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Estimation of risk factors of early postoperative mortality in elderly patients who are subjected to emergency operations of the gastrointestinal tract

Процена фактора ризика раног постоперативног морталитета пацијената старијег животног доба подвргнутих ургентним хируршким операцијама на гастроинтестиналном тракту

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Estimation of risk factors of early postoperative mortality in elderly patients who are subjected to emergency operations of the gastrointestinal tract

Процена фактора ризика раног постоперативног морталитета пацијената старијег животног доба подвргнутих ургентним хируршким операцијама на гастроинтестиналном тракту

SUMMARY

Introduction/Objective The elderly (age ≥ 65 years) comprise an increasing proportion of patients undergoing emergency general surgery (EGS) procedures nowadays. The aim was to determine the intra-hospital mortality rate in elderly patients undergoing emergency gastrointestinal surgical procedures.

Methods 914 elderly patients (> 65 years old) were examined, divided into two groups: emergency and elective surgery patients, treated for diseases (benign and malignant) of the stomach, duodenum, small intestine and colon. The patients were divided into four age groups and five American Society of Anesthesiologists (ASA) groups, taking into account the presence of chronic diseases, the values of some laboratory parameters, administering transfusion and the occurrence of surgical complications during hospitalization.

Results The mortality rate among elderly patients was 17.8%. The univariate analysis in EGS patients revealed that gastro-duodenal surgical interventions ($p < 0.001$), ASA ≥ 3 score ($p < 0.001$), heart, lung, kidney diseases and postoperative complications ($p < 0.001$), as well as the white cell count > 10,000/mm³ ($p = 0.043$) were independent risk factors for mortality. In the multivariate analysis, in EGS patients, the significant risk factors for mortality were: gastric surgical interventions ($p = 0.001$), ASA score of 4 ($p < 0.001$), heart and kidney disease ($p \leq 0.001$) and white cell count > 10,000 / mm³ ($p = 0.039$).

Conclusion The characterization of independent validated risk indicators for mortality in those patients is essential and may lead to an efficient specific workup, which constitutes a necessary step towards developing a dedicated score for elderly patients.

Keywords: elderly; gastrointestinal surgery; mortality

САЖЕТАК

Увод/Циљ Пацијенти старијег животног доба (≥ 65 година) узимају све више удела као ургентно хируршки збринути пацијенти. Циљ студије је био одредити стопу интрахоспиталне смртности пацијената старијег животног доба, подвргнутих ургентним гастроинтестиналним хируршким интервенцијама.

Методе Испитивано је 914 пацијената старијег животног доба (> 65 година) подељених у две групе: ургентно и елективно хируршки збринутих, а због болести (бенигних и малигних) на желуцу, дуоденуму, танком и дебелом цреву. Пацијенти су били подељени и у четири старосне групе и пет група које је дефинисало Америчко удружење анестезиолога (*American Society of Anesthesiologists – ASA*) уз осврт на присуство хроничних обољења, вредности неких лабораторијски параметара, давање трансфузије и појаву хируршких компликација током хоспитализације.

Резултати Укупна стопа смртности у испитиваној популацији била је 17,8%. Униваријантна регресиона анализа код ових пацијената открива да су гастродуоденалне хируршке интервенције ($p < 0,001$), *ASA* ≥ 3 скор ($p < 0,001$), срчана, респираторна, бубрежна обољења, постоперативне компликације ($p < 0,001$) као и вредност леукоцита > 10,000/*mm*³ ($p = 0,043$) представљали независне ризик факторе смртности. У мултиваријантној анализи исте групе пацијената статистички значајни факори смртности били су: гастричне хируршке интервенције ($p = 0,001$), *ASA* 4 скор ($p < 0,001$), респираторна и срчана обољења ($p \leq 0,001$) вредност леукоцита > 10,000 /*mm*³ ($p = 0,039$).

Закључак Карактеризација независних прогностичких ризик фактора ове групе пацијената је од суштинског значаја и може довести до ефикаснијег лечења, што представља неопходан корак у изради наменског скоринг система ових пацијената.

Кључне речи: старија животна доб; гастроинтестинална хирургија; морталитет

INTRODUCTION

Increase in the very number of people in the elderly population in developed societies, as well as the use of screening programs, increases the number of requests for surgical procedures in this group of patients. In people aged 65 or older, the patient's risk of requiring surgical procedures is three times higher than in the younger population, especially in the case of emergency conditions [1, 2, 3].

Surgeons are still generally reluctant to treat elderly patients, considering them more sensitive to surgical treatments, having lower physiological reserves inside themselves, as well as more concealed diseases. The published data that indicate the poor outcome of surgical procedures in the elderly corroborate these facts [2, 3, 4].

Some studies suggest that surgery should often not be postponed in elderly patients. They conclude that the rate of mortality in the elderly can be reduced by performing elective surgical procedures, by carefully "selecting" patients with emergency conditions, thereby excluding the possibility of having inoperable patients, as well as by the participation of a large number of surgeons of various subspecialties during surgery [5].

