Predictive role of selective laboratory parameters for the occurrence of “unwanted events” in the patient treated with laparoscopic appendectomy

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INTRODUCTION

The open appendectomy (OA) that is performed through the so called Mac Burney’s incision [1] was the gold standard in the surgical treatment of acute appendicitis (AA) for over 100 years. Laparoscopic appendectomy (LA) as an alternative to OA was introduced in 1983 by **Kurt Semm** [2]. Since then, an enormous number of studies had given various advantages to LA over OA like shorter length of hospital stay, less postoperative pain, better cosmetics, quicker return to the normal professional and everyday activities and less surgical site infections [3]. Additionally, the current recommendations from relevant surgical societies are mainly aimed towards routine usage of LA wherever there is suitable equipment and trained personnel [4,5]. However, despite all proven advantages, recommendations and experience of over 30 years, for various reasons, the usage of LA worldwide is still partial [6]. One way to increase the usage of LA especially in the beginning of the implementation trough the institutions, is to improve the safety of this surgical procedure by recognizing and managing the situations where LA could lead to various kinds of “unwanted events” (UE) such as intraoperative or postoperative complications or conversion to the open approach.

AIM

The aim of our study was to assess the potential predictive role of selected laboratory parameters in recognition of cases in which laparoscopic appendectomy would be associated with intraoperative difficulties and complications, conversion or early extra and intraabdominal postoperative complications.

METHOD

During the period 2016-2018 we conducted a prospective, clinical study at the Clinical hospital of Shtip and at the University clinic for digestive surgery, in Skopje, Republic of North Macedonia. The study consists of 75 adults with AA selected by a simple random sample, according to well defined inclusive and exclusive criteria. Laparoscopic exploration was performed to all of them. A total of 25 laboratory parameters were measured preoperatively. In each patient LA was performed by using one 10 mm supraumbilical port and two 5 mm ports, one in the suprapubic region and one in the lower left abdominal quadrant. Conversion to open approach if needed was performed trough Mac Burney incision or infraumbilical median laparotomy. The mesoappendix with appendicular artery was cut and sealed with the ligasure device (figure 1 a). The appendiceal base was ensured with endoloop (figure 1 b,c) and cut with ligasure (figure 1 d). For each patient the intraoperative difficulties or complications were registered as well as a conversion if present. Postoperatively each patient was followed on the 7th and 30th postoperative day for the presence of any kind of abdominal or extra abdominal early postoperative complication. We defined the term “unwanted events” as any kind of intraoperative difficulties or complications, conversion or early postoperative complications.

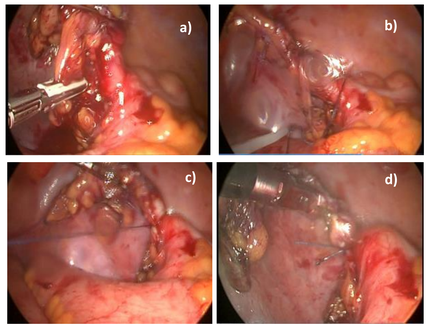
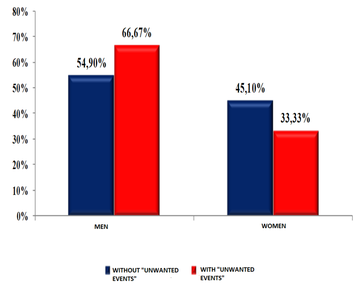


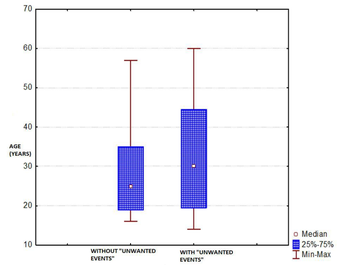
Figure 1 Laparoscopic appendectomy (a, b, c, d)

RESULTS

Graphic 1 Analysis according to groups and gander



Graphic 2 Analysis according to groups and age



The study sample was divided in two groups due to the presence or absence of “unwanted events”. Out of 75 participants with LA, 51 (68%) were included in the group “without unwanted events” and 24 (32%) were included in the group “with unwanted events”. In the group “without unwanted events” 28 (54.9%) were male and 23 (45.1%) were female with a female to male ratio of 1 : 1.22. In the group “with unwanted events”, 16 (66.7%) were male and 8 (33.3%) were female with a sex ratio of 1:2 in favor of the male patients (graphic 1). For p> 0.05 there was no significant association between gender and the group to which the patient belonged (Pearson Chi square=0.9315, df=1, p=0.3345).

