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Original article

Accreditation and dedication in Coloproctology is associated with good perioperative care

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A B S T R A C T

Complex data analysis methods require optimisation techniques such as evolutionary algorithms in order to generate reliable results.

The objective of this study is to analyse the relationships of particular perioperative care in colorectal surgery (CRS) with surgeon epidemiological data, performing partition grouping to look for significant relationships.

Methods: Data were used from a survey of members of Spanish coloproctology associations on perioperative care in colorectal surgery, and analysing the responses associated with mechanical bowel preparation (MBP), nasogastric intubation (NGI), drainages (D), and early feeding (EF), over the existing scientific evidence (SE) which shows that the first ones are unnecessary and the importance of the last one. We applied a variant of particle swarm optimization (PSO), to group data conglomerates, optimising variables with statistical grouping criteria.

Results: A total of 130 surveys were analysed, finding 2 clear groups which included 21.5% and 78.5% of the sample, respectively. Sixty eight per cent of the surgeons in Group A belonged to the European Board in Coloproctology, compared to none in Group B, and the former performed 80% of the coloproctology activity, compared to 60% of the rest. A responded homogeneously to questions on MBP, NGI, D and EF, those of group A following the SE, while the others did it randomly and without following it. Age, work position or academic range were not significant in the grouping.

Conclusions: The evolutionary algorithm was shown to be able to identify groups according to the use of perioperative care in CRS. Accreditation and dedication was associated with behaviour based on the SE.

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La acreditación y dedicación en Coloproctología se asocian a buenos cuidados perioperatorios

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RESUMEN

Los métodos complejos de análisis de datos precisan de técnicas de optimización tales como los algoritmos evolutivos para generar resultados fiables.

El objetivo de este estudio es analizar las relaciones de determinados cuidados perioperatorios en cirugía colorrectal (CCR) con datos epidemiológicos de cirujanos efectuando un agrupamiento particional para buscar asociaciones relevantes.

Métodos: Se emplearon datos de una encuesta sobre cuidados perioperatorios en CCR a miembros de las asociaciones coloproctológicas españolas, analizando respuestas relacionadas con preparación cólica (PMC), sonda nasogástrica (SNG), drenajes (D) y alimentación precoz (AP), sobre las que existe evidencia científica (EC) que muestra innecesarias las primeras e importante la última. Aplicamos una variante de Particle Swarm Optimization (PSO), para agrupar conglomerados de datos optimizando variables con criterios de agrupación estadística.

Resultados: Se analizaron 130 encuestas hallando 2 grupos claros que incluían respectivamente al 21,5 y 78,5% de la muestra. El 68% de cirujanos del grupo A eran European Board in Coloproctology, frente a ninguno del B y los del primero desarrollaban 80% de actividad coloproctológica frente al 60% del resto. A preguntas sobre PMC, SNG, D y AP respondieron homogéneamente siguiendo la EC los del grupo A, mientras los otros lo hicieron de modo disperso y sin seguirla. Edad, puesto de trabajo o rango académico no fueron relevantes en el agrupamiento.

Conclusiones: El algoritmo evolutivo se ha mostrado capaz de identificar grupos según el empleo de cuidados perioperatorios en CCR. La acreditación y dedicación se han asociado a comportamientos basados en la EC.

Introduction

Computer systems that are able to extract large quantities of data, and recognise, classify and diagnose patterns, are based on efficient search techniques, as well as those that are able to adapt and show an ability to learn. To do so, they process high-dimensional and multimodal spaces. Traditional clustering methods, such as Partitioning Around Medoids (PAM)[1] are only efficient for small databases.[2] Others are adequate but only if the variables are constrained in intervals.[3] Evolutionary algorithms, which imitate certain natural principles, have been used in many fields. One of them is particle swarm optimisation (PSO),[4] which originated from a simulation of a simplified social system: the elegant but unpredictable movement of a flock of birds.

Recently, authors have described a PSO algorithm adapted to consider continuous and discrete variables, which can find solutions much more efficiently by introducing diversity to a population, and by choosing adequate parameter values through a self-adaptive control.[5-7]

Perioperative surgical care is currently being reviewed, and evidence-based medicine has shown that obsolete techniques are still being employed. Coloproctology is not only an exception, but is one of the areas in which most concepts have been developed, such as multimodal or fast track rehabilitation, which reduce morbidity and secondarily, postsurgical stays.[8-10] However, this type of care is traditionally linked to surgical training customs, meaning that it is not easy for it to change in practice.

The aim of this study is to analyse the relationships that certain colorectal perioperative care methods have with surgeons' epidemiological data, linking them to relevant facts that are hidden in the database obtained from surveying members of Spanish coloproctology associations.

