacent tissues appears to overwhelm host defense mechanisms, resulting in clinical infection. Although the gastrointestinal microflora is similar in different individuals, there may be significant differences between the causative microorganisms, as intra-abdominal infection may be either hospital-acquired or community-acquired

Available culture results and susceptibility reports depend mainly on clinical presentation and also on whether the intra-abdominal infection occurred in the community or within the hospital setting.

The number and diversity of microorganisms progressively increases from the upper to the lower part of the gastrointestinal tract. The stomach and proximal small intestine support a lower amount of bacterial flora, including aerobes and anaerobes (less than 104 counts/ml). Acidity and motility seem to be the main factors inhibiting bacterial growth in the stomach. Stomach and duodenal diseases can compromise these factors. Thus, in cases of duodenal perforation or gastric ulcers, as well as carcinomas, the number of organisms in the stomach microflora usually increases. When present, the gastric microflora is composed primarily of oral anaerobes and aerobic coliforms.

Between the upper and lower gastrointestinal tract, there is a transition in the number of aerobic and anaerobic microorganisms (104 - 108 counts/ml). The highest concentrations of microorganisms are localized in the colon, where up to 1011 anaerobes per gram of feces or milliliter of intestinal aspirate can be identified (Fig. 14). Parenchymal intra-abdominal organs, including the liver and spleen, rarely contain significant endogenous microflora, a factor that is undoubtedly responsible for the low incidence of infections of these organs. This geographic location of microorganisms within the gastrointestinal tract partly explains the differences in septic complications associated with upper and lower bowel injuries. Abscesses following leakage from the upper bowel are generally less severe and associated with less morbidity and mortality than those following colonic injuries.

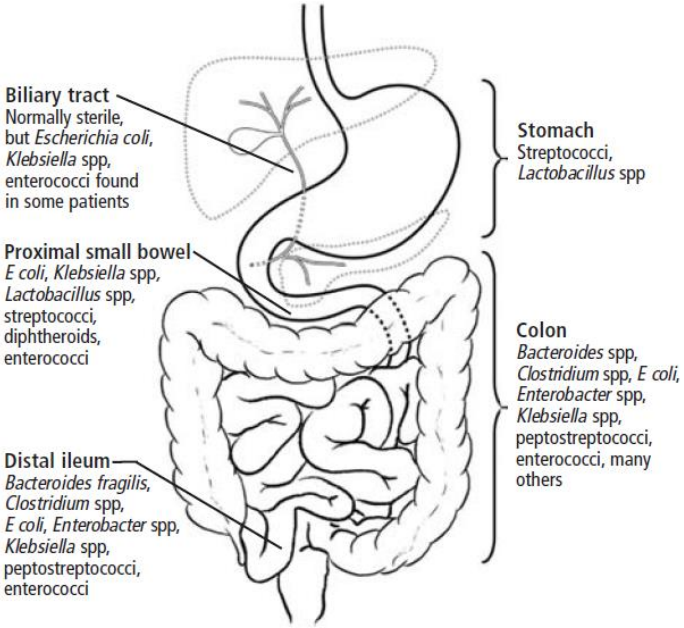


Fig. 14: Microflora of the gastrointestinal tract

One or more anaerobic species were isolated from 65 to 94 percent of patients. The aerobes typically isolated in all studies included Escherichia coli and Klebsiella, Streptococcus, Proteus, and Enterobacter species. The most commonly isolated anaerobes were Bacteroides, Peptostreptococcus and Clostridium species. Bacteroides fragilis was the most commonly isolated anaerobe. B. fragilis and other Bacteroides species accounted for 30 to 60 percent of all anaerobic isolates in these studies. In most studies, less than 15 percent of cases of intra-abdominal sepsis were due to anaerobes alone, while about 10 percent were due to aerobes alone. Both aerobes and anaerobes are involved in more than 75 percent of cases of intra-abdominal infections.

In our own series of patients, 41 different types of microbiological agents were recorded, and in 189 cases, sterile cultures were isolated (34, 05%). The most commonly isolated causative organisms were E. coli - 123 cases (22.2%), Klebsiella pneumoniae - 45 cases (8.1%), Enterococcus faecalis - 29 cases (5.22%) Enterobacter cloacae - 28 cases (5.04%), Pseudomonas aeruginosa - 27 cases (4.86%). It is noteworthy the predominance of Gram-negative microorganisms, and of the most common causative agents in the own series only Enterococcus faecalis was Gram-positive.

The prevalence of infection in the peritoneal cavity depends on five factors: the location and size of the primary leak; the nature of the underlying injury or disease; the presence of adhesions from previous operations; the duration of the current disease; and the effectiveness of the patient's defense mechanisms. Using logistic-regression analysis, the risk of infection was greater with advancing age, injury to the left colon necessitating colostomy, greater requirements for blood or blood products during surgery, and increasing numbers of organs injured.

Diagnostic imaging

Intra-abdominal and retroperitoneal abscesses pose difficult diagnostic challenges. Definitive diagnosis often requires specialized radiologic procedures in addition to clinical findings that may be nonspecific. CT and US provide targeted, objective information to expedite diagnosis and determine treatment plans.

Ultrasound showed a mean sensitivity and specificity of 91.5% and 93%, respectively. The location of the abscess also influenced the diagnostic accuracy of USV. Although USV is a highly sensitive test for detecting superficial abscesses, its sensitivity for detecting deep pelvic or retroperitoneal abscesses is significantly lower than that for CT and MRI.

The US showed a mean sensitivity and specificity of 91.5% and 93%, respectively. The location of the abscess also influenced the diagnostic accuracy of USG. Although US is a highly sensitive test for detecting superficial abscesses, its sensitivity for detecting deep pelvic or retroperitoneal abscesses is significantly lower than that for CT and MRI.

Imaging systems can be helpful in establishing the correct diagnosis. However, each imaging system has limitations that can lead to false positive and/or false negative results. In patients with intra-abdominal abscess, such inaccuracies can lead to serious consequences - uncontrolled sepsis with associated high mortality (false negatives) or unnecessary surgery (false positives) in critically ill patients. Therefore, it is important to choose an imaging method that can identify and localize an abscess effectively while excluding the possibility that other lesions or collections are present.

For our own patients, all possible imaging modalities were available, which facilitated the most rapid and adequate diagnosis and measures to eradicate the pathological process.

Ultrasound

Ultrasound is a sensitive and useful tool for the diagnosis of intra-abdominal abscesses. Ultrasound examination is non-invasive and does not require exposure of patients to ionizing radiation. In addition, greater cost-effectiveness compared with other methods of diagnosis should be reported.

As ultrasound is portable, it can be carried in seriously ill patients who are not easily transported. However, because ultrasound is not fully automated, its accuracy depends on the user. It is less accurate than computed tomography (CT), less able to detect small abscesses, and may miss an infected focus in the retroperitoneum. The usefulness of ultrasonography may be adversely affected by the size of the patient or the presence of surgical wounds, dressings, drains, and stomas that may interfere with imaging of all areas of the abdomen and pelvis. Large amounts of intestinal gas (e.g., ileus) may obscure underlying structures.

Ultrasound was the most frequently applied imaging modality in the patient series itself, being applied in 460 patients (82.9%). Ultrasound due to its many advantages, ease of application and safety is the main imaging tool for the diagnosis of intra-abdominal abscess, guiding the diagnostic process in this direction, and permanently resolving the problem by drainage.

Computed tomography

Although ultrasound is extremely useful, we have mainly relied on computed tomography, which provides high anatomical resolution and has greater specificity than ultrasound. Compared with ultrasound, CT allows better visualization of structures and their relationships. CT allows visualization of structures and intraluminal fluid collections that may not be visualized with other visualization techniques.

Contrast administration helps differentiate between intestinal looping and formed fluid collections, but its application may be limited by clinical factors (e.g., allergy or renal failure for intravenous contrast, ileus for oral contrast). Despite the presence of necrosis, loculated fluid, and extraluminal gas suggestive of infection, CT sometimes cannot distinguish between sterile and infected fluids. CT is the imaging modality along with US used in majority of patients hospitalized in the clinic with intra-abdominal abscesses. We have applied CT in 337 patients (60.7%) - also for diagnosis in addition to problem resolution by drainage under CT control.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) has several limited advantages over CT in patients with intra-abdominal infection. MRI can better delineate the extent of the abscess and the presence of a capsule. In addition, MRI is a valuable alternative to CT, especially in patients at higher risk of radiation exposure.

Compared with other imaging techniques, MRI also demonstrates more clearly the interaction of the abscess with adjacent structures, especially muscle and large blood vessels. However, image quality is susceptible to motion artifact, which cannot be avoided when imaging the abdomen with MRI. Furthermore, the main disadvantage is the long duration of the study, which leads to a serious difficulty in performing it in hemodynamically unstable patients or those in severe condition and in need of oxygen ventilation. We have applied MRI in a limited number of patients, and MRI cholangiopancreatography has mostly been used to search for hepatobiliary system abscesses, determine their localization, size and relationships with other abdominal organs. Less frequently, we used MRI for abscesses located in the pelvis minora. MRI was applied in 20 patients (3.6%) in our own series.