The mean age of patients in the group “without unwanted events”, was 29±11.6 years, with a minimum/ maximum age 16/57 years and 50% of the patients younger than 25 years for Median (IQR)=25 (19-35). The mean age of the patients in the group “with unwanted events” was 33±15.1 years with a minimum/maximum age of 15/60 years with 50% of patients younger than 30 years for Median (IQR) = 30 (19.5-44.5) (graphic 2). For p> 0.05 there was no significant difference between the two groups regarding the age of the patients (Mann Whitney U Test: Z=-0.8404; p=0 4006).

Table1 Analysis of the 25 laboratory parameters according to the groups

Parameters	Results from laboratory investigations				p
	Mean	N	Std.Dev	Median	
Glycemia (mmol/l)					
without UE	5.56	50	0.86	5.76	T-test for independent samples (df=72)=-1.6141; p=0.1109
with UE	5.91	24	0.89	5.87	
Serum albumin (g/l)					
without UE	44.74	39	4.75	45.00	Mann-Whitney U Test: Z=-1.4568; p=0.1452
with UE	46.50	21	2.89	46.00	
Total serum protein (g/l)					
without UE	68.49	39	12.20	70.00	Mann-Whitney U Test: Z=-1.2089; p=0.2267
with UE	72.16	21	6.02	71.00	
Creatinine (µmol/l)					
without UE	71.51	49	13.25	69.60	Mann-Whitney U Test: Z=-0.1820; p=0.8556
with UE	71.10	24	9.76	69.85	
Serum urea (mmol/l)					
without UE	4.08	50	1.67	3.80	Mann-Whitney U Test: Z=-0.8545; p=0.3928
with UE	4.37	24	1.53	4.05	
Aspartate transaminase (u/l)					
without UE	18.56	50	8.03	17.00	Mann-Whitney U Test: Z=-0.5716; p=0.5676
with UE	17.91	24	3.85	17.50	
Alanine transaminase (u/l)					
without UE	22.40	50	13.61	16.50	Mann-Whitney U Test: Z=0.4907; p=0.6236
with UE	18.61	24	7.91	17.50	
Alkaline phosphatase (u/l)					
without UE	61.94	48	22.74	60.00	Mann-Whitney U Test: Z=0.5316; p=0.5950
with UE	62.21	24	29.27	53.00	
Lactate dehydrogenase (u/l)					
without UE	165,34	47	38,17	157,00	Mann-Whitney U Test: Z=-0,8562; p=0,3919
with UE	172,95	21	42,09	173,00	
Gamma glutamate transaminase (u/l)					
without UE	27.69	42	17.39	20.50	Mann-Whitney U Test: Z=-0.5061; p=0.6127
with UE	33.15	19	24.73	28.00	

Parameters	Results from laboratory investigations				p
	Mean	N	Std.Dev	Median	
Total serum bilirubin (µmol/l)					
without UE	17.61	45	9.42	14.60	Mann-Whitney U Test: Z=-2.2764; p=0.0228*
with UE	22.24	22	9.26	20.60	
Pothasium (mmol/l)					
without UE	3.94	45	0.44	3.90	T-test for independent samples (df=64)=-0.7234; p=0.4721
with UE	4.02	21	0.34	4.00	
Sodium (mmol/l)					
without UE	133.47	45	18.96	137.00	Mann-Whitney U Test: Z=-2.4092; p=0.0161*
with UE	138.2	21	3.08	138.00	
C – reactive protein (CRP) (mgl/l)					
without UE	45.35	51	58.61	23.80	Mann-Whitney U Test: Z=-3.4925; p=0.0005*
with UE	97.81	24	83.26	83.75	
Leucocytes (×10⁹/l)					
without UE	14.74	51	5.14	14.02	Mann-Whitney U Test: Z=-0.8745; p=0.3818
with UE	15.33	24	3.71	14.87	
Erythrocytes (×10¹²/l)					
without UE	4.86	51	0.58	4.77	Mann-Whitney U Test: Z=1.2891; p=0.1974
with UE	4.72	24	0.36	4.72	
Hemoglobin (g/l)					
without UE	142.51	51	16.32	145.00	Mann-Whitney U Test: Z=0.3918; p=0.6952
with UE	141.54	24	13.99	142.50	
Hematocrit (%)					
without UE	41.41	51	4.78	41.00	T-test for independent samples (df=73)=-0.2459; p=0.8062
with UE	41.69	24	4.31	42.92	
Thrombocytes (×10⁹/l)					
without UE	249.63	51	71.55	236.00	Mann-Whitney U Test: Z=1.4992; p=1.4992
with UE	224.08	24	57.44	219.00	