The aim of the research was to determine the total rate of early postoperative mortality of elderly patients undergoing emergency surgical interventions on the gastrointestinal tract, with an overview of the impact of the American Society of Anesthesiologists (ASA) score, malignant diseases, septic conditions, associated chronic diseases, and the localization of a pathological process to the occurrence of the mentioned.

METHODS

The study, done in accord with standards of the institutional committee on ethics, included the examination of 914 elderly patients (65 years of age and those older than 65) in the period from January 1, 2013 to December 31, 2014 at the Clinic for General Surgery of the Clinical Center in Niš, divided into two groups: emergency and elective surgical care. Patients included in the study were surgically treated for diseases (benign and malignant) of the GIT, and were divided into the following groups: patients with gastric surgical diseases; patients with diseases which required duodenal surgery; patients with diseases which required

small intestinal surgery; patients with diseases which required colon surgery. Owing to the increased incidence of patients with appendicitis, this group of patients was also isolated. During the research, the sex and age of the patients were also monitored, (four age groups of patients were examined): the 1st group of patients aged 65 to 69; 2nd group of patients from 70 to 75 years of age; 3rd group of patients between 76 and 80; 4th group of patients aged over 80. Particular attention was paid to the nature of the underlying disease (benign or malignant), associated chronic diseases (heart diseases, pulmonary function disorder, neurological diseases of the CNS, diabetes). In the study, patients were also included in the ASA classification, and divided into five categories.

The study also included monitoring some laboratory parameters with their measurement on two occasions during patient hospitalization: before the surgery itself and just before the end of the clinical treatment or before the fatal outcome. The tables show the average values of the tested parameters. The following values were monitored: serum creatinine, serum albumin, total proteins of the serum, erythrocyte values, leukocytes, serum hemoglobin, serum sodium and potassium values, serum parameters that indicate infection (C-reactive protein-CRP, procalcitonin-PCT), glycemic level.

Surgical treatment of the examined patients included: surgery of the stomach, duodenum, small intestine and colon, appendectomy.

In the immediate postoperative period, the appearance of surgical complications was observed: laparotomy dehiscence, dehiscence of the primarily performed intestinal / gastro-intestinal anastomosis, postoperative bleeding.

Since the surgical treatment, as well as the nature of the underlying disease, is accompanied by a smaller or greater blood loss, a decrease in the blood cell count, a decrease in the serum levels of hemoglobin, albumin and total proteins, the number of received transfusion units was also monitored in the examined patients.

Statistical data processing

The data are presented in the form of an arithmetic mean and a standard deviation, or in the form of absolute and relative numbers. Frequency comparisons were done with the Chi-

squared test. The comparison of the continuous variables was done with the Mann-Whitney test. The correlation of potential risk factors with mortality was investigated with a univariate and multivariate (Backward: Wald method) logistic regression analysis. The calibration ability of the model was tested with the Hosmer-Lemeshow test. The discriminatory ability of the multivariate model was tested on the basis of the ROC curve. The hypothesis was tested with a significance threshold of $p < 0.05$. The data analysis was performed with the SPSS 16.0 software package.

RESULTS

It was determined that there is a statistically significant difference in age categories between emergency and elective procedures ($p < 0.001$). Elective surgical procedures are statistically significantly more common in female patients (66.0% vs. 9.0%, $p < 0.001$). ASA score 2 is dominant in elective surgical procedures ($p < 0.001$). The elective surgical procedures are dominant in patients with diseases requiring colon surgery (84.4% vs. 31.4%, $p < 0.001$). Small intestine surgery was statistically significantly more commonly performed in emergency surgical procedures (38.4% versus 0.4%, $p < 0.001$). The incidence of heart disease, kidney disease and neurological disorders is statistically significantly higher in patients undergoing emergency surgical procedures ($p < 0.001$). Malignant surgical diseases are statistically significantly more commonly treated as elective surgical procedures ($p < 0.001$). The death outcome was statistically significantly more common in emergency surgical procedures ($p=0.021$). Surgical complications were equal between emergency and elective surgical procedures ($p = 0.262$).

In emergency surgical procedures, the following values were statistically more significant: serum creatinine ($p < 0.001$), erythrocyte count ($p < 0.001$), leukocyte count ($p < 0.001$), hemoglobin ($p < 0.001$), CRP ($p < 0.001$), PCT ($p < 0.001$) and glycaemia ($p < 0.001$). In patients with performed elective surgery, statistically significant values were the following: total serum proteins ($p < 0.001$), serum albumin ($p < 0.001$) and serum Na ($p < 0.001$).

In emergency surgical procedures, in the univariate model, the statistically significant risk factors for a fatal outcome were the following: age, surgical interventions on the stomach and duodenum, ASA 3 and ASA 4 score, comorbidity on the heart, lungs, kidneys, surgical

complications, transfusion, and the value of Le above 10,000 units / ml. In elective surgical procedures, in the univariate model, statistically significant risk factors for a fatal outcome were the following: ASA 3 score, comorbidity on the heart, lungs, diabetes, surgical complications, malignant type of surgical disease, receiving transfusion, Le value over 10,000 units / ml.

For emergency surgical procedures, in the multivariate model, the following were statistically significant risk factors, corrected for the other parameters in the model: surgical gastrointestinal diseases, ASA 4 score, heart and renal disease, and Le level above 10,000 units / ml. For elective surgical procedures, in the multivariate model, the following were statistically significant risk factors for a fatal outcome, corrected for other parameters in the model: the ASA 3 score, heart and respiratory diseases and malignant surgical diseases.

Patients who underwent emergency surgery had statistically significantly lower survival compared to elective surgically treated patients ($p < 0.001$) (Figure 1). The shortest survival was exhibited by patients with duodenal surgery, followed by surgery of the small intestine, while the patients with surgical diseases of the stomach and colon had the longest survival. It has been established that there is a statistically significant difference in the length of intra-hospital survival compared to the localization of the surgical disease itself ($p < 0.001$) (Figure 2). The patients with malignancies had statistically significantly shorter survival compared to the patients with benign diseases ($p < 0.001$) (Figure 3).

DISCUSSION

In people aged 65 years and older, the risk of death to the patient from the required surgical procedures is three times higher than to the younger population, especially in the case of emergency conditions [5]. Ozturk et al. [6] did not show a statistically significant correlation between age and mortality of elderly patients undergoing gastrointestinal tract surgery (GIT), while in other authors, the “age of the patients”, as an independent risk factor of direct postoperative mortality, was statistically significant [7]. According to our data, it was found that the largest number of patients who underwent surgical care was between 65 and 69 years of age. In addition, there is a statistically significant difference in age in relation to the fatal outcome, so in the group of emergency surgically treated patients, the group of 70 to 74 year-olds had an almost 2.5 times greater chance of a fatal outcome (OR 2.465)

compared to the reference group (65-69), while in the group of elective surgically treated patients, the group of 75 to 79 year-olds had a 1.5% greater chance of a death outcome (OR 1.402) than the reference group (65-69).

Emergency surgery is a well-known risk factor [8–12]. It increases the operative mortality rate from 3 to as many as 10 times [10]. Ozturk et al. [6] state that about 70% of the non-surviving patients were subjected to emergency surgery. Other authors [12] indicate a better outcome in elderly patients who underwent elective surgery, compared to emergency surgical care patients, which was in correlation with the data obtained in some other studies. Our data suggest that the fatal outcome was statistically significantly more common in emergency procedures (p=0.021).

The data obtained in our study show that elective surgical procedures were statistically significantly more frequent in female patients (66.0% vs. 9.0%, $p < 0.001$). In the group of elective patients, female patients had a 2 times higher chance of a death outcome (OR 2.083), compared to male patients, which was in correlation with some other studies [13].

Patients with a higher ASA score have a higher chance of a fatal outcome [14]. In elective care patients, with an increase in the ASA score by 1, the chance of a fatal outcome increases by almost 3 times (OR 2,780), while the chance is far greater in emergency care patients.

Some studies indicate that the primary preoperative factor for a poor surgical outcome in the elderly was the comorbidity itself rather than age [15]. Electively treated patients with respiratory diseases had an almost 5 times greater chance of a fatal outcome (OR 4.823), while emergency care patients with respiratory and renal diseases had an almost 5 and 9 times greater chance of a fatal outcome, respectively (OR 5,097; OR 9,537).

In the category of “laboratory values”, Vizer at al. [13] reveal 3 statistically significant morbidity and mortality factors: an elevated level of serum creatinine, reduced preoperative albumin level and elevated leukocyte levels. In our study, serum creatinine values were statistically significantly higher in emergency procedures ($p < 0.001$).

Hypoalbuminemia is a common laboratory abnormality in the elderly, which can lead to high morbidity and mortality [16]. In patients who underwent elective surgical procedures,

the statistically significantly higher values were: total serum proteins ($p < 0.001$), serum albumin ($p < 0.001$).

In sepsis, the underlying problem is the high rate of mortality, which is even higher than in patients at the moment of myocardial infarction [17]. According to our data, the CRP values were statistically significantly higher in emergency procedures ($p < 0.001$).

Neumayer et al. [18] report that the leukocyte value above 10,000 / ml was statistically significant for the development of a serious infectious process, while, according to Devenport et al. [19], the value of Le above 10,000/ml was statistically significant for the development of heart complications. Our data indicate that Le values were statistically significantly higher in emergency surgically treated patients. Emergency surgically treated patients, with values of Le above 10,000 / ml, have a 2 to 4 times greater chance of a fatal outcome (OR 2.781; OR 4.246), compared to patients of the same examined group without leukocytosis, while in the case of elective surgically treated patients, with Le values above 10,000 / ml, the chance of a fatal outcome was 3.5 times higher (OR 3.655).

The serum hemoglobin concentration was higher in emergency surgically treated patients, compared to the elective ones, but not at the level of statistical significance, which was in correlation with previous studies [16].

Surgery of the upper part of the digestive tract increases the risk of heart and respiratory complication occurrence [20]. Our research has established that there is a statistically significant difference in the localization of the disease itself compared to fatal outcomes, so gastric surgical diseases were at the level of statistical significance ($p < 0.001$). The shortest survival was exhibited in patients with duodenal diseases, followed by the ones with diseases on the small intestine, while the patients with stomach and colon diseases had the longest survival.

Many patients who develop surgical anemia receive a transfusion. The outcome of such patients is poor, and it is not clear whether this is due to bleeding, anemia, or the transfusion itself [21]. In our study, both in emergency and in elective surgical procedures, in the univariate model, the transmission of transfusion was also considered as a statistically significant risk factor for a fatal outcome. Patients receiving transfusion had 14 times (OR 13,955) greater chance of a fatal outcome in emergency cases and a 10 times (OR 10,333)

greater chance of a fatal outcome in elective care patients, compared to non-transfusion patients.

Duron et al. [22] indicate that the presence of a malignant surgical disease as a risk factor for immediate postoperative mortality is at the level of statistical significance. Malignant changes are statistically significantly more commonly operated on in the form of elective surgical procedures ($p < 0.001$). Elective surgically treated oncology patients have a 3 times greater chance of a fatal outcome, compared to non-oncology patients of the same group (OR 2.499).

Wound dehiscence is one of the most common early postoperative complications with a frequency of approximately 2% [23]. There is no unique cause that leads to laparotomy dehiscence, and, as a rule, there is a combination of several factors, such as: old age, anemia, jaundice, uremia, diabetes, hypoalbuminemia, COPD, malignancy, steroid use, obesity, wound infection, intra-abdominal sepsis, emergency surgery [24]. Among the postoperative complications, anastomosis dehiscence leads to greater pain and distress of the patient than any other surgical complication [25]. The percentage of anastomosis dehiscence depends on the place where it occurs: stomach 1–9%, small intestine 1–3%, colon 3–29%, and rectum 8–41% [26–30]. Owing to surgical complications, re-intervention was performed in 15 deceased emergency surgically-treated patients and 5 deceased elective surgically treated patients. Emergency surgically treated patients with surgical complications had a 14 times greater chance of a fatal outcome (OR 13,965), while in elective surgical patients with surgical complications, this chance was 12 times higher (OR 12,012).

CONCLUSION

Our research suggests that the fatal outcome was statistically significantly more common in emergency surgical procedures. Premorbid factors, characteristics of the disease, the preoperative condition of patients and operative factors predict a poor surgical outcome.

The characterization of independent validated risk indicators for mortality in those patients is essential and may lead to an efficient specific workup, which constitutes a necessary step towards developing a dedicated score for elderly patients.

Conflict of interest: None declared.

REFERENCES

1. Cvijanovic R, Ivanov D. Complications in laparoscopic surgery. Srp Arh Celok Lek. 2008; 136 (Suppl. 2): 129-34. https://doi.org/10.2298/SARH08S2129C
2. Spivak H, Vande Maele D, Friedman I, Nussabaum M. Colorectal surgery in ocotogenarians. J. Am Coll. Surg. 1996; 183: 46-50. doi: [10.3393/ac.2016.32.4.126]. PMID: 27626021
3. Mednes da Costa P, Lurqui PH. Gastrointestinal surgery in the aged. Br. J. Surg. 1993; 80: 239. https://doi.org/10.1002/bjs.1800800320
4. Lubin M. Is age risk factor for surgery? Med. Clinic N. Am. 1993; 77: 327-33. https://doi.org/10.1016/S0025-7125(16)30254-1. PMID: 8441298
5. Richardson JD, Cocanour CS, Kern JA, Garrison RN, Kirton OC, Cofer JB et al. Perioperative risk assessment in elderly and high-risk patients. J Am Coll Surg 2004; 199(1): 133-146. DOI:10.1016/j.jamcollsurg.2004.02.023 PMID:15217641
6. Ozturk E, Yilmazlar T. Factors affecting the mortality risk in elderly patients undergoing surgery. ANZ J Surg 2007; 77: 156-159. https://doi.org/10.1111/j.1445-2197.2006.03997.x
7. Ingraham AM, Cohen ME, Raval MV, Ko CY, Nathens AB. Variation in Quality of Care after Emergency General Surgery Procedures in the Elderly. J Am Coll Surg 2011; 212: 1039-1048. DOI:10.1016/j.jamcollsurg.2011.03.001. PMID: 21620289
8. Ingraham AM, Nathens AB, Peitzman A, Bode A, Dorlac G, Dorlac W et al. Assessment of emergency general surgery care based on formally developed quality indicators. Surgery 2017; 162: 397-407. DOI:10.1016/j.surg.2017.03.025. PMID: 28647046
9. Sharoky CE, Bailey EA, Sellers MM, Kaufman EJ, Sinnamon AJ, Wirtalla CJ et al. Outcomes of hospitalized patients undergoing emergency general surgery remote from admission. Surgery 2017; 162:612-619. DOI:10.1016/j.surg.2017.05.008. PMID: 28689604
10. Havens JM, Peetz AB, Do WS, Cooper Z, Kelly E, Askari R et al. The excess morbidity and mortality of emergency general surgery. J Tareuma Acute Care Surg. 2015; 78: 306-311. DOI: 10.1097/TA.0000000000000517. PMID: 25757115
11. Lees MC, Merani S, Tauh K, Khadaroo RG. Perioperative factors predicting poor outcome in elederly patients following emergency general surgery. A multivariate regression analysis. Can J Surg. 2015; 58:312-317. DOI: 10.1503/cjs.011614
12. El-Haddawi F, Abu-Zidan FM, Jones W. Factors affecting surgical outcome in the elderly at Auckland Hospital. ANZ J Surg. 2002; 72:537-541. https://doi.org/10.1046/j.1445-2197.2002.02484.x PMID:12190721
13. Visser A, Geboers B, Gouma DJ, Goslings JC, Ubbink DT. Predictors of surgical complications: A systematic review. Surgery. 2015; 158(1):58-65. DOI: 10.1016/j.surg.2015.01.012. PMID: 25731783
14. Wolters U, Wolf T, Stutzer H, Schroder T. ASA classification and perioperative variables as predictors of postoperative outcome. Br J Anaesth. 1996; 77:217-222. PMID: 8881629
15. Wilson I, Barrett MP, Sinha A, Chan S. Predictors of in-hospital mortality amnong octogenarians undergoing emergency general surgery: A retrospective cohort study. Int J Surg. 2014; 12:1157-1161. DOI:10.1016/j.ijsu.2014.08.404. PMID: 25229887
16. Horasan ES, Dag A, Ersoz G, Kaya A. Surgical site infections and mortality in elderly patients. Med Mal Infect. 2013; 43(10):417-422. DOI: 10.1016/j.medmal.2013.07.009. PMID: 24012414
17. Esper A, Martin GS. Is severe sepsis increasing in incidence and severity? Crit Care Med. 2007; 35:1414–1415. doi: [10.1371/journal.pone.0067175]. PMID: 23843991
18. Neumayer L, Hosokawa P, Itani K, El-Tamer M, Henderson WG, Khuri SF. Multivariable predictors of postoperative surgical site infection after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg. 2007; 204: 1178-1187. DOI: 10.1016/j.jamcollsurg.2007.03.02. PMID: 17544076
19. Davenport DL, Ferraris VA, Hosokawa P, Henderson WG, Khuri SF, Mentzer RM Jr. Multivariable predictors of postoperative cardiac adverse events after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg 2007; 204: 1199-1210. DOI: 10.1016/j.jamcollsurg.2007.02.065. PMID: 17544078
20. Hardin RE, Zenilman ME. Surgical consideration in the elderly. In: Brunicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Pollock RE (eds). Schwartz`s Principles of Surgery. 8th edn. New York, Chicago: McGraw-Hill Medical Publishing Division, 2005; 1835-1849.

21. Kim Y, Spolverato G, Lucas DJ, Ejaz A, Xu L, Wagner D et al. Red cell transfusion triggers and postoperative outcomes after major surgery. J Gastrointest Surg 2015;19:2062-2073. DOI: 10.1007/s11605-015-2926-9. PMID: 26307346
22. Duron JJ, Duron E, Dugue T, Pujol J, Muscari F, Collet D et al. Risk factors for mortality in major digestive surgery in the elderly. Ann Surg. 2011; 254(2):375-382. DOI:10.1097/SLA.0b013e318226a959. PMID: 21772131
23. Wong SY, Kingsnorth AN. Abdominal wound dehiscence and incisional hernia. In: Lumley JSP, Caraven JL. Surg Int. 2002; 57:100-103.
24. Burger JW, Van't Riet M, Jeekel J. Abdominal incisions: techniques and post operative complications. Scand J Surg 2002; 91: 315-321. DOI: 10.1177/145749690209100401. PMID:12558078
25. Falconi M, Pederzoli P. The relevance of gastrointestinal fistulae in clinical practice: a review. Gut 2001; 49 [Suppl IV]: 2-10. doi: [10.1136/gut.49.suppl_4.iv2]. PMID: 11878790
26. Johnson W, Fernandez A, Farrell T, MacDonald K, Grant J, McMahon R et al. Surgical revision of loop ("mini") gastric bypass procedure: multicenter review of complications and conversions to Roux-en-Y gastric bypass. Surg Obes Relat Dis 2007; 3: 37-41. doi:10.1016/j.soard.2006.09.012
27. Carucci LR, Turner MA, Conklin RC, DeMaria EJ, Kellum JM, Sugerman HJ. Roux-en-Y gastric bypass surgery for morbid obesity: evaluation of postoperative extraluminal leaks with upper gastrointestinal series. Radiology 2006; 238: 119-127. DOI: 10.1148/radiol.2381041557. PMID: 16373763
28. Hyman N, Manchester TL, Osler T, Burns B, Cataldo PA. Anastomotic leaks after intestinal anastomosis: It's later than you think. Ann Surg 2007; 245: 254-258. DOI:10.1097/01.sla.0000225083.27182.85. PMID: 17245179
29. Konishi T, Watanabe T, Kishimoto J, Nagawa H. Risk factors for anastomotic leakage after surgery for colorectal cancer: results of prospective surveillance. J Am Coll Surg 2006; 202: 439-444. DOI:10.1016/j.jamcollsurg.2005.10.019. PMID:16500248
30. Jorgren F, Johansson R, Damber L, Lindmark G. Anastomotic leakage after surgery for rectal cancer: a risk factor for local recurrence, distant metastasis and reduced cancer-specific survival? Colorectal Dis. 2011; 13: 272-283. DOI:10.1111/j.1463-1318.2009.02136.x. PMID:19912285

Table 1. Demographic and clinical characteristics of the examined population related to the type of operation

Risk factors	Emergency n = 458		Elective n = 456		p†
	Count	%	Count	%	
Patient characteristics					
Age					
65–69	208	45.4	71	15.6	< 0.001
70–74	101	22.1	117	25.6	
75–79	100	21.8	140	30.7	
80+	49	10.7	128	28.1	
Sex of the patients					
Male	417	91.0	155	34.0	< 0.001
Female	41	9.0	301	66.0	
Clinical characteristics					
Localization					
Stomach	44	9.6	64	14.0	0.049
Duodenum	53	11.6	5	1.1	< 0.001
Small intestine	176	38.4	2	0.4	< 0.001
Appendix	41	0	0	0.0	< 0.001
Colon	144	31.4	385	84.4	< 0.001
Type of surgical disease					
Malignant	99	21.6	397	87.1	< 0.001
Benign	359	78.4	59	12.9	
ASA					
1	21	4.6	0	0	< 0.001
2	207	45.2	329	72.1	< 0.001
3	139	30.3	114	25.0	0.083
4	76	16.6	13	2.9	< 0.001
5	15	3.3	0	0	< 0.001
Heart diseases	375	81.9	328	71.9	< 0.001
Respiratory diseases	52	11.4	61	13.4	0.407
Renal diseases	43	9.4	4	0.9	< 0.001
Neurological disorders	47	10.3	3	0.7	< 0.001
Diabetes mellitus	11	2.4	13	2.9	0.828
Transfusion	230	50.2	242	53.1	0.324
Surgical complications[1]	18	3.9	11	2.4	0.262
Mortality	129	28.2	34	7.5	< 0.001

ASA – American Society of Anesthesiologists scoring;
†χ^2 test;
[1]laparotomy dehiscence, anastomose dehiscence, postoperative bleeding

Table 2. Biochemical parameters with regard to the type of surgery

Biochemical marker†	Emergency	Elective	p‡
Ser. creatinine	160.67 ± 86.59	106.54 ± 37.77	< 0.001
Total proteins	61.42 ± 14.22	66.76 ± 8.28	< 0.001
Ser. albumin	34.84 ± 10.67	40.45 ± 7.17	< 0.001
Er. count	4.22 ± 1.04	4.11 ± 0.46	0.003
Le count	11.57 ± 6.75	8.68 ± 3.16	< 0.001
Serum Hgb	125.25 ± 30.68	122.80 ± 16.66	0.003*
Serum Na	133.95 ± 5.35	137.14 ± 3.04	< 0.001
Serum K	4.32 ± 0.71	4.37 ± 0.57	0.061
CRP	133.41 ± 93.23	82.46 ± 68.40	< 0.001
PCT	1.41 ± 9.02	0.27 ± 3.72	< 0.001
Glycaemia	18.36 ± 4.13	4.79 ± 6.08	< 0.001

†Mean ± SD;

‡Mann–Whitney test;

*t-test

Table 3. Risk factors of a fatal outcome with regard to the type of surgery (univariate logistic regression analysis)

Risk factors	Emergency procedure				Elective procedure			
	Death Yes/no	OR	95% CI	p	Death Yes/no	OR	95% CI	p
Female	41/41	-		< 0.001	27/301	2.083	0.886–4.899	0.127
Male	88/417				7/155	reference group		
Age								
65-69	28/208	Reference group			7/71	Reference group		
70-74	28/101	2.465	1.367–4.449	0.004	10/117	0.948	0.349–2.606	0.917
75-79	24/100	2.031	1.106–3.727	0.032	17/140	1.402	0.554–3.543	0.623
80+	49/49	-	-	-	0/128	-	-	-
Localization of surg. dis.								
Stomach	24/44	3.531	1.874–6.653	< 0.001	7/64	1.660	0.691–3.990	0.257
Duodenum	23/53	2.163	1.203–3.888	0.010	0/5	-	-	-
Small intestine	46/176	0.848	0.556–1.295	0.446	0/2			
Colon	36/144	0.792	0.506–1.240	0.308	27/385	0.690	0.288–1.651	0.404
Appendix	0/41	-			0/0			
ASA								
1	0/21				0/0			
2	4/207				11/329	Reference group		
3	41/139	21.232	7.395–60.955	< 0.001	10/114	2.780	1.148–6.732	0.023
4	69/76	500.250	142.112–1760.932	< 0.001	13/13	-	-	-
5	15/15	-	-		0/0	-	-	-
Heart diseases	114/375	1.980	1.086-3.611	0.026	33/328	14.207	1.922–105.00	0.009
Respiratory diseases	32/52	5.097	2.788–9.319	< 0.001	13/61	4.823	2.269–10.254	< 0.001
Renal diseases	32/43	9.537	4.634–19.628	< 0.001	4/4	-	-	-
Neurological disorders	13/47	0.972	0.495–1.908	0.935	3/3	-	-	-
Diabetes mellitus	11/11				3/13	3.987	1.043–15.240	0.043
Transfusion	114/230	13.955	7.783–25.022	< 0.001	31/242	10.333	3.111–34.320	< 0.001
Surgical complications[1]	15/18	13.965	3.970-49.117	< 0.001	5/11	12.012	3.458–41.790	< 0.001
Malignant surg. diseases	24/99	1.292	0.774–2.157	0.328	32/397	2.499	0.583–10.711	0.218
Le>10.000	92/118	4.246	1.199–15.032	0.043	25/78	3.655	1.389–9.619	0.014