Material and method

Databases

We used data from a survey that was e-mailed to members from the coloproctology section of the *Asociación Española de Cirujanos* (Association of Surgeons) and the *Asociación Española de Coloproctología* (Association of Coloproctology), performed between December 2006 and February 2007. The survey included 12 questions on demographic and general data, 87 on the use of various perioperative procedures, and 83 on surgeons' opinions of these procedures. It was sent to 413 surgeons, with 130 respondents. The survey results have recently been published.[11-13] For our study, we have chosen 35 questions related with mechanical bowel preparation (MBP), nasogastric intubation (NGI), drainage (D), and early

feeding (EF), given that there is enough existing scientific evidence (SE) on their use. Variables related to personal data, profession, and education formed part of the 45 study fields.

Partitional clustering

A cluster is a group of similar objects.[14] Partitional clustering algorithm tries to assign a set of objects into *k* clusters, so that the similarity between the patterns of a given cluster is at a maximum, and the patterns are as different as possible for the different clusters.[15] A fitness function has been recently published to measure similarity and difference.[16] The objective is to obtain the prototype coordinates for each of the clusters (values for each one of the fields), so that the fitness function reaches its optimum value. For each cluster, the object obtained with these coordinates is called the cluster medoid (Figure 1). Optimisation, which is performed by the PSO algorithm, aims to obtain the coordinates for each medoid. The database consists of 130 records, each one of which has 45 variables. As such, 45x*k* decision variables or dimensions were involved in the process, all of which are different. Robust algorithms are needed, such as the PSO variant that we used, when searching for optimum values in a space of this size and these characteristics.

The mathematicians involved in this study were not aware of the sample's statistical analysis results, or the scientific reality of the problem, and they approached the problem as if they were not professionals in the area.

The data were then obtained for both each cluster and the overall sample. They were analysed by surgeons involved in the area, with the SPSS® statistical software package, version 15 for Windows (SPSS Inc. Chicago, IL, USA). The chi square test and Fisher's exact test was used to compare the qualitative variables, considering $P<.05$ as statistically significant.

Results

We carried out a cluster analysis evaluating different possibilities, such as finding 2, 3 or 4 clusters. The result was two clusters (as presented here) and when we tried to find more than two, the algorithm found two again, with secondary clusters, and several data were lost. We therefore identified two clear clusters within the surveyed population. The first (cluster A) included 28 (21.5%) and the second (cluster B) 102 (78.5%) respondents (Figure 2).

Most of cluster A (67.8%) had a European Board of Surgery Qualification in Coloproctology (EBSQ-C), but none of cluster B did; $P<.0001$. Cluster A members had more specific coloproctology experience (80% of surgical interventions) compared to 60% of cluster B; $P<.012$. Thirty-five per cent of cluster A members used colorectal laparoscopic surgery compared with 22% of cluster B: $P<.068$.

There were no differences with regards age, sex, years of work experience, type of hospital, university level or

Figure 1 – a) Two-dimensional database: there is data that is not easily comprehensible; b) two clusters identified; c) medoids (stars) represent clusters. Very complex functions with different types of variables and highly dimensional spaces are needed to find them. (Evolutionary algorithms seem essential).

Figure 2 – Partitional diagram. The silhouette graph clearly shows two clusters: A and B: the first is made up of 28 respondents and the second of 102.

professional range, but 92.3% of cluster A had a doctorate compared with 47.5% of cluster B; *P*<.0001.

We studied four fundamental perioperative care methods in the survey, MBP, NGI, D, and EF. The overall results are shown in Table 1 and the comparison between the clusters in Table 2. Cluster A members did not agree with using MBP, while cluster B members continued using it, and there was only agreement between the two clusters in that it should be used for rectal surgery. In more specific questions, cluster A members believed that it did not reduce infections or anastomotic dehiscences, and that it even aided hydroelectrolytic depletion. Cluster B's opinions were completely contradictory, and although both clusters agreed that MBP should be used less, cluster B considered it useful.

Cluster A surgeons never employed drainages, or only used them for rectal surgery, while cluster B often performed drainages in colic surgery. Both clusters behaved similarly with regards rectal surgery. When asked their opinion about drainage use, cluster A members did not consider it very useful, while cluster B members thought it was useful or very useful.

Cluster A members never used NGI, and cluster B employed them selectively. Once again, specific opinions with regards their use were different and as such, cluster B considered NGI to reduce vomiting and postoperative ileus, although it increased lung infections. Cluster A agreed with this last point, although they did not believe that it was necessary to use them. Cluster B however accepted their use.

Cluster A started EF on 0 or 1 day after open surgery or laparoscopy with anastomosis, and cluster B waited for peristalsis to start in both cases. Cluster A members did not link EF with an increase in anastomotic leaks, which was the opposite of cluster B's opinion. However, both clusters agreed that EF reduced postoperative ileus. Cluster A considered this method to be very useful, but cluster B did not share this opinion.

Lastly, fast-track protocols were considered. Cