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Research Article

The Clastering in Analyzing Effect of the Presence of Patient Age, Infection and Systemic Disease of Connective Tissue on the Occurrence of Dehiscence Laparotomy

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Abstract

The aim of this study was to determine the impact of patient age, infection and systemic disease of connective tissue on the occurrence of dehiscence laparotomy.

In this paper the clustering method is applied in surgery post operational complications. The clustering method is new method applied in medicine. We first collect data after surgery of 674 patients in hospital in Serbia, taking into account 3 their attributes. Among 674 patients, 25 of them had the occurrence of dehiscence laparotomy. We analyze the risk of taking surgery based on clustering patient in groups, taking into account the presence of patient age, infection and systemic disease of connective tissue on the occurrence of dehiscence laparotomy. The minimum sum-of-squares model is used and tested by k-means heuristic and variable neighborhood search based method. It appears that the method used is very important, i.e., VNS based heuristic provides significantly better results. Some interesting conclusions are also derived.

Keywords: Dehiscence laparotomy; Infection; Patients age; Systemic disease of connective tissue; Clastering; Wound

Introduction

Dehiscence of laparotomy is a sudden partial or complete opening or tearing wounds, or the formation of cracks in the surgical wound sewinged [1]. Complete wound disruption with evisceration of abdominal organs requires urgent reintervention. It occurs most often during the first week after surgery. It occurs in 0.5% to 3% of operated patients [2]. Dehiscence of laparotomy is accompanied by high morbidity and mortality that ranges up to 40%.

The healing process of the wound is an extremely complex and dynamic set of cellular, biochemical and immunological processes, which depends on several factors.

Extension of the age limit of surgical patients leads to the emergence of new problems related to the altered response of the organism (burdened by homeostasis disorders and the function of all age-old systems) on the surgical procedure.

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Infection of the surgical wound is one of the most important risk factor for dehiscence of laparotomy. Gastrointestinal surgery, emergency surgery, prolonged surgical time are associated with an increased risk of surgical wound infection.

Wound infection defined as purulent secretion from the wound contents, regardless of the bacteriological findings [3]. It occurs in upto 15% of treated patients [4-6].

Systemic connective tissue disease (lupus, RA) and collagen disease (Sy. Marphan, Sy. Oehler-Dunloss), although relatively rare, are characterized primarily by disorders in the fibroplasias phase [7]. Also, the use of corticosteroid therapy as part of these disorders reduces the healing of the epidermis and collagen biosynthesis. Systemic steroid therapy reduces resistance to tearing, slows down angiogenesis and epithelialization, especially when given prior to surgery or during the first three days after surgery. Preferably the dosage of steroids is reduced during a critical inflammatory phase of healing of the wound. Simultaneous administration of vitamin A can lead to a reduction in the harmful effects of steroids. Vitamin A accelerates the achievement of hardness of the wound, re-enteritis and steroid-inhibited wound healing [8].

The survey aims to determine the effect of the patient age, infection and systemic disease of connective tissue on the occurrence of dehiscence laparotomy.

Methods

Statistical tests

Research is organized by type of retrospective-prospective studies that have analyzed the following data as risk factors: the

presence of patient age, infection and systemic disease of connective tissue on the occurrence of dehiscence laparotomy of 674 operated patients at the Department of General Surgery of Nis in the period from January 2018 to September 2018. Complications-dehiscence of laparotomy was found in 25 patients. Statistical sample size is determined by the statistical methodology to meet the basic principle of representativeness. Was used to determine the optimal norm gram sample. In this paper, results are presented in tables and graphically. The statistical analysis using the methods of descriptive statistics (mean, standard deviation), parametric tests (Student's t-test) and nonparametric Chi-square test. For statistical analysis we used the software package SPSS 14.0, and the imaging table and a Microsoft Office Word 2003.

Minimum sum-of-squares clustering

One of mostly used criterion for clustering is minimum sum-of-squares (MSS), where all entities are placed in n-dimensional Euclidean space and their dissimilarities calculated as squared distances in Rn. The number of clusters m is given in advance. The objective is to make groups of entities such that the total sum of squared distances within each group or cluster is minimum. It appears that minimizing the intra group distances is equivalent to maximizing the square distances among entities from different groups [9]. This property makes MSS most popular criterion since it measures in the same time homogeneity and separation. Moreover, MMS may be equivalently presented as the problem of minimizing the square distances from each entity to its own cluster center or centroid.

Since MMS problem is NP-hard, there are many heuristics already appeared in the literature. The most popular heuristic is so-called k-means method. It alternatively solves allocation of entities to their closest centroid and finding the corresponding centroid of each cluster. Although being very popular due to its simplicity, the results obtained by k-means sometimes are very far from the global optimum. That is the reason why there are many heuristics that are trying to improve precision of k-means algorithm. One among the m is k-means and Variable neighborhood search (VNS) based heuristic [9].

In this paper we presented data of 674 patients in 3-dimensional space. As mentioned earlier, those three attributes (or risk factors) are: the presence of patient age, infection and systemic disease of connective tissue on the occurrence of dehiscence laparotomy. All three are considered as binary variables. In the next section we will analyze the results obtained by both k-means and VNS heuristics.

Results

Statistical tests

Dehiscence of laparotomy occurred in 3.7% of patients or 25 patients of the total 674 respondents (Figure 1).

Of the total 25 patients with dehiscence of laparotomy, 16 patients were male or 64% and 9 female patients, or 36%.

Patients with dehiscence of laparotomy are statistically significantly younger than patients without dehiscence of laparotomy (χ^2=26.944; p<0.05). The average age of the respondents in the dehiscence group is 56.82 years, and in the group without dehiscence 64.25 years.

If patients with dehiscence of laparotomy are divided into two groups (upto 60 and over 60), the largest number of patients, 22 of them were under the age of sixty or 88%, while only 3 patients were over sixty or 12% (Figure 2).

There is a statistically significant relationship between dehiscence of laparotomy and infections (χ^2=42.196; p<0.01).

Infection was significantly more prevalent in patients with dehiscence of laparotomy. Of 25 patients with dehiscence of laparotomy them 12 or 48% had an infection, and of the 649 patients without infection, dehiscence had only 69 of them, or 10.6% (Figure 3).

Of the 674 patients examined, 50 had systemic disease of connective tissue or 7.42%. There is no statistically significant correlation between dehiscence of laparotomy and systemic disease (χ^2=0.105; p>0.05). Systemic disease had 4 patients with dehiscence of laparotomy or 8% and 46 patients without dehiscence of laparotomy or 92%. Of the patients who did not have a systemic disease 21, they had dehiscence of laparotomy or 3.4%, or 603 patients without dehiscence of laparotomy or 96.6% (Figure 4). In all investigated patients, the disease was in remission, well regulated and with intensive control of the immunologist, 14 days before, during surgery and 14 days after surgery they did not use corticosteroid and immunosuppressive therapy.

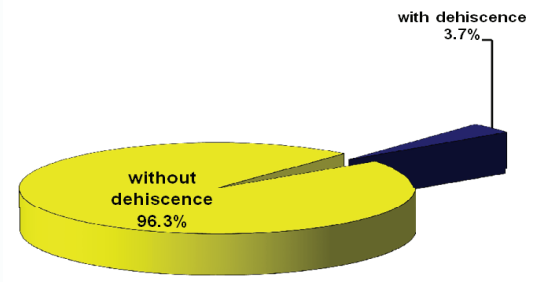

Figure 1: Number of dehiscence of the total number of respondents.

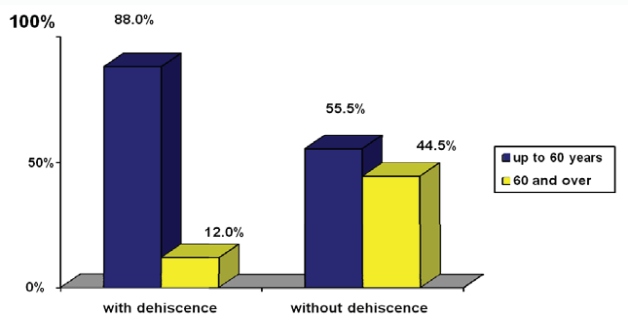

Figure 2: Occurrence of dehiscence of laparotomy in relation to age, younger than 60 years and older than 60 years.

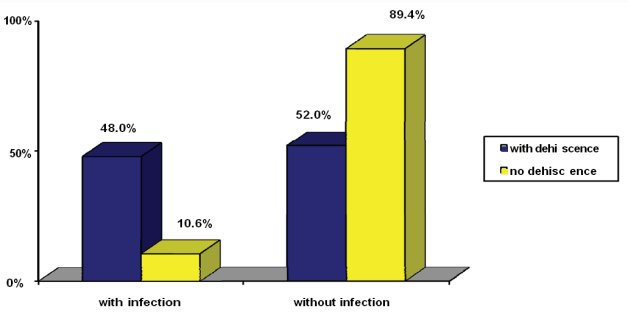

Figure 3: Impact of infection on the occurrence of dehiscence of laparatomy.

Clustering results

In Table 1 we report results obtained by two heuristics for Minimum sum-of-squares clustering: k-means and VNS. The first the number of desired clusters are given. The second line gives the value of the objective function, while in column 3 we report the number of entities in each cluster obtained by k-means. The next 3 columns report the same values given by VNS. It appears that both methods keep 25 patients with dehiscence laparotomy in the same cluster. The difference in results starts after m=5, where the total sum of squares are 73.51 and 60.20 obtained by k-means and VNS respectively. Moreover, VNS keeps the 25 patients in the same cluster up to m=8. This means that not only the clustering model is important but also the method used.

Some observations regarding results reported at Table 1 are:

1. Clustering models and methods may be successfully used in medicine in general and more particularly in Surgery in parallel with statistical tests;
2. Hypotheses may be automatically derived, e.g., the 25 patients with dehiscence of laparotomy are kept in the same group with up to 8 clusters;
3. Results obtained by clustering techniques are more rich in a sense that they provide more information to practitioners: relations between clusters, introduction of many patient's attributes in analysis, etc.;
4. The clustering method used may play a significant role in understanding the final results, i.e., VNS based heuristic outperform significantly k-means heuristic for number of clusters grater or equal to 5.

Discussion

In this section we first discuss our results obtained by statistical tests and then comment on their relations with clustering.

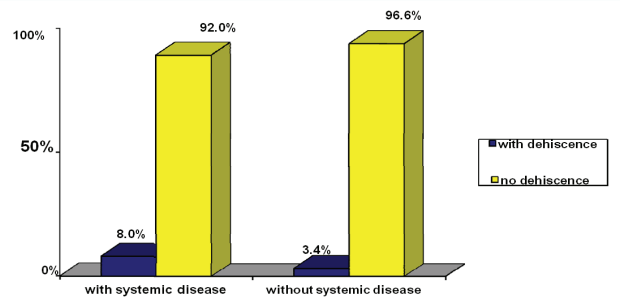

Figure 4: The presence of systemic diseases of connective tissue on the occurrence of dehiscence of laparotomy.

Despite major advances in the understanding of the process of wound healing physiology, surgical techniques and the application of modern technologies and materials in surgery, the percentage of impaired healing laparotomy is still high. Dehiscence of laparotomy occurs in approximately 3% of patients. In a retrospective study by Rodriguez-Hermosa et al. [10] and all from Spain, in 57 patients or 0.45% of the total 12,622 patients with laparotomy, there was dehiscence of laparotomy. There were 45 male patients and 12 female patients [10]. In India, studies from Rajindra Hospital in Patiala male predominance (37/50) was observed with ratio of male to female being 2.84:1 [11].