OR – odds ratio; CI – confidence interval;
[1]laparotomy dehiscence, anastomose dehiscence, postoperative bleeding

Table 4. Risk factors for a fatal outcome with regard to the type of procedure (multivariate logistic regression analysis)

Risk factors	Emergency procedure			Elective procedure		
	OR	95% CI	p	OR	95% CI	p
Sur. diseases on the stomach	4.028	1.742–9.311	0.001			
ASA 3				1.899	0.757–4.762	0.171
ASA 4	65.896	26.913–161.343	< 0.001			
Heart diseases	5.032	1.928–13.138	0.001	8.029	1.055–61.085	0.044
Respiratory diseases				6.453	2.635–15.801	< 0.001
Renal diseases	27.714	10.110–75.977	< 0.001			
Malignant sur. diseases				0.177	0.032–0.974	0.047
Le>10.000	2.781	1.596–36.097	0.039			
Hosmer–Lemeshow test	p = 0.633			p = 0.123		
C index	0.852, p < 0.001			0.863, p < 0.001		

OR – odds ratio; CI – confidence interval

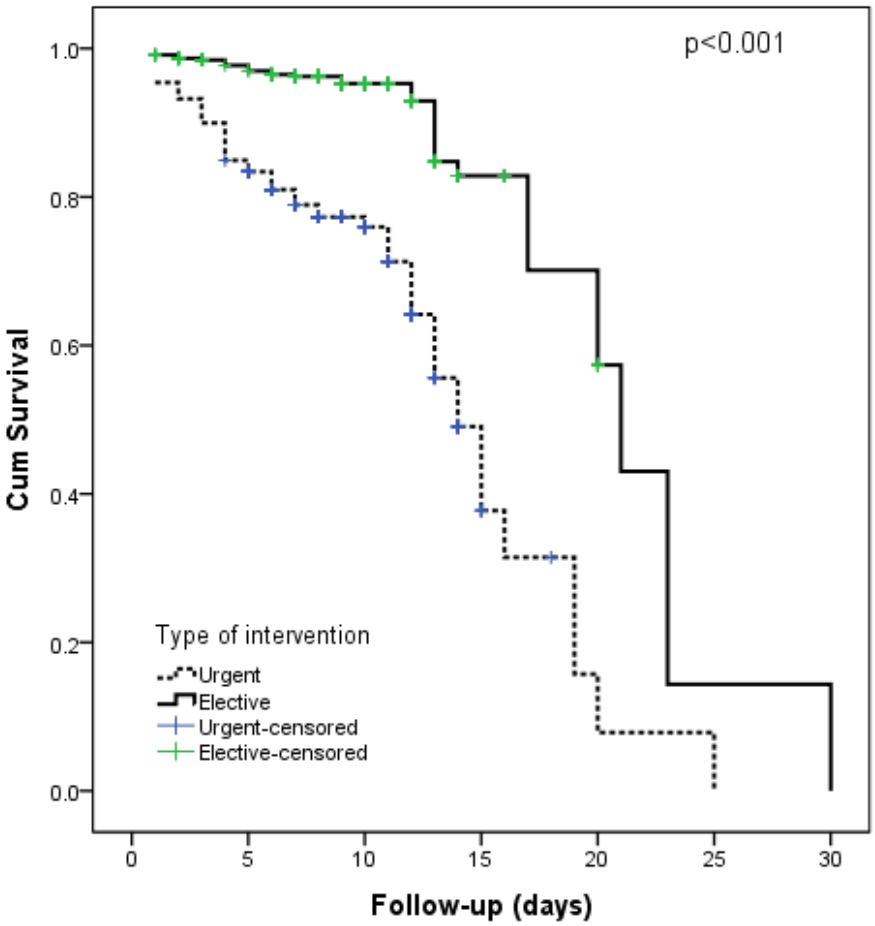

Figure 1. The Kaplan–Meier curve of intra-hospital survival with regard to the type of surgery in the whole population

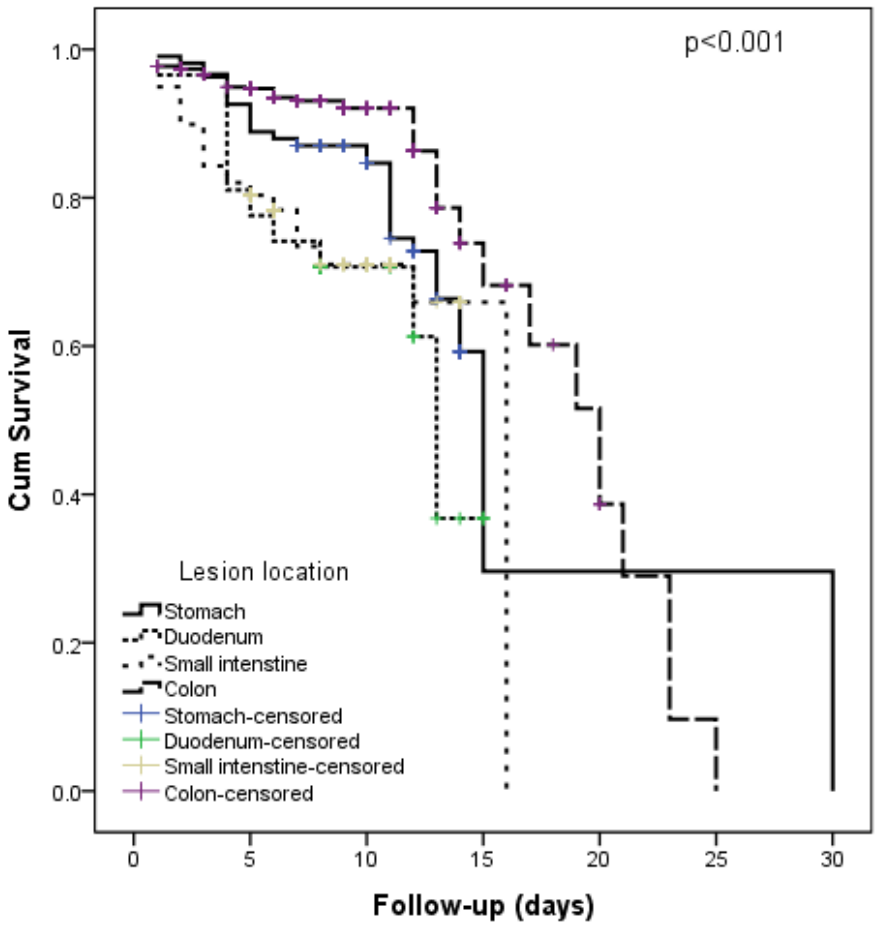

Figure 2. The Kaplan–Meier curve of intra-hospital survival with regard to the localization of the surgical disease in the whole population

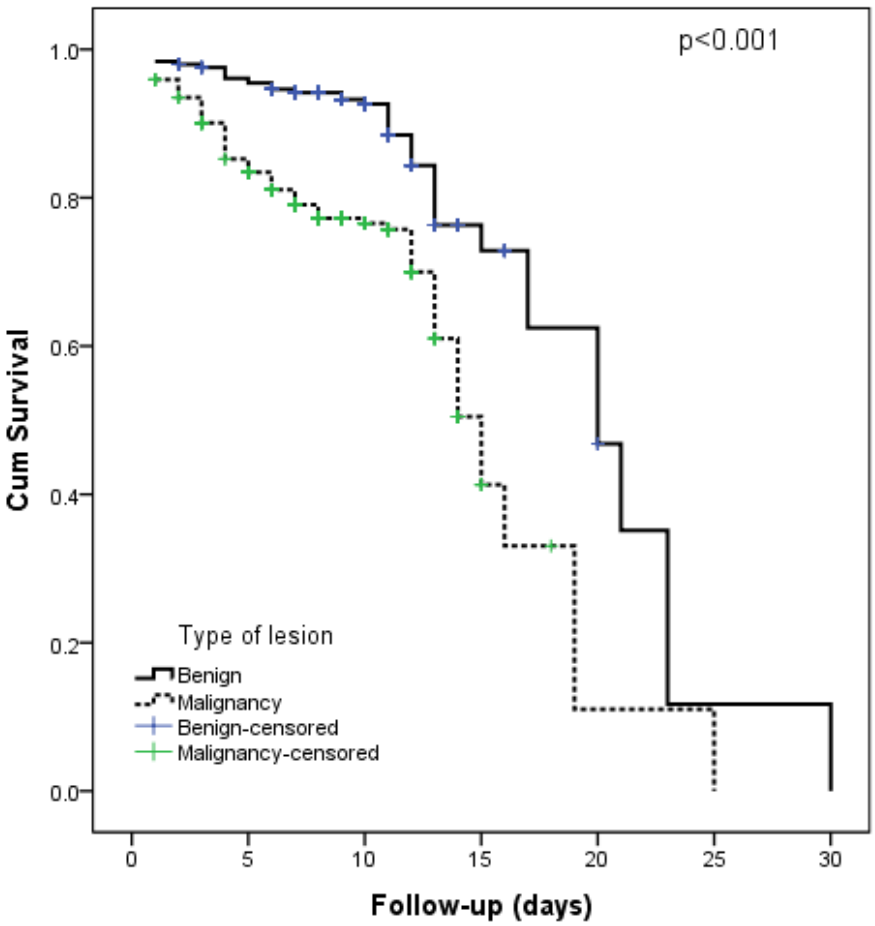

Figure 3. The Kaplan–Meier curve of intra-hospital survival with regard to the type of lesion in the whole population

