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Surgical Wound Infections and Duration of Intensive Care Stays in Robotic, Laparoscopic and Conventional Surgery

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Abstract: ***The problem with the increased duration of the intensive care stays due to surgical wound infections in patients which have undergone grave surgical operations is a serious problem in the modern surgery. However, thanks to the new generations of antibiotics and surgical methods, the share of this complication is considerably reduced.***

Keywords: robotic surgery, infection, intensive care stay

1. Introduction

With the approval of Food and Drug Administration (FDA) in 2000 to the usage of robotic surgery, it became widely spread method, especially in the sphere of Gynaecology. In 2007 only 0.5% robotic hysterectomies with benign origin were done but in 2010 this figure increased to 9.5%.

The introduction of minimal invasive operations in abdominal surgery in the last years became possible due to the achievements of the modern technologies. Laparoscopic and robotic surgical approaches insured the opportunity for effective treatment and reducing of hospital stays. [1], [2] [3], [4], [5].

At the same time, no doubt is there about the advantages of these interventions today but their disadvantages and primarily the complications they cause are a subject of active study.

The total number of the infectious complications in minimal invasive operations according to different authors varies widely (3.6-13.3 %). Their nature is different and the prophylaxis and treatment are subject to debate. [6], [7], [8]. Surgical wound infections are one kind of these complications and they are closely connected with significant morbidity and mortality, continuous hospital stay and increasing costs of the treatment. Surgery wound infections lead to death 75% of the patients during the postoperative period. [9], [10], [11].

Till the middle of 19th century when Ignaz Semmelweis and Joseph Lister became pioneers in the sphere of control of the infections by introducing antiseptics in surgery, the most of the postoperative wounds had been infected. [12]

In cases of deep or extensive infection, this was the reason for lethal outcome in 70-80% of the patients. A series of important changes since that time, especially in the sphere of Microbiology have made the operations safer. [13]

However, the total frequency of Healthcare-associated Infections (HAIS) remains high and it represents a significant burden of disease. It is proven that many factors influence the surgical wound healing and play important role for determination of the frequency of infections (Figure 1).

The level of bacterial burden is one of the most considerable risk factors of the modern surgical techniques. However, the antibiotical prophylaxis in surgery and mini-invasive surgical techniques reduce this risk to a great extend. It is determined that the percentage of patients developing infection of surgical wound within 30 postoperative days is considerable and it depends on the type of operation. According to a series of studies, the minimal invasive surgery (laparoscopic and robotic operations) is connected with decreased probabilities for development of infectious process. [15]

The mini-invasive character of this kind of surgery along with adequate antibiotic preoperative and postoperative therapy represents a precondition for low percentage of complications in the first few days after the operation. Recommended antimicrobial prophylactic regimes and doses as well as redosing intervals in gynaecological surgery are described in Table 1 and Table 2.