In our study compared to sex the patients of the total 25 patients with dehiscence of laparotomy, there were 16 males and 9 females. When it comes to full structure, our study does not show a statistically significant difference between sexes. The Cracow study Kenig et al. [12] and associates with dehiscence of laparotomy occurred in 56 patients or 2.9% of their patients. Our results show that dehiscence of laparotomy was present in 3.7% of patients or 25 patients of the total 674 respondents. Preoperative preparation is an important stage in the treatment of surgical patients and the adequacy of preoperative depends on result of the operation, the incidence of complications and mortality of patients. It is necessary that all the general condition of the patients preoperatively stabilized and carry a minimum of anesthesia and surgical preoperative whenever the patient's condition allows [13]. In the work of Rodriguez-Hermosa et al. [10] and all results were shown that out of 57 patients with dehiscence of laparotomy, 44 were younger than sixty years old. In India, studies from Rajindra Hospital in Patiala the highest incidence of wound dehiscence was found to be in patients of fourth decade [11]. The mean age for wound dehiscence was 41.61 years. Patients above 60 years were considered as elderly, which constituted 14% of the total patients in this study. Of the 50 patients who had dehiscence of laparotomy in that study, 7 of them were older than 60 years old. In our research, the largest number of patients, 22 of them were younger than sixty, while only 3 patients were over sixty. All three studies confirm recent views that chronological age of more than sixty years ago, in itself is not a contraindication for extensive operations in abdominal surgery [7,8,14,15]. Far more important are the parameters that determine the biological age of the patient: the patient's general condition and ability to care for oneself (performance status), nutritional status (Seltzerov index), as well as the risk of anesthesia-estimated ASA score [7]. Infection is extremely destructive effect on the wound healing process by increasing the production of cytokines and proteases, which disrupt the synthesis of fibroblasts, and the stability of the wound [16]. Our study confirms this claim, because in patients with the presence of infection, dehiscence of laparotomy is more common, 48% of patients with dehiscence of laparotomy had an infection. In Germany, the study was done by Fleischer et al. [17] and

Table 1: Comparison of k-means and VNS heuristics in clustering n=674 patients into m groups.

M	K-means			VNS		
	f	# of entities	Time	f	# of entities	Time
2	200.7	{25, 649}	0.3	200.7	{25, 649}	0.6
3	129.8	{25, 114, 535}	0.3	129.8	{25, 67, 582}	0.8
4	88.81	{15, 10, 47, 602}	0.5	88.81	{25, 66, 67, 516}	1
5	73.51	{4, 6, 15, 45, 604}	0.6	60.2	{4, 25, 62, 67, 516}	1.4
6	63.63	{4, 6, 15, 45, 49, 555}	0.7	43.82	{25, 28, 47, 53, 141, 380}	1.6
7	47.14	{2, 4, 9, 10, 31, 65, 553}	0.8	33.86	{4, 13, 25, 28, 49, 53, 502}	1.9
8	39.46	{2, 2, 4, 9, 11, 19, 50, 575}	0.9	24.2	{13, 14, 17, 21, 25, 38, 44, 502}	1.9

all, the dehiscence of laparotomy occurred in 5% to 10% of patients with infection. In our study, the percentage of the effect of infection on the occurrence of dehiscence is much higher.

Comparing the results with the results of international studies in this paper comes to the conclusion that our results are not worse than the results of the world's health task.

Conclusion

Dehiscence of laparotomy occurs in less than 5% of patients. In patients under sixty years and in the presence of infection, dehiscence of laparotomy is common. Dehiscence of laparotomy occurs less frequently in patients with systemic connective tissue disorders. By analyzing these three risk factors, the surgeon can identify patients at high risk and take all measures for prophylaxis.

In this paper, for the first time, we present a grouping technique in analyzing risk factors: the presence of patient age, infection and systemic connective tissue disease on the occurrence of dehiscence of laparotomy. We show that the minimum sum-square modeling group is well suited for these purposes. Moreover, we show that some hypotheses can be performed automatically instead of assuming their validity, and then testing in the usual statistical way. The future work may consist of the further implementation of other clustering paradigms for the analysis of various risk factors for performing surgical operations, as well as in medicine in general.

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