Treatment

In 1926, the approach to surgical treatment of intra-abdominal infection was defined by Kirschner as "Elimination of the source of infection, removal of the exudate, treatment of the abdominal cavity with disinfectant and drainage of the exudate". Today, elimination or control of the source of peritoneal contamination, removal of purulent material, and drainage are still the cornerstones of operative treatment. Parenteral administration of antibiotics and hemodynamic and respiratory support complete the treatment of intra-abdominal sepsis. In recent decades, this combined surgical and medical approach has resulted in complete recovery in most patients with intra-abdominal infection. However, it may fail in patients with severe intra-abdominal infection, for example in colonic perforation or insuffiency of intestinal anastomoses and in immunosuppressed patients.

Specific topics that are frequently addressed in the current literature include the following:

Minimally invasive intervention

- Diagnostic laparoscopy for intra-abdominal infection
- Laparoscopic treatment of intra-abdominal infection
- Percutaneous drainage of a collection of infected fluid
- Challenging "old" surgical principles
- Approach after initial surgery
- Elective relaparotomy or if necessary
- Continuous peritoneal lavage
- Abdominal closure
- Temporary abdominal closure techniques
- Abdominal compartment syndrome
- Permanent abdominal closure techniques

One of the main questions that arises in the treatment of intra-abdominal abscesses is whether open or laparoscopic surgery should be applied in this type of pathology. Does laparoscopy have an impact towards intra-abdominal infection and are all its advantages really real in the healing process and therefore economic indicators ?

Influence of laparoscopy on intra-abdominal infection

Laparoscopic procedures are widely accepted by the medical community as the primary means of diagnosing and treating intra-abdominal abscesses. The laparoscopic approach is an extremely useful technique, especially for the diagnosis of uncertain cases. Depending on the anatomic source of infection and the experience of the treating surgeon, laparoscopy may be recommended for the treatment of many intra-abdominal abscesses.

Laparoscopic treatment of conditions complicated by intra-abdominal infection is generally recommended because of its advantages of less operative trauma, less pain, fewer wound infections, a more cosmetically acceptable outcome, shorter hospital stay, and faster recovery than with open treatment.

Surgery induces changes in the local and systemic immune response. These changes appear to be associated with an increase in postoperative morbidity. Minimally invasive techniques are thought to improve preservation of immune function compared with open surgery

and may therefore be beneficial to patient recovery. As laparoscopic techniques are increasingly used in abdominal surgery, more research is focusing on the immunologic implications of these techniques. However, the changes that occur in response to trauma are not yet fully understood.

Reduction of trauma with minimally invasive techniques appears to be associated with improved preservation of immune function. All trauma, whether controlled or accidental, causes an acute phase response, which is an acute metabolic and inflammatory response that prevents further tissue damage and activates repair mechanisms. Surgery, a form of controlled trauma, induces this acute stress response. The extent and duration of the acute phase response is proportional to the severity of the trauma. Although the acute phase response is a normal response to trauma, an extensive response, or reaction to a noninflammatory site, can be harmful. Therefore, reducing this response is thought to be beneficial to the patient's recovery. Surgery is also associated with transient suppression of cellular immune function. Improved preservation of cell-mediated immunity is associated with lower rates of infectious complications, local recurrence, and distant tumor metastasis. Therefore, maintaining a sufficient immune response may be of particular interest to patients who are being surgically treated for malignancies.

The many advantages of laparoscopic surgery include a lower incidence of postoperative infections, as evidenced by a lower inflammatory response, which is associated with a better preserved immune response to infection. However, different aspects of laparoscopic surgery can affect the intraperitoneal environment and, in the event of infection, should be assessed in two different situations: during clean and potentially contaminated surgery or in the presence of established infection. The most important differential factors of laparoscopic surgery are the pneumoperitoneum and the use of CO2.

The pneumoperitoneum exerts a direct dual effect on the peritoneal defense system. The first is the mechanical stretching of the peritoneal mucosa. The second is the result of the type of gas used during surgery. The mechanism that facilitates the spread of bacteria is not yet well understood. It is likely that increased intra-abdominal pressure causes an increased pressure gradient as well as physical stretching of the diaphragm, both of which favor the passage of bacteria. Pneumoperitoneum also causes morphological changes in the peritoneal microstructure: loss of contact and fissures between mesothelial cells, and infiltration of macrophages between them.

It has been shown that smoke produced by electrocauterization is able to spread viable cells and viruses, furthermore CO2 affects intracellular conditions, creating an acidic

environment and thus impairing macrophage cell physiology /West et al, Wunsch et al/ . Also of note is the relatively longer duration of laparoscopic interventions compared to open interventions, which is also a factor influencing the spread of intra-abdominal infection. We believe that it is the surgeon who should evaluate the potential advantages of the minimally invasive approach, both in terms of its technical complexity so that patients can benefit from all possible advantages, and also in terms of the complications that may arise as a result of dissipation of the septic medium.

Because changes are proportional to the extent of injury, the physiologic response to minimally invasive surgery may intuitively be different from that of traditional open surgery. The protein response of the acute phase appears to be one example. The cytokines interleukin-1 (IL-1), tumor necrosis factor (TNF), and interleukin-6 (IL-6) are known to be major mediators of the acute phase response. Interleukin-6 primarily regulates the hepatic component of the acute phase response, leading to the production of acute phase proteins. Acute phase protein generation is a well-known response to tissue injury. C-reactive protein is a key marker of acute phase protein that has a consistent response and provides a reliable screening test in general for acute phase reagents. C-reactive protein rises approximately 4 to 12 hours after surgery and peaks at 24 to 72 hours. Subsequently, C-reactive proteins remain elevated for approximately 2 weeks.

C-reactive protein has been found to be lower in laparoscopic procedures compared to more traditional laparotomy. C-reactive protein remained significantly elevated at 24 and 48 hours in patients undergoing open cholecystectomy compared with those undergoing laparoscopic procedure. Changes in C-reactive protein were also associated with elevated erythrocyte sedimentation rate and complement C-3 levels at both the 24th and 48th hour after open cholecystectomy, but not after laparoscopic cholecystectomy. The degree of change in C-reactive protein was noted to be increased 20-fold after open cholecystectomy, but only a 5-fold increase after laparoscopic cholecystectomy. In summary, the acute phase response as measured by C-reactive protein was significantly less after cholecystectomy performed laparoscopically.

Ostrophage response after laparoscopic surgery has been investigated in several clinical trials measuring IL-6 levels after laparoscopic cholecystectomy. It has been noted that interleukin-6 levels are reduced in patients undergoing laparoscopic procedures compared to traditional laparotomy. In addition, a linear correlation between peak IL-6 and C-reactive protein concentrations was reported. However, other studies have shown opposite findings: no relative correlation was found between plasma IL-6 and C-reactive protein concentrations. McMahontet

al. showed no significant difference between the laparoscopic cholecystectomy and mini-laparotomy cholecystectomy groups. This study found that IL-6 levels in both the laparoscopic and mini-cholecystectomy groups were similar to historical reports of standard cholecystectomy levels.

In summary, although there are several studies that have examined IL-6 in laparoscopic surgery, no consensus has been reached regarding its metabolic or immunologic role. The IL-6 response may not accurately reflect the acute phase response, as is the C-reactive protein.

Laparoscopic surgery can reduce cellular immunosuppression caused by the stress of surgery. A number of studies have assessed this in terms of total leukocyte counts, specific leukocyte populations and leukocyte subpopulations. Some have demonstrated a significant increase in total peripheral leukocytes in open but not laparoscopic cholecystectomy patients.

Pneumoperitoneum is usually required in laparoscopic surgery and never in open laparotomy. The question naturally arises whether carbon dioxide pneumoperitoneum affects the systemic metabolic and immune response to laparoscopic surgery. There are recently published new studies showing that it can. West examined cytokine production in peritoneal macrophages incubated in carbon dioxide. Macrophage TNF and IL-1 responses to bacterial endotoxin were lower for macrophages incubated in carbon dioxide than in air or helium.

A proposed mechanism for this difference is that carbon dioxide affects the intracellular environment by creating a more acidic environment. Macrophage function is known to be impaired by a drop in extracellular pH. West speculates that impairment in cytokine production in peritoneal macrophages may contribute to the apparent lack of a systemic inflammatory response during laparoscopic surgery, rather than the physiological stress of the surgery itself. This provides a potential molecular mechanism to explain the immunosuppression of peritoneal macrophages.

Significant reversible inhibition of TNF and IL-1 has been demonstrated in macrophages incubated in carbon dioxide but not with helium or air. Inhibition of IL-1 occurred within 15 minutes of exposure to carbon dioxide. IL-1 and RNA production similarly declines during this time. This difference in IL-1 production is rapidly abolished after incubation in a controlled atmosphere. Conversely, TNF and macrophage levels exposed to carbon dioxide are inhibited only after longer incubation. Inhibition of TNF continues after removal of carbon dioxide for 30 to 60 minutes after incubation in a controlled atmosphere. These experiments indicate that the

effects on IL-1 and TNF in peritoneal macrophages exposed to carbon dioxide may occur through distinct and independent cellular mechanisms.

Macrophage release from peritoneal tissue of superoxide and tumor necrosis factor after laparotomy and air laparoscopy was significantly increased compared with the control procedure and carbon dioxide laparoscopy. However, in these studies, peritoneal macrophage phagocytosis was significantly reduced with air laparoscopy and laparotomy compared with carbon dioxide insufflation. Furthermore, a decrease in CD11 expression and an increase in bacterial translocation were found in both laparotomy and air laparoscopy groups. Pneumoperitoneum with carbon dioxide, through unclear mechanisms, appears to attenuate the immune response of peritoneal macrophages. Without doubt, the clinical efficacy of laparoscopic surgery has been established. It is becoming apparent that systemic immune and metabolic responses to surgical interventions in general may not apply to laparoscopic surgery.

Laparoscopic surgery has a lower rate of surgical site infections compared to open surgery. Differential factors that may alter bacterial biology and explain this finding to some extent include CO2 atmosphere, less desiccation of intra-abdominal structures, less temperature changes, and better preserved peritoneal and systemic immune response. Previous data have shown that the immune response and acute phase response are better preserved after laparoscopy.

It has been shown that there is better preservation of phagocytic activity and better antigen presentation by macrophages after laparoscopic surgery than after open surgery. When peritonitis develops, the deficiency of phagocytic activity facilitates bacterial proliferation. The delayed increase in IL-6 can be understood as a biphasic phenomenon. Contamination in association with more severe injury (e.g. laparotomy) is not followed by an appropriate local macrophagic response. This reduced immune response associated with local tissue injury facilitates bacterial proliferation and peritonitis, which is followed by massive release of inflammatory mediators. Another possible explanation is that local macrophage activity is impaired and thus unable to control peritoneal infection, and bacterial proliferation induces massive cytokine release.

In our own series of patients, the laparoscopic approach was applied in all patients in whom it was judged to be the most appropriate and quickest to resolve the problem with the least subsequent complications and the fastest recovery. Laparoscopic approach was applied in 19 patients (3.42%).

The relatively low percentage is due to the fact that unfortunately in this type of pathology, there was often involvement of adjacent organs and structures, severe patient condition requiring the shortest duration of surgical intervention, the presence of previous surgical interventions and adhesions making adequate laparoscopic view difficult, and not infrequently the financial inability of patients to pay for one-time consumables not covered by health insurance.

However, we believe that laparoscopic surgery provides tremendous benefits to patients, including faster recovery, shorter hospital stays, and rapid return to normal activities. In addition, laparoscopic procedures provide better cosmesis, greater patient satisfaction and lead to greater demand for new procedures.

Percutaneous drainage

Percutaneous drainage has become the treatment of choice for intra-abdominal abscesses. Occasionally, drainage of a percutaneous abscess may be an adjunctive procedure to surgical intervention, for example, in peridiverticular abscess or periappendicular abscess. Small simple abscesses can be cured completely by percutaneous drainage; more complex abscesses (septated, large in size) have a cure rate between 30% and 80%. In many intra-abdominal abscesses, lack of adequate access for needle insertion and drain placement are obstacles to successful percutaneous drainage of infected collections of intra-abdominal fluid.

Since the first studies in the 1980s, percutaneous drainage has become a serious option for the treatment of intra-abdominal abscesses. In the literature, reported success rates for percutaneous drainage range from 30% to 80%. The choice between surgical and interventional radiological drainage is widely debated in the literature.

In our own series of patients, percutaneous drainage under US or CT control was performed in 58 patients (10.5%), as an intervention for definitive cure or to stabilize the patient for a subsequent surgical procedure.

Challenging "old" surgical principles

Intra-abdominal infection caused by bowel perforation is usually managed by resection of the perforated viscus followed by either primary anastomosis or proximal enterostomy. For pathology localized to the small bowel, most surgeons adopt primary anastomosis. In contrast, a

proximal colostomy with distal closure is usually performed after resection of a perforated colon, for example due to a diverticular abscess (Hartmann's procedure). The perceived superiority of the Hartmann procedure is somewhat surprising given its high rate of postoperative complications, including rectal malleolar dehiscence, the marked morbidity and mortality associated with second-stage bowel reconstruction, and the 25% rate of patients who remain permanently with an anus preter. To avoid most of these complications, the single-stage procedure (primary resection and anastomosis) has been the method of choice preferred over the past decade. Resection and primary anastomosis is the ideal approach for patients with complicated diverticular disease, as the provoking problem is solved in one operation and patients do not have to live with a (temporary) colostomy, but we have used this method in small abscesses without diffuse peritonitis and without the presence of multiple comorbidities. The reasons that surgeons are reluctant to perform the one-stage procedure are the risk of anastomosis insufficiency in the infected area and the associated high mortality. Recent studies have challenged the notion of greater anastomosis leakage and higher mortality rates by addressing common risk factors for anastomosis healing such as hemodynamic instability, malnutrition, and comorbidities.

Common factors that influence surgeons' decision whether to perform a single-stage procedure include duration of symptoms, age, circulatory stability, general condition, nutritional status, and use of immunosuppressive medications. Three systematic factors were found to predict mortality: persistent postoperative sepsis, preoperative hypotension, and long duration of symptoms. Advanced age, presence of comorbid illness, and preoperative shock were significant adverse prognostic factors for death in hospitalized patients with intra-abdominal abscesses.

It can be concluded that primary resection and anastomosis are safe in terms of anastomotic insufficiency and mortality in patients with localized abscess and local peritonitis only. We do not recommend primary anastomosis in generalized purulent or fecal peritonitis, especially when the patient is in poor clinical condition, but such can be performed in the setting of intra-abdominal abscess except in the setting of a long-persistent problem or additional aggravating factors. We believe that the appropriate treatment also depends much on general factors (age, duration of symptoms, cardiovascular and respiratory status) than on local factors (degree of intra-abdominal infection, fecal load).

Relaparotomy

The traditional approach to abdominal re-exploration after surgery for residual or recurrent intra-abdominal infection is elective re-laparotomy.

Reexamination of the abdominal cavity is: (a) planned at the time of the initial operation, regardless of the patient's immediate postoperative course, performed from the 24th to 48th hour, (b) designed to remove residual infectious material such as pus, necrosis, and fibrin, (c) designed to prevent fluid collections, and (d) designed for early detection and prediction of intra-abdominal problems including ischemia, bleeding, and anastomotic insufficiency.

Of the variables flagged, we consider the diffuse extent of abdominal contamination, the localization of the infectious focus (mostly lower gastrointestinal tract), the tendency for inflammatory marker values to increase after laparotomy, and the inability to assess the viability of affected tissues and organs during the initial operation to be particularly important.

Obviously, elective relaparotomy is mandatory when the source of infection is not controlled at the first laparotomy. However, failure to control the source of infection is rare and occurs only in patients in whom the assessment of the vitality of the affected organ is difficult or progression of the pathological process is expected despite the curative measures taken. There is no doubt that the concept of elective relaparotomy in terms of reducing residual infection-promoting factors such as necrosis and fibrin and early detection of complications is sound. This approach is a good method to eradicate residual intra-abdominal infection and adequately treat early intra-abdominal complications. However, criticisms have focused on the lack of evidence that elective relaparotomy reduces mortality and leads to additional complications related to reoperation and anaesthesia. Relaparotomy, in addition to being planned, may be based on clinical deterioration or lack of improvement closely monitored by clinical parameters, quantification of changes in organ function using validated assessment systems, timely computed tomography with contrast, and evidence of changes in tissue vitality.

Rates of mortality from elective salvage laparotomy ranged from 21% to 38%, compared with 13% to 42% for elective salvage laparotomy. Other studies have found lower mortality rates for elective salvage laparotomy (29-31%) compared with salvage laparotomy as needed (73-89%). Some studies have shown that a planned strategy increases the risk of multiple organ failure because it amplifies the systemic inflammatory response through multiple surgical lavages, leading to increased mortality, morbidity, ICU stays, and hospital stays.

In the clinic, we have used the elective re-laparotomy approach in patients in whom we judged that adequate assessment of the viability of the affected organs was not possible, the presence of multiple abscesses requiring re-sanitization of the abdominal cavity, or in order to perform resection with primary anastomosis in the setting of absent infection in the abdominal cavity.

16 patients (2.88%) underwent relaparotomies, in 12 cases it was elective at the 24th - 48th hour, and in the remaining 4, due to complications following the initial surgical intervention.

Severe intra-abdominal bleeding, fistula formation, incisional hernia, and exacerbation of local and systemic inflammation generated by cytokines were complications associated with repeated entry into the abdominal cavity. We would not recommend performing more than two or three elective relaparotomies in the first week after the initial operation. In most patients, control of the source of infection is achieved relatively quickly, necrosis is removed, pus is evacuated, and the initial bacterial load is dramatically reduced. Resolution of the inflammatory process takes longer, which can lead to the collection of ascites, which can often be assumed to be infected. We do not consider this to be an indication for continuing elective relaparotomies. In some patients, superimposed infections - a condition described by the term "tertiary peritonitis" - may occur, which may be very difficult or never cured and even aggravated by repeated surgical interventions.

Postoperative lavage

We do not consider this concept necessary in patients with intra-abdominal abscesses except in cases with pancreatic abscesses. The idea of placing drains in "strategic" positions to lavage the entire abdomen, to evacuate and wash away necrotic and inflammatory material to avoid re-laparotomy, is often ineffective and has not been applied in our own patients except for the above source. The disadvantage of this concept is the rapid obstruction of drains, leading to localization of residual infection and re-formation of abscesses. Only in the treatment of localized infection, such as infected pancreatic necrosis, has continuous postoperative lavage proven to be a valuable adjunct to debridement of pancreatic necrosis.

Abdominal compartment syndrome

It is important to emphasize tension-free closure to avoid "abdominal compartment syndrome," which is the main indication for laparostomy after surgery for peritonitis. However, it is doubtful whether temporary closure without approaching the fascial edges is necessary and useful in most patients. The physiologic benefits of "decompressive" laparostomy for significant intra-abdominal hypertension causing abdominal compartment syndrome are well established only in patients with trauma and undergoing vascular surgery, in whom relief of elevated intra-abdominal pressure improves ventilation, splanchnic circulation, cardiac output, and renal function in these patients. In patients with intra-abdominal abscesses and peritonitis, the benefit of abdominal decompression has not been proven and therefore we have not applied "decompressive" laparostomy for the treatment of our own patients.

Abdominal wall reconstruction

Considering the immense stress of the diagnosis, multiple surgeries, and long ICU stays, doctors and patients are very reluctant to repair an early abdominal wall defect resulting in laparostomy or temporary closure. Definitive treatment is often delayed until recovery is advanced or not at all. The result is a patient with large granulating defects, secreting wounds, ultimately large ventral hernias with physical and cosmetic complaints. The magnitude of this late postoperative morbidity is probably much higher than usually expected. Patients who have complaints due to an abdominal wall defect, such as chronic back pain, inability to move normally from bed to standing position, and inability to perform sports, are embarrassed to undergo abdominal wall reconstruction, remembering their previous long hospital stay.

The type of abdominal wall reconstruction depends on many factors, including retained skin, subcutaneous tissue, muscle and fascia, and bowel percentage, present "outside" the abdominal cavity, preservation of the omentum, and comorbidities, particularly respiratory dysfunction.

When dealing with huge defects composed of both fascia and skin, for example after necrotizing fasciitis, prosthetic closure material should be used. From a theoretical point of view, those meshes should be used which have good attachment to the fascia, prevent ingrowth of internal organs and are least susceptible to infection. However, the optimal mesh has not yet been

developed for this purpose. When faced with these huge defects, polypropylene mesh should only be used if it can be covered with full thickness skin and subcutaneous tissue.

Based on the results of elective laparotomy and temporary and definitive closure of the abdomen, we recommend that (a) the period of elective laparotomy should not exceed 7 days, (b) fascia should preferably be closed in a primary fashion, and (c) if "abdominal compartment syndrome" occurs, temporary closure followed by delayed primary closure as early as possible using component separation techniques is recommended.

Antibiotic treatment

There is little or no evidence that antibiotic therapy has reduced the overall incidence of intra-abdominal abscesses, but increasing evidence suggests that it may be used more effectively than it is administered.

Antimicrobial therapy plays an important role in the treatment of intra-abdominal abscesses. The choice of an inappropriate antimicrobial agent is a common cause of therapeutic failure.

Antibiotic agents chosen for the treatment of intra-abdominal abscesses should be administered parenterally in appropriate doses before, during and after surgery to ensure adequate levels of antibiotics in the tissues. This factor may help reduce further local infection, secondary septicemia, and metastatic abscess formation. Debate continues regarding both the optimal antibiotic regimen and duration of treatment for intra-abdominal sepsis.

he abscess environment often presents special challenges for antimicrobial therapy. Abscesses have low redox potential and low pH as a result of limited vascularity and poor perfusion, anaerobic conditions, and dying tissue. High bacterial concentrations tend to inhibit oxygen-dependent phagocytosis and killing of bacteria by neutrophils and saturate the confined space with high concentrations of b-lactamase enzymes. The penetration of antibiotics into the abscess is limited not only by poor perfusion but also by mechanical barriers such as fibrin clots and the abscess wall. Thus, treatment with antimicrobial therapy alone is usually insufficient to clear these infections - effective treatment requires drainage of the abscess.

Reporting on many clinical trials, the results of different antibiotic regimens are difficult to interpret accurately because of uncontrolled host variables, lack of a uniform study design, and different study groups. The inevitable absence of untreated control subjects further confounds our

understanding of pathophysiologic events associated with intra-abdominal bacterial contamination and subsequent intraperitoneal infection.

Antimicrobial treatment

Although source control is the most important component of successful treatment of intra-abdominal abscesses, proper selection of antibiotic therapy is no less important in the overall approach to treatment. The choice of empiric antimicrobial therapy for intra-abdominal abscesses depends on the severity of the disease and the type of infection.

Once the diagnosis of complicated intra-abdominal infection has been made, it is appropriate to initiate empiric antimicrobial therapy before the exact diagnosis has been established and before the results of appropriate cultures have been obtained.

Empiric broad-spectrum antibiotic therapy is usually initiated before laparotomy in cases with intra-abdominal abscesses. When

laparotomy reveals intra-abdominal infection many surgeons recommend prolonged postoperative antibiotic therapy." The current trend is to continue postoperative antibiotics for "fixed" periods of 5 to 10 days. Little attention has been paid to the proper duration of postoperative therapy. Most studies consider "short" ("single-dose") versus "prolonged" (24-72 hours) prophylaxis, concluding that the short regimen is as good as repeated-dose prophylaxis.

Other studies have shown that postoperative antibiotics provide no benefit in reducing infectious complications in patients with intra-abdominal abscesses. In addition, it is unclear whether postoperative antibiotics provide an actual clinical improvement in outcomes or is a result of the source of infection removed ?

The diverse bacteriology causing intra-abdominal infections and the emergence of resistance make antimicrobial treatment a serious clinical challenge. Emerging resistance of many gram-negative enteric pathogens and Bacteroides fragilis continues to stimulate the search for effective new antimicrobials.

With the availability of sophisticated anaerobic culture techniques, serious intra-abdominal infections were found to involve synergistic mixtures of bacteria in the mid-1970s. The bacteria that cause intra-abdominal infections are derived from the endogenous flora of the gastrointestinal tract. The role of enterococci in intra-abdominal infections remains controversial, but treatment failure attributed to these organisms appears to be common in high-risk patients.

Pseudomonas aeruginosa and other enteric gram-negative bacteria (e.g., Acinetobacter species) are other potential pathogens of concern because they are increasingly resistant to many antimicrobials. Infection with Pseudomonas aeruginosa is commonly seen in high-risk patients such as those with an established nosocomial infection and those who have received previous antimicrobial therapy, undergone repeat surgeries, or both. Staphylococcus aureus is also a potential pathogen with inherent antibiotic resistance problems.

Patients with intra-abdominal infections are generally classified as low- and high-risk with respect to antibiotic treatment. Although the definition of 'risk' in intra-abdominal infections remains not fully clarified, 'high risk' is generally understood to mean patients at high risk of treatment failure. In these patients, intra-abdominal infections may be associated with a high risk of isolation of resistant pathogens from the intra-abdominal source. Effective treatment of high-risk patients requires early use of appropriate broad-spectrum empiric antimicrobials.

Patient risk stratification is important to optimize the antibiotic treatment plan. Increased mortality associated with inappropriate empiric antibiotic therapy cannot be reversed by subsequent changes. Therefore, knowledge of the patient's risk is essential to initiate treatment as soon as possible with the most appropriate regimen.

Many factors can contribute to a patient's risk of isolating resistant pathogens. These include:

- Healthcare associated infections
- High disease severity (APACHE II score >15)
- Advanced age
- Comorbidities and degree of organ dysfunction
- Poor nutritional status and low albumin level
- Immunosuppression
- Presence of malignancy

In high-risk patients, the normal flora may be altered and intra-abdominal infections may be caused by several unexpected pathogens and by more resistant flora that may include methicillin-resistant staphylococci, Pseudomonas aeruginosa, extended-spectrum enterobacteriaceae producing b-lactamases, etc. Broader spectrum antimicrobial regimens are used in these infections as adequate empiric therapy is important in reducing mortality.

Principles of antimicrobial treatment

In treating our own patients, we have followed several basic principles in order to manage intra-abdominal infection more quickly and efficiently:

1. Avoiding inappropriate use. Routine use of full-course antimicrobial therapy is not appropriate for all patients with intra-abdominal infections.
2. According to guidelines, for mild to moderate complicated infections, the use of ampicillin-clavulanic acid, cephalosporins, moxifloxacin or tigacycline, clindamycin as monotherapy or in combination with metronidazole
3. For more severe infections - meropenem, imipenem-cilastatin, piperacillin/tazobactam in combination with metronidazole

Ampicillin-sulbactam is indicated for mild to moderate infections, but increasing Enterobacteriaceae resistance reported over the past decade compromises its clinical effectiveness when used alone.