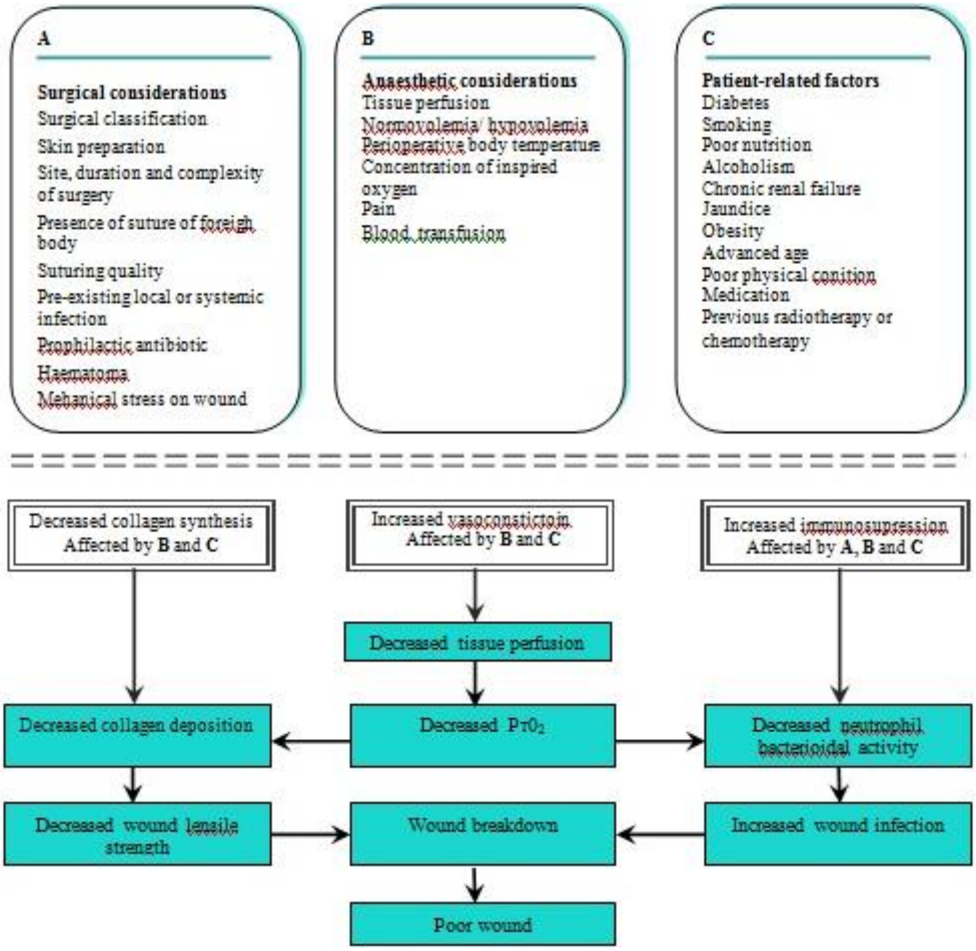

Figure 1: Factors that influence surgical wound healing [14]

Table 1: Antimicrobial prophylaxis in gynecological surgery [16]

Type of procedure	Recommended agents	Alternative agents in pts with β-lactam allergi
Hysterectomy	Cefazolin, cefotetan, or ampicillin-sulbactam[a]	Clindamycin or vancomycin + aminoglycoside[b]; or aztreonam alone; or fluoroquinolone alone[a, c]; or metronidazole + aminoglicozide or fluoroquinolone
Laparoscopic procedure, Low-risk	None	None
Laparoscopic procedure, high-risk.[d]	Cefazolin, cefoxitin, cefotetan, ampicillin-sulbactam[a]	Clindamycin or vancomycin + aminoglycoside[b]; or aztreonam alone; or fluoroquinolone alone[a, c]; or metronidazole + aminoglicozide or fluoroquinolone
Clean-contaminated cancer surgery	Cefazolin + metronidazle, cefuroxim + metronidazole, ampicillin-sulbactam[a]	Clindamycin

Adapted from [17]

[a] Due to increasing resistance of *Escherichia coli* to fluoroquinolones and ampicillin – sulbactam, local population susceptibility profiles should be reviewed prior to use.

[b] Gentamicin

[c] Ciprofloxacin or levofloxacin; fluoroquinolones are assotiated with an increased risk of tendonitis rupture in all ages. However, this risk would be expected to be quite small with singl-dose antibiotic prophilaxis.

Although the use of fluoroquinolones may be necessasery for surgical antibiotic prophilaxis in some children, they are not drugs of first choice in the pediatric population due to an increased incident of adverse events as compared with controls in some clinical trials.

[d] Factors that indicate a high risk of infectious complications include emergency procedures, diabetes, long procedure duration, age of > 70 years, Amercan Society of Anesthesiologists classification of 3 of greater, pregnancy, immunosupression, and insertion of prosthetic device.

Table 2: Recommended Doses and Redosing intervals for Commonly Used Antimicrobials for Surgical prophilaxis [18]