Parameters	Results from laboratory investigations				p
	Mean	N	Std.Dev	Median	
Medium corpuscular volume (fl)					
without UE	85.13	50	6.74	86.25	Mann-Whitney U Test: Z=-1.6981; p=0.0894
with UE	88.49	23	5.94	88.50	
Medium corpuscular hemoglobin (pg)					
without UE	29.49	50	2.35	29.90	Mann-Whitney U Test: Z=-0.7101; p=0.4776
with UE	30.01	24	1.91	30.00	
Mean corpuscular hemoglobin concentration (g/dl)					
without UE	343.74	50	14.95	340.50	T-test for independent samples (df=72)=0.8581; p=0.3937
with UE	340.37	24	17.44	341.00	
Neutrophils (%)					
without UE	83.54	51	9.29	85.30	Mann-Whitney U Test: Z=-0.8291; p=0.4071
with UE	85.91	24	4.99	85.30	
Lymphocytes (%)					
without UE	11.55	51	8.12	9.70	Mann-Whitney U Test: Z=0.9654; p=0.3343
with UE	9.22	24	4.37	8.50	
Monocytes (%)					
without UE	4.62	50	2.61	4.05	Mann-Whitney U Test: Z=-0.1212; p=0.9035
with UE	4.74	24	2.79	4.45	

Binary analysis of 25 laboratory parameters showed significant difference between the two groups for total bilirubin: 17.61±9.42 vs 22.24±9.28 µmol/l (Mann-Whitney U Test: Z=-2.2764; p=0.0228), sodium: 133.47±18.92 vs 138.2±3.08 mmol/l (Mann-Whitney U Test: Z =-2.4092; p = 0.0161) and C – reactive protein (CRP): 45.35±58.61 vs 97.81±83.26 mg/l, (Mann-Whitney U Test: Z =-3.4925; p=0.0005) with significantly higher levels in the group “with unwanted events” (Table 1).

Table 2 Multiple logistic regression analysis

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Total serum bilirubin (µmol/l)								
Total serum bilirubin	.076	.037	4.180	1	.041*	1.079	1.003	1.162
Sodium (mmol/l)								
Sodium	.149	.129	1.336	1	.248	1.161	.902	1.494
CRP(mgl/l)								
CRP	.009	.006	2.320	1	.128	1.009	.997	1.021

Additionally, multiple logistic regression analysis confirmed the total serum bilirubin as the only independent predictor. Increasing of bilirubin level in the serum by one unit is raising the probability for “unwanted events” by 1.079 [p=0.041, 95% CI=1.003-1.162] times (Table 2).

DISCUSSION

In many studies there is a clear relation between high levels of CRP and emergence of intraoperative and postoperative complications as well as conversion to open approach during LA in patients with AA. **Shelton at al.** [7] in 2013 calculated significantly higher levels of CRP (162mg/l vs 71mg/l) in the group of patients with conversion opposite the group where LA was performed. They also concluded that CRP >150mg/l is in statistically significant relation with the emergence of complications. **Abe at al.** [8] registered that the level of CRP is significantly higher (103mg/l vs 41mg/l) in the group with conversion. **Andert at al.** [9] concluded that high level of CRP is an independent predictor of postoperative complications in patients with AA treated with LA. In our study high level of CRP is a strong predictor for “unwanted events” related to LA.

Unlike CRP we couldn’t find a single study that relates hypernatremia to complications or conversion during LA so we can just say that this parameter probably deserves more future investigations and should be taken into consideration when diagnosing AA as well as In the choice of treatment.

Hyperbilirubinemia was first reported as a relevant parameter for establishing the diagnosis of AA especially for complicated form of AA by **Estrada at al.** [10] in 2007. After that, several studies give the same results regarding the relation of hyperbilirubinemia with advanced grades of AA, but on the other hand only a few found a relation with the emergence of complications and conversion during LA and without statistical significance [11]. Hyperbilirubinemia in the patients with AA is mostly contributed to the disturbance of the normal bile flow by the Escherichia coli endotoxin. In our study the high value of this parameter is the only independent predictor of intraoperative difficulties, complications or conversion during LA.

CONCLUSION

Extremely high levels of CRP, high levels of serum sodium and most importantly, high levels of total serum bilirubin could be indicators of unwanted intraoperative or postoperative course in the patients treated with laparoscopic appendectomy.

In such cases it is wise to consider performing the laparoscopic exploration in the presence of an experienced surgeon.

CONTACT INFORMATION

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