Piperacillin/tazobactam is a combination of beta-lactam/beta-lactamase inhibitors with enhanced gram-negative spectrum and antipseudomonal activity. Piperacillin/tazobactam has in vitro activity against beta-lactamase-producing bacteria, extended-spectrum beta-lactamase-producing Enterobacteriaceae, and many Pseudomonas isolates, making it a viable option for the empiric treatment of high-risk intra-abdominal infections.

Carbapenems have a spectrum of antimicrobial activity that includes gram-positive (excluding resistant gram-positive cocci) and gram-negative aerobic and anaerobic pathogens and important options for empiric treatment of high-risk intra-abdominal infections.

In the past, cephalosporins were frequently used to treat intra-abdominal infections. Cephalosporins, with the exception of the second-generation subgroup with activity against Bacteroides spp (cefoxitin and cefotetan), do not exhibit anti-anaerobic activity and should always be used in combination with anti-anaerobic resources. Second-generation cephalosporins are widely used in surgical prophylaxis. We recommend their use in the treatment of mild to moderate infections, but limitations in their spectra and microbial resistance limit their usefulness in complex intra-abdominal infections. Among the third-generation cephalosporins, both subgroups with poor activity against Pseudomonas aeruginosa (cefotaxime, ceftriaxone, and ceftizoxime) and with good activity against Pseudomonas aeruginosa (cefoperazone and

ceftazidime) have been used in the treatment of intra-abdominal infections in combination with metronidazole. The presence of resistance of cephalosporins to Enterobacteriaceae has led to a restriction of their use in high-risk intra-abdominal infections.

A "fourth-generation" cephalosporin, cefepime, introduced into clinical practice in 1994, is used together with metronidazole to treat severe infections. Cefepime has higher in vitro activity than other extended-spectrum cephalosporins against common gram-negative and gram-positive pathogens and can be effective, along with metronidazole, in high-risk intra-abdominal infections.

Fluoroquinolones have been widely used in recent years to treat intra-abdominal infections because of their excellent activity against aerobic Gram-negative bacteria and tissue penetration. In addition, all fluoroquinolones are rapidly and almost completely absorbed from the gastrointestinal tract. Peak serum concentrations obtained after oral administration are very similar to those achieved with intravenous administration. Quinolones do not exhibit potent antinaerobic activity and we recommend their use in combination with other therapeutic antinaerobic agents. Many studies have demonstrated that fluoroquinolones in combination with metronidazole are an effective therapeutic option for the treatment of patients with intra-abdominal infections.

Ciprofloxacin is a potential therapeutic option for the treatment of infections caused by Pseudomonas and Enterobacteriaceae; however, in recent years, ciprofloxacin consumption has increased and ESBL-producing isolates resistant to fluoroquinolones have increased over time, initially in K. pneumoniae, and later in E. coli. In addition, ciprofloxacin has an unreliable activity against enterococci and staphylococci. We therefore have doubts about the appropriateness of ciprofloxacin plus metronidazole for the treatment of severe intra-abdominal infections in high-risk patients and do not recommend this combination in patients with severe intra-abdominal abscesses.

Compared with ciprofloxacin, moxifloxacin has increased activity against Gram-positive bacteria and decreased activity against Gram-negative bacteria (Enterobacteriaceae and Pseudomonas species). Moxifloxacin also appears to be effective against Bacterioides fragilis, suggesting that it may be effective for the treatment of low-risk intra-abdominal infections without antianaerobic agents.

Levofloxacin has a spectrum of action similar to moxifloxacin and even compared to moxifloxacin has no activity against anaerobic bacteria, less activity against resistant gram-

positive bacteria. In combination with metronidazole, it is effective for the treatment of low-risk intra-abdominal infections.

Aminoglycosides in general are particularly active against aerobic Gram-negative bacteria and act synergistically against some Gram-positive organisms. Gentamicin is the most commonly used aminoglycoside, but amikacin may be particularly effective against resistant organisms. They are effective against Pseudomonas aeruginosa. Aminoglycosides are not effective against anaerobic bacteria. Because of ototoxicity and nephrotoxicity, aminoglycosides are often not recommended for routine empiric treatment of intra-abdominal infections. Aminoglycosides may be reserved for patients with allergies to b-lactam agents and may be selected for the treatment of patients with healthcare-associated intra-abdominal infection.

Tigecycline is the first member of the glycylcycline class of antibacterial agents to be marketed for clinical use. represents a new treatment option for complicated intra-abdominal infections due to its favorable against a wide variety of aerobic Gram-positive (including multidrug-resistant pathogens) Gram-negative (including ESBL-producing strains of E. coli and Klebsiella) and anaerobic organisms. Tigecycline also showed significant antimicrobial activity against Acinetobacter (including carbapenem-resistant). We recommend the use of tigecycline for the empiric treatment of infections of mild to moderate severity.

Tigecycline has shown efficacy in the treatment of multidrug-resistant bacteria in complicated intra-abdominal infections. Judicious use of antibiotics for multidrug-resistant pathogens is important to maintain their effectiveness, and tigecycline is one of the few available compounds active against multidrug-resistant strains. In combinations with other broad-spectrum antibiotics, it is suitable in critically ill patients.

Adequate indications and duration of therapy are particularly important. Inadequate duration of therapy is probably the main inappropriate use of antibiotics in surgical practice and intensive care unit. Antimicrobial therapy for established infections should be continued until normalization of clinical signs of infection, including normalization of temperature and a trend toward a decrease in leukocyte count. If clinical signs and symptoms persist after a reasonable course of antibiotic therapy, another infectious cause should be sought rather than prolonging antibiotic treatment of the initial infection. Unnecessarily extensive coverage or prolonged therapy may result in high cost and toxicity of therapy.

Antibiotic resistance

The use of antibiotic drugs is one of the main treatment modalities for intra-abdominal abscesses, along with surgical or drainage procedures performed under ultrasound or CT guidance. The choice of antibiotic or combination of antibiotics, the duration of treatment, and the frequent changing of antibiotics during the healing process has led to a serious problem of antibiotic resistance, an increasingly serious public health problem and a leading threat to patient safety in hospitals:

- Infections with resistant bacteria lead to an increase in patient morbidity and mortality, as well as an increase in the length of hospital stay;

- Antibiotic resistance often leads to deferral of appropriate antibiotic therapy;

Inappropriate or delayed antibiotic therapy in patients with severe infections is associated with worse patient outcome and sometimes death

Inappropriate use of antibiotics in hospitals is one of the main factors in the development of antibiotic resistance. Inappropriate antibiotic use can include any of the following:

- Inappropriate prescribing of antibiotics;

- Delaying the administration of antibiotics in critically ill patients;

- Overuse of broad-spectrum antibiotics or inappropriate use of narrow-spectrum antibiotics;

- Lower or higher than the optimal dose of antibiotics for the individual patient;

- Too short or too long antibiotic treatment;

- Antibiotic therapy not selected according to microbiological culture results

A study by the Laboratory of Microbiology of St. Marina University Hospital EAD found a significant use of strategic antibiotics for hospital consumption in Bulgaria compared to the European Union - Fig. 15, as well as serious antibiotic resistance in relation to the most commonly isolated infectious agents - Fig. 16.

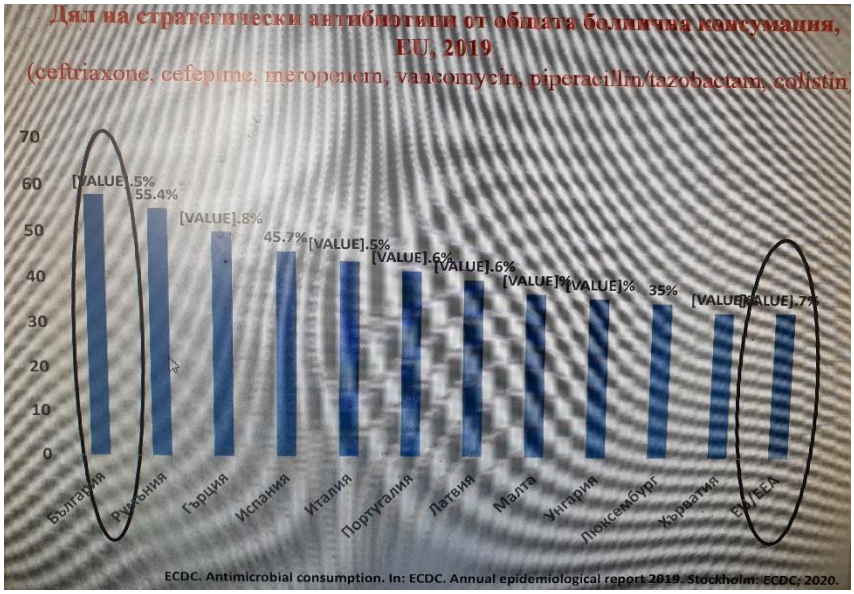
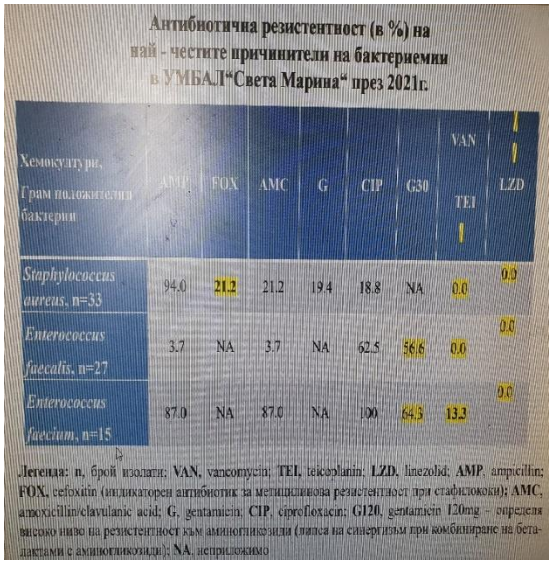