	Recommended Doses		Recommended	
Antimicrobial	**Aduts[a]**	**Pediatrics[b]**	Half-life in Adults With Normal Renal Functiun, hr[19]	Redosing interval (From Iniatiation of Preoperative Dose), hr[c]
Ampicillin-sulbactam	3g (ampicillin 2g/ sulbactam 1g	50 mg/kg of the ampicillin component	0.8-1.3	2
Ampicillin	2 g	50 mg/kg	1-1.9	2
Aztreonam	2 g	30 mg/kg	1.3-2.4	4
Cefazolin	2 g, 3g for pts wegning ≥kg	30 mg/kg	1.2-2.2	4
Cefuroxime	1.5 g	50 mg/kg	1-2	4
Cefotaxime	1 g[d]	50 mg/kg	0.9-1.7	3
Cefoxitin	2 g	40 mg/kg	0.7-1.1	2
Cefotetan	2 g	40 mg/kg	2.8-4.6	6
Ceftriaxone	2 g[e]	50-75 mg/kg	5.4-10.9	NA
Ciprofloxacin[f]	400 mg	10 mg/kg	3-7	NA
Clindamycin	900 mg	10 mg/kg	2-4	6
Ertapenem	1 g	15 mg/kg	3-5	NA
Fluconazole	400 mg	6 mg/kg	30	NA
Gentamicin[g]	5 mg/kg based on dosing weight (single dose)	2.5 mg/kg based on dosing weight	2-3	NA
Levofloxacin[f]	500 mg	10 mg/kg	6-8	NA
Metronidazole	500 mg	15 mg/kg Neonates weighing < 1200 g should Receive a single 7.5 mg/kg dose	6-8	NA
Moxifloxacin[f]	400 mg	10 mg/kg	8-15	NA
Piperacillin-tazobactam	3.375 g	Infants 2-9 mo: 80 mg/kg of the piperacillin component 15 mg/kg	0.7-1.2	2
Vancomycin	15 mg/kg		4.8	NA
Oral antibioptic for colorectal surgery prophylaxis (used in conjuction with a mechanical bowel preparation)				
Erythromycin base	1 g	20 mg/kg	0.8-3	NA
Metronidazole	1 g	15 mg/kg	6-10	NA
Neomycin	1 g	15 mg/kg	2-3 (3%absorbed under normal gastrointestinal conditions)	NA

[a]Adult doses are obtained from the studies cited in each section. When doses differed between studies, expert option used the most-often recommended dose.

[b]The maximum pediatric dose should not exceed the usual adult dose.

[c]For antimicrobials with a short half-life (e.g., cefazolin, cefoxitin) used before long procedures, redosing in the operating room is recommended at an interval of approximately two times jhe half-life of the agent in patients with normal renal function. Recommended redosing interval marked as ―not applicable" (NA) are based on typical case length: for unusually long procedures, redosing may le needed.

[d]Although FDA-approved package insert labeling indicates 1g, 14 experts recommend 2g for obese patients.

[e]When used as a single dose in combination with metroni9dazole for colcrectal procedures.

[f]While fluoroquinolones have been assotiated with an increased risk of tendinitis/tendon rupture in all ages, use of these agents for single-dose prophilaxis is generally safe.

[g]In general, gentamicin for surgical antibiotic prophilaxis should be limited to a single dose giving preoperatively. Dosing is based on the patient's actual body weight. If the patient's actual weight is more than 20% above ideal body weight (IBW), the dosing weight (DW) can be determined as follows: DW=IBW + 0.4 (actual weight – IBW).

2. Methodology and Materials

95 women with gynaecological diseases were tested for a period of three years (2013-2015). They have undergone operations in the Oncologic Department of Dr G.Stranski University Hospital. 33 of them were operated by means of robotic surgical method, 26 by laparoscopic method and 36 by open method. (Figure 2)

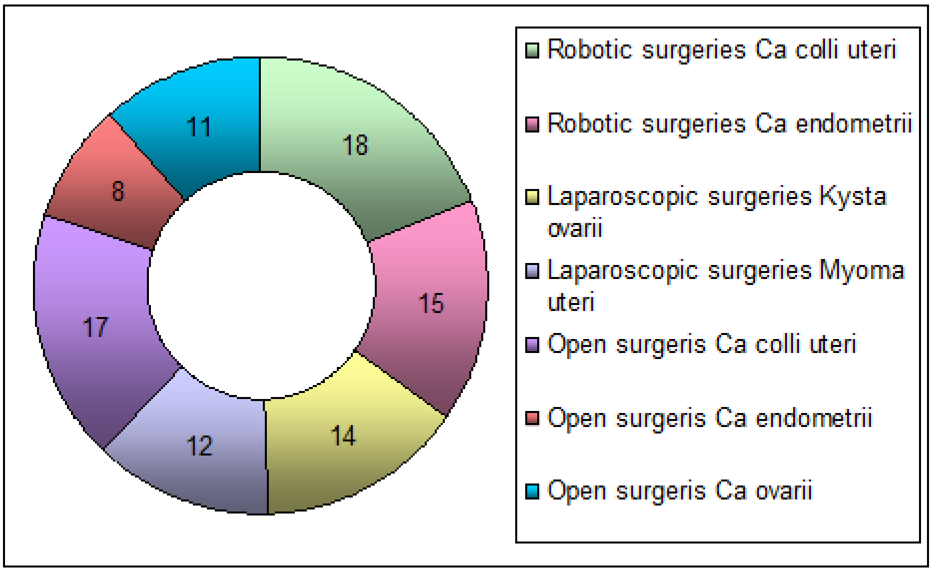

Figure 2: Number of female patients and division according to their diagnosis and the type of surgery

After waking from anesthesia all the patients were admitted to the intensive care ward. Preoperatively and postoperatively antibiotic (Ceftriaxon) was appointed as well as low molecular weight heparin (Fraxiparine). Dosing was based on the type of surgery and on the female patients' actual body weight. Daily, during all the stay of the patients, an account was given of full blood count, body temperature (axillary) and status of the surgical wound.

3. Results and Discussions

Fever was registered in the early postoperative period in only 2 of all the tested female patients from robotic group with diagnosis cervical carcinoma and only 1 of them with diagnosis carcinoma of the endometrium. In the laparoscopic group respectively, high temperature was measured in the first few postoperative hours in 6 women with diagnosis myoma and 1 woman with diagnosis ovarian cyst.

As it was expected, the highest percent of this complication was registered in women from the third group (open surgical approach): in 8 of them with diagnosis cervical carcinoma, 3 with diagnosis ovarian carcinoma and 3 with diagnosis carcinoma of the endometrium.

Surgical wound infection was registered in 4 women operated by conventional type of surgery (2 with diagnosis cervical carcinoma and 2 with carcinoma of the endometrium). (Table 3)

Table 3: Division of female patients by diagnosis, type of surgery applied, presence of fever, surgical wound infection and leucocytosis

Type of surgery	Female patients with fever	Female patients with surgical wound infections	Female patients with leucocytosis
Robotic operations			
1. Cervical carcinoma	2	—	0
2. Carcinoma of the endometrium	1	—	1
Laparoscopic operations			
1. Myoma	6	—	2
2. Ovarian cyst	1	—	0
Open operations			
1. Cervical carcinoma	8	2	8
2. Ovarian carcinoma	3	—	4
3. Carcinoma of the endometrium	3	2	2

Regarding the hospital stay, Table 4 indicates clearly that it depends on the diagnosis and the type of surgical approach preferred.

With most continuous stay in intensive care ward are patients with open conventional surgery. Women with minimal invasive surgery applied (laparoscopic and robotic one) have shorter stay as no statistically significant difference is established between these two groups according to the indicator pointed.

Table 4: Intensive care stay

Type of surgery	Number of patients	Stay in intensive care ward (in days)
Robotic operations		
1. Carcinoma of the cervix	**18**	**1**
2. Carcinoma of the endometrium	**15**	**1**
Laparoscopic operations		
1. Myoma	**8**	**1**
	4	**2**
2. Ovarian cyst	**14**	**1**
Open operations		
1. Carcinoma of the cervix	**10**	**2**
	7	**3**
2. Ovarian cancer	**6**	**2**
	2	**1**
	3	**3**
3. Carcinoma of the endometrium	**8**	**1**
	5	**2**
	1	**4**
	4	**3**

4. Conclusion

The problem with the infection of surgical wound as a factor which makes more continuous the intensive care stay and worsens the quality of life of the patients in the early postoperative period is indisputable.

The study made indicates clearly that the frequency of these complications and the fever, leucocytosis and increased hospital stay connected with it are in correlation with the surgical approach preferred. Mini-invasiveness of laparoscopic and robotic surgical techniques represents a precondition for lower frequency of these extremely unfavourable effects.

On the other hand, the proper preoperative and postoperative antibiotic therapy depending on the type and scope of the operative intervention and individual characteristics of each patient, are certain way for their prevention.

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