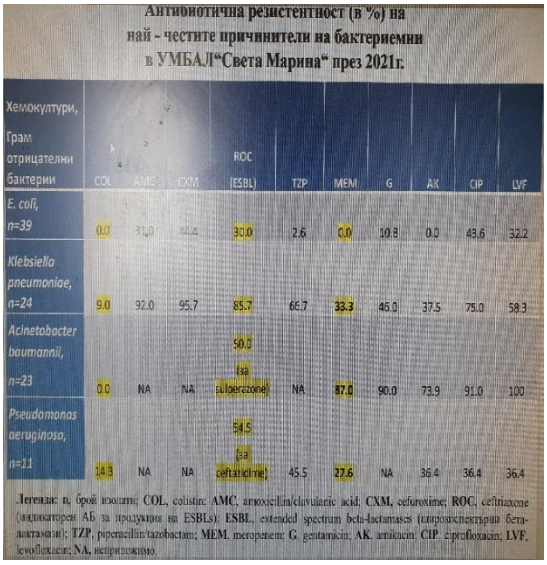
Fig. 15: share of strategic antibiotics



Антибиотична резистентност (в %) на най - честите причинители на бактериемии в УМБАЛ"Света Марина" през 2021г.

Хемокултури, Грам положителни бактерии	AMP	FOX	AMC	G	CIP	G30	VAN TEI	LZD
Staphylococcus aureus, n=33	94.0	21.2	21.2	19.4	18.8	NA	0.0	0.0
Enterococcus faecalis, n=27	3.7	NA	3.7	NA	62.5	56.6	0.0	0.0
Enterococcus faecium, n=15	87.0	NA	87.0	NA	100	64.3	13.3	0.0

Легенда: n, брой изолати; VAN, vancomycin; TEI, teicoplanin; LZD, linezolid; AMP, ampicillin; FOX, cefoxitin (индикаторен антибиотик за метицилинова резистентност при стафилококи); AMC, amoxicillin/clavulanic acid; G, gentamicin; CIP, ciprofloxacin; G120, gentamicin 120mg – определя високо ниво на резистентност към аминогликозиди (липса на синергизъм при комбиниране на бета-лактами с аминогликозиди); NA, неприложимо



Антибиотична резистентност (в %) на най - честите причинители на бактериемии в УМБАЛ"Света Марина" през 2021г.

Хемокултури, Грам отрицателни бактерии	COL	AMC	CXM	ROC (ESBL)	TZP	MEM	G	AK	CIP	LVF
E. coli, n=39	0.0	31.0	40.4	30.0	2.6	0.0	10.8	0.0	43.6	32.2
Klebsiella pneumoniae, n=24	9.0	92.0	95.7	85.7	66.7	33.3	46.0	37.5	75.0	58.3
Acinetobacter baumannii, n=23	0.0	NA	NA	50.0 (за cefotaxime)	NA	87.0	90.0	73.9	91.0	100
Pseudomonas aeruginosa, n=11	14.3	NA	NA	54.5 (за ceftazidime)	45.5	27.6	NA	36.4	36.4	36.4

Легенда: n, брой изолати; COL, colistin; AMC, amoxicillin/clavulanic acid; CXM, cefuroxime; ROC, ceftriaxone (индикаторен АБ за продукция на ESBLs); ESBL, extended spectrum beta-lactamases (широкоспектърни бета-лактамази); TZP, piperacillin/tazobactam; MEM, meropenem; G, gentamicin; AK, amikacin; CIP, ciprofloxacin; LVF, levofloxacin; NA, неприложимо

Fig. 16: % antibiotic resistance.

Conclusions drawn from this study indicate the presence of indicators of excessive antibiotic consumption:

 Dominance in the microbial spectrum of fungi of the genus Candida spp.

 Dominance in the aetiological spectrum of Enterococcus spp blood infections

 25% of fecal samples are positive for C. difficilae - Vancomycin overconsumption

 The high relative proportions of Meropenem-resistant Acinetobacter baumannii (84%) and Pseudomonas aeruginosa (33%) persist.

 A clear trend for a significant increase in the proportion of Meropenem-resistant Klebsiella pneumoniae: from 9% in 2020 to 19% in 2021 and up to 33% in blood isolates

 Trend of increasing proportion of Colistin-resistant Klebsiella pneumoniae and Pseudomonas aeruginosa (from 6% in 2020 to 12.2% in 2021), incl. for blood isolates

 Increasing trend in the proportion of Colistin-resistant Klebsiella pneumoniae and Pseudomonas aeruginosa (from 6% in 2020 to 12.2% in 2021), incl. for blood isolates

 High proportion of ESBL-producing Gram-negative bacteria, with the proportion reaching up to 86% for Klebsiella pneumoniae isolates The drugs of choice for the treatment of these infections are Meropenem and Imipenem (overconsumption !!!)

 Persistent trend of isolation of Vancomycin-resistant Enterococcus faecalis and Enterococcus faecium, including isolates from blood (up to 13%).

In the antibiotic treatment of patients with intra-abdominal abscesses, we have tried to follow the recommendations for the treatment of infections with the appropriate anatomical localization and according to the isolated microbiological causative agent, and empirical therapy oriented to the most likely causative agent has been conducted until the result of the microbiological examination has been obtained. The application of antibiotic therapy unfortunately had a limiting factor, i.e. the antibiotic preparations available in the hospital pharmacy, and therefore it was not always possible to choose the most appropriate one to start the empirical treatment.

Algorithm in intra-abdominal abscesses

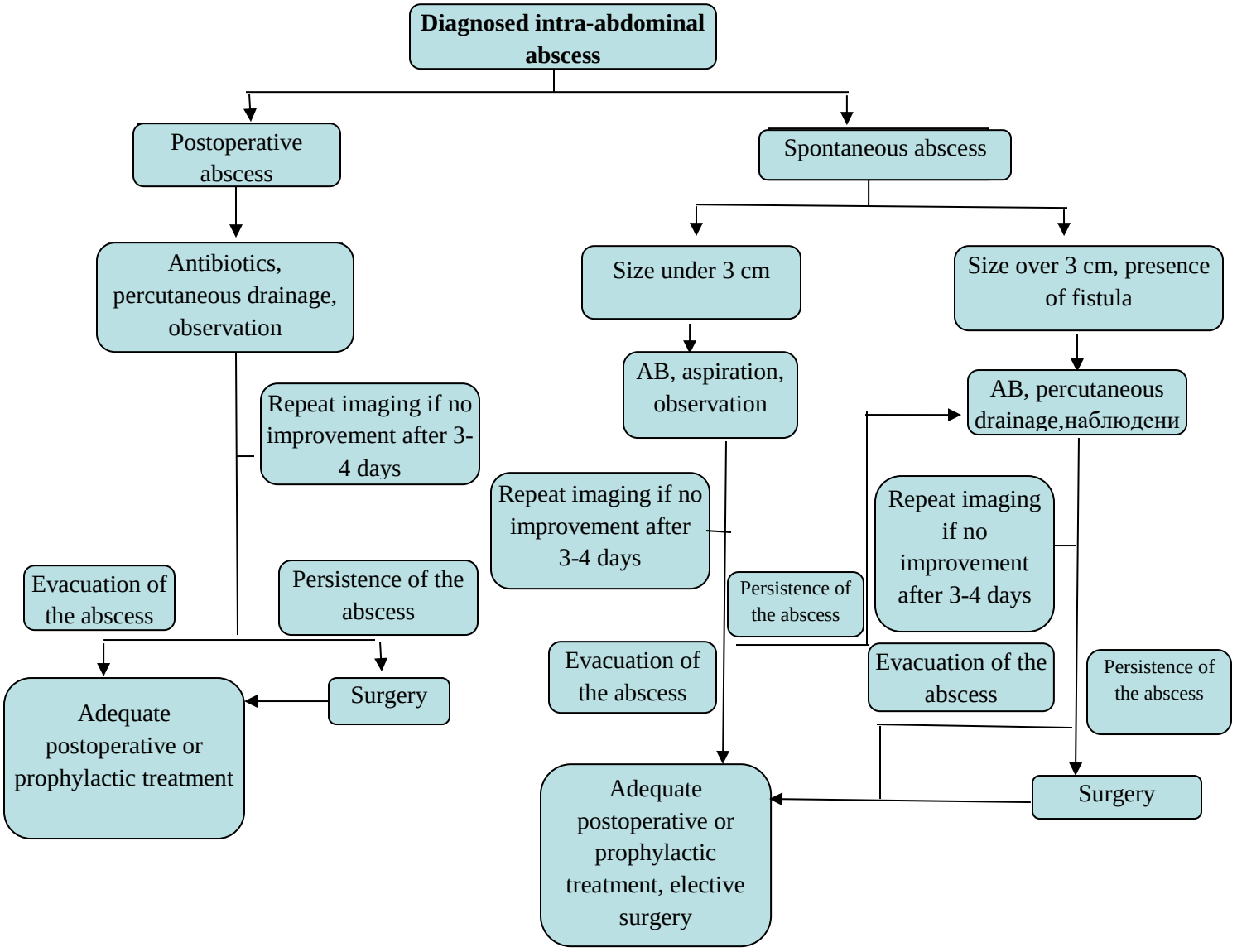


Fig. 17: Algorithm for intra-abdominal abscesses

Testing statistical hypotheses

Correlation analysis

Correlation analysis is a statistical method that measures the strength and direction of the correlation between two or more phenomena. When developing a correlation model, it is essential to correctly define the independent variable X (factor) and the dependent variable Y (effect). A key measure of the closeness of the relationship is the correlation coefficient r. Its value is interpreted according to the scale presented below (Table 27).

Value of the correlation coefficient r	**Interpretation of the strength of the dependence**
0	No relationship
0-0,3	Weak relationship
0,3-0,5	Moderate relationship
0,5-0,7	Significant relationship
0,7-0,9	Strong relationship
0,9-1	Very strong connection
1	Functional relationship

Table 27: Correlation coefficient

When the correlation coefficient r has a positive value, it can be said that the relationship between the phenomena is straight. When the sign of the correlation coefficient r is negative, the dependence is said to be inverse.

To correctly conduct a correlation analysis it is necessary to observe the following steps:

1. Determine the independent variables (factors) X and the dependent variable Y (effect).
2. To select an appropriate correlation coefficient according to the statistical scale to which the variables under study belong.
3. Evaluate the closeness of the correlation.

4. Evaluate the statistical significance of the obtained coefficient.
5. To interpret the obtained results

It is essential to assess whether the correlation coefficient obtained is statistically significant. In the context of using modern statistical and econometric software, science allows to decide in an alternative way, which boils down to comparing an accepted benchmark significance level (risk of error α) and a calculated Significance (p) cut-off level. This method was applied in the present study in checking the statistical significance of the obtained correlation coefficient r.

If the significance level (p) calculated from the sample data is less than the significance level (α) accepted as the norm, the resulting correlation coefficient is considered statistically significant and reliable. If the calculated significance level (Sig) is greater than the accepted norm level of significance (α), it is assumed that the resulting correlation coefficient is not statistically significant.

Emphasis is placed on the non-parametric contingency correlation coefficient, which is applicable when examining relationships with variables located on a nominal scale (qualitative variables).

Age-bed days

		Age	Bed-days
Age	Pearson Correlation	1	,238**
	Sig. (2-tailed)		,000
	N	555	555
Bed-day	Pearson Correlation	,238**	1
	Sig. (2-tailed)	,000	
	N	555	555

**. Correlation is significant at the 0.01 level (2-tailed).

Table 28:age-bed-day correlogram

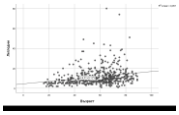


Fig. 18: age-bed-day correlogram

A parametric Bravet correlation coefficient is calculated given that the factor variable /age/ and the outcome variable /leglodnias/ are located on an interval scale. The parametric Bravet correlation coefficient revealed the presence of a weak linear relationship between the two parameters in all 555 patients /+0.238/. The coefficient can be accepted as statistically reliable ($p=0.000<\alpha=0.05$), given that the calculated cut-off level of occupancy Significance /p/ is less than the perceived risk of error of 5%. The presented graphical representation /correlogram/ further visualizes the communication between the two indicators.

Number of concomitant diseases - number of complications

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,270	,000
N of Valid Cases		555	

Table 29: correlation concomitant diseases complications

A non-parametric contingency coefficient is calculated given that the two variables (factor and outcome) between which a relationship is sought are categorical, located on a nominal scale.

The calculated contingency coefficient of 0.270 indicates the presence of a weak linear relationship between the two variables. The coefficient can be assumed to be statistically reliable ($p=0.000<\alpha=0.05$), given that the estimated marginal level of employment Significance /p/ is less than the perceived risk of error of 5%.

Number of concomitant diseases-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,461	,000
N of Valid Cases		555	

Table 30: number of concomitant diseases-ASA relationship

The estimated coefficient of contingency of 0.461 indicates the presence of a moderate linear relationship between the two variables. The coefficient can be assumed to be statistically reliable ($p=0.000<\alpha=0.05$), given that the estimated cut-off level of employment Significance /p/ is less than the perceived risk of error of 5%.

Lethality-Diagnosis

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,370	,000
N of Valid Cases		555	

Table 31: lethality-diagnosis relationship

The calculated contingency coefficient of 0.370 indicates the presence of a moderate linear relationship between the indicators Diagnosis and Lethality. The coefficient can be

assumed to be statistically reliable (p=0.000<α=0.05), given that the calculated cut-off level of Significance occupancy /p/ is less than the perceived risk of error of 5%.

Symptom pain-image study

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,159	,079
N of Valid Cases		555	

.Table 32: pain-image study relationship

The estimated coefficient of contingency of 0.159 indicates the presence of an extremely weak linear relationship between the two variables. The coefficient cannot be assumed to be statistically reliable (p=0.079>α=0.05) given that the estimated marginal level of employment Significance /p/ is greater than the perceived risk of error of 5%.

Symptom nausea/vomiting-image study

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,142	,181
N of Valid Cases		555	

Table 33: Symptom nausea/vomiting-image study

The estimated coefficient of contingency of 0.142 indicates the presence of a weak linear relationship between the two variables. The coefficient cannot be assumed to be statistically reliable (p=0.181>α=0.05) given that the estimated marginal level of employment Significance /p/ is greater than the perceived risk of error of 5%.

Symptom impaired passage-image study

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,215	,001
N of Valid Cases		555	

Table 34: impaired passage-image study relationship

The estimated coefficient of contingency of 0.215 indicates the nature of a weak linear relationship between the two variables. The coefficient can be assumed to be statistically reliable ($p=0.001<\alpha=0.05$), given that the estimated marginal level of employment Significance /p/ is less than the perceived risk of error of 5%. This is the only symptom in the study that can be considered to correlate weakly with the imaging conducted!

Symptom febrility-imaging

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,145	,725
N of Valid Cases		555	

Table 35: febrility-imaging relaionhip

The estimated coefficient of contingency of 0.145 indicates the presence of a weak linear relationship between the two variables. The coefficient cannot be assumed to be statistically reliable ($p=0.725>\alpha=0.05$) given that the estimated marginal level of employment Significance /p/ is greater than the perceived risk of error of 5%.

Lethality-gender

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,045	,317
N of Valid Cases		555	

Table 36: lethality-gender relationship

The estimated contingency ratio of 0.045 largely negates any association between lethality and sex in the study. The coefficient cannot be assumed to be statistically reliable ($p=0.317>\alpha=0.05$) given that the estimated cutoff level of occupancy Significance /p/ is greater than the perceived risk of error of 5%.

Lethality-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,399	,000
N of Valid Cases		555	

Table 37: lethality- ASA relationship

The estimated contingency coefficient of 0.399 indicates the presence of a moderate linear relationship between the ASA and Lethality indicators. The coefficient can be assumed to be statistically reliable ($p=0.000<\alpha=0.05$), given that the estimated cut-off level of employment Significance /p/ is less than the perceived risk of error of 5%.

Type of antimicrobial therapy-treatment outcome

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,365	,000
N of Valid Cases		555	

Table 38: antimicrobial therapy-treatment outcome relationship

The calculated contingency ratio of 0.365 indicates the presence of a moderate direct relationship between the indicators "Antimicrobial therapy" and "Treatment outcome". The coefficient can be assumed to be statistically reliable ($p=0.000<\alpha=0.05$), given that the calculated cut-off level of Significance occupancy /p/ is less than the perceived risk of error of 5%.

Symptoms-ASA

Symptom pain-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,209	,000
N of Valid Cases		555	

Table 39: pain- ASA relationship

The calculated contingency coefficient of 0.209 indicates the presence of a weak linear relationship between Symptom Pain and ASA scores. The coefficient can be assumed to be statistically reliable ($p=0.000<\alpha=0.05$), given that the calculated cut-off level of Significance occupancy /p/ is less than the perceived risk of error of 5%.

Symptom nausea/vomiting-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,125	,166
N of Valid Cases		555	

Table 40: nausea/vomiting – ASA relationship

The estimated coefficient of contingency of 0.125 indicates the presence of an extremely weak linear relationship between the two variables. The coefficient cannot be assumed to be statistically reliable (p=0.166>α=0.05) given that the estimated marginal level of employment Significance /p/ is larger than the perceived risk of error of 5%.

Symptom impaired passage-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,077	,709
N of Valid Cases		555	

Table 41: impaired passage-ASA relationship

The estimated contingency ratio of 0.077 largely rules out an association between "Symptom disturbed passage" and "ASA". The coefficient cannot be accepted as statistically reliable (p=0.709>α=0.05), given that the calculated cut-off level of Significance occupancy /p/ is greater than the perceived risk of error of 5%.

Symptom febrility-ASA

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,207	,015
N of Valid Cases		555	

Table 42: febrility-ASA relationship

The calculated contingency coefficient of 0.207 indicates the presence of a weak linear relationship between Symptom Febrility and ASA scores. The coefficient can be accepted as statistically reliable (p=0.015<α=0.05), given that the calculated cut-off level of Significance occupancy /p/ is less than the perceived risk of error of 5%.

Lethality-age ranges

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,170	,001
N of Valid Cases		555	

Table 43: lethality-age ranges relationship

The estimated coefficient of contingency of 0.170 indicates the presence of an extremely weak linear relationship between the indicators Age Intervals and Lethality. The coefficient can be assumed to be statistically reliable (p=0.001<α=0.05), given that the estimated cut-off level of employment Significance /p/ is less than the perceived risk of error of 5%.

Diagnosis-Microbiology

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,818	,002
N of Valid Cases		555	

Table 44: diagnosis-microbiology relationship

The calculated contingency coefficient of 0.818 indicates the presence of a strong direct relationship between the indicators "Diagnosis" and "Microbiology". The coefficient can be assumed to be statistically reliable (p=0.002<α=0.05), given that the calculated cutoff level of Significance /p/ is less than the perceived risk of error of 5%.

Antibiotic therapy-diagnosis

		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	,515	,309
N of Valid Cases		555	

Table 45: antibiotic therapy-diagnosis relationship

There is a moderate linear relationship between the two indicators, but statistically insignificant p=0.309>α=0.05. The large variation in the possible responses for both indicators can be considered as a likely reason for this.

Symptoms-bed days

			Value
Nominal by Interval	Eta	Симптом коремна болка Dependent	,374
		Леглодни Dependent	,108

			Value
Nominal by Interval	Eta	Симптом повръщане Dependent	,297
		Леглодни Dependent	,016

			Value
Nominal by Interval	Eta	Симптом смутен пасаж Dependent	,322
		Леглодни Dependent	,030

			Value
Nominal by Interval	Eta	Симптом фебрилитет Dependent	,204
		Леглодни Dependent	,020

Table 46: symptoms-bed days

In this particular case, a non-parametric coefficient Eta is calculated given that one variable is on a nominal statistical scale /categorical trait/ and the other on an interval scale /quantitative trait/. The Eta coefficient in the SPSS environment does not have an option to check for statistical reliability. If in the hypothesis the indicator "Beddays" is considered as the dependent variable, then it correlates in a balanced way with the four symptoms, the relationships being rather extremely weak.

Conclusions

1. The diversity of organisms found in the gastrointestinal tract is responsible for the polymicrobial nature of these infections. The type and number of microorganisms involved have a significant impact on the clinical outcome.

2. The treatment of intra-abdominal infections focuses on timely and appropriate surgical intervention; antimicrobial therapy is an important adjunct. Antimicrobial coverage of both aerobes and anaerobes should be initiated promptly, prior to completion of culture and sensitivity studies, and should reflect whether the infection is hospital-acquired or community-acquired.

3. Surgical source control is the most important determinant of survival and should be placed at the top of the therapeutic priority list.

4. Successful outcome depends primarily on early diagnosis, prompt, appropriate surgical intervention, and the selection of effective antibiotic regimens.

5. There is a statistically significant association between age and bed days, between number of comorbidities and number of complications, between number of comorbidities and ASA, and between diagnosis and lethality.

6. There was a statistically significant association between anaesthetic risk (ASA) and lethality, and between type of antimicrobial therapy and outcome.

7. There was a statistically significant association between diagnosis and microbiological causative agent.

8. There was no statistically significant association between clinical symptoms and imaging performed, except for the symptom of impaired passage; there was also no statistically significant association between gender and lethality.

Contributions

1. Formation and introduction into clinical practice of an algorithm for management of intra-abdominal abscesses.
2. Comparison of different types of interventions performed in patients with intra-abdominal abscesses and their benefits.
3. Analyzing the options for preoperative selection of the most appropriate diagnostic and therapeutic procedure.
4. Determine the impact of the choice of surgical intervention on the duration of treatment and the recovery process.
5. Study of complications in patients with intra-abdominal abscesses and ways to reduce and prevent them.

Publications related to the dissertation

1. Я. Стефанов, В. Божков, **П. Чернополски**, Д. Чаушев, В.Маджова, Р. Маджов, Ж. Русева. Особености на острия холецистит и смъртността след холецистектомия при възрастни пациенти. Списание „Обща медицина“ , том 23, бр. 2/2021г, стр. 25 – 29
2. Атанас Лисничков, **Пламен Чернополски**, Борислав Чаушев, Нели Згурова, Васил Божков, Илко Плачков, Тодор Иванов, Дилян Чаушев, Янко Стефанов, Вяра Драганова, Анелия Клисарова, Мария Цанева, Росен Маджов. Пиогенен чернодробен абсцес при пациенти с предхождащ карцином на жлъчните пътища – случай от практиката. Списание „Варненски медицински форум: т.6, бр. 2/2017г, стр.26-30.
3. Р. Маджов, В. Божков, **П. Чернополски**. Първичен, вторичен и третичен перитонит. Определение, класификация, специфика на клиничната картина и лечение. Сборник доклади „Остър корем. експертиза при хирургични случаи, достигащи до съдебната практика“ - 2019. ISBN 978-954-756-225-7,стр. 17 - 23
4. **П. Чернополски**, В. Драганова, Д. Чаушев, В. Божков, Р. Маджов. Остър хирургичен корем при болест на Крон. Сборник доклади „Остър корем. експертиза при хирургични случаи, достигащи до съдебната практика“ - 2019. ISBN 978-954-756-225-7,стр. 108 – 113
5. Atanas Lisnichkov, Milena Bozhkova, Temenuga Stoeva, Vassil Bozhkov, Ilko Plachkov, **Plamen Chernopolsky**, Todor Ivanov, Gergana Nedelcheva, Victoria Snegarova, Dobromira Dimitrova, Rossen Madjov. Pyoigenic liver abscess – etiological spectrum and antimicrobial susceptibility. Списание „Scripta Scientifica Medica” 2017;49 (4):53 – 57
6. **Чернополски П.**, Чаушев Д., Божков В., Арнаудов П., Плачков И., Иванов Т., А. Лисничков А., Стефанов Я., Маджов Р. Синдром на Мирици. XV Национален конгрес по хирургия. Доклади под ред. на проф. Д-р Р.Маджов, дмн, проф. Д-р Кр. Иванов, дмн, 2016 ISBN 1314-297; стр.118 – 123
7. Д. Чаушев, **П. Чернополски**, В. Божков, П.Арнаудов, И. Плачков, Т. Иванов, А. Лисничков, Я. Стефанов, К.Георгиев, Р. Маджов. Усложнени форми на остър холецистит при възрастни пациенти. XV Национален конгрес по хирургия. Доклади под ред. на проф. Д-р Р.Маджов, дмн, проф. Д-р Кр. Иванов, дмн, 2016 ISBN 1314-297; стр.149 – 154

8. Плачков И., Пл. Арнаудов, **Пл. Чернополски**, В. Божков, Кр. Георгиев,А. Лисничков, Т. Иванов, Д.Чаушев, Я. Стефанов, Р. Маджов. Остър некротичен панкреатит. XV Национален конгрес по хирургия. Доклади под ред. на проф. Д-р Р.Маджов, дмн, проф. Д-р Кр. Иванов, дмн, 2016 ISBN 1314-297; стр.58-64
9. Т. Иванов, И. Плачков, П.Арнаудов, В.Божков, **П. Чернополски**, Я. Стефанов, А. Лисничков, Д. Чаушев, Р.Маджов. Постоперативни усложнения след ехинококектомия. XV Национален конгрес по хирургия. Доклади под ред. на проф. Д-р Р.Маджов, дмн, проф. Д-р Кр. Иванов, дмн, 2016 ISBN 1314-297; стр.246 – 250
10. А. Лисничков, Р.Георгиев, В. Божков, И. Плачков, **П. Чернополски**, Т. Иванов, Б. Чаушев, Р. Маджов. Ролята на магнитно резонансното изследване в диагностиката на пиогенните чернодробни абсцеси. Списание „Хирургия“, бр. 1/2018; ISSn 0450 – 2167, стр. 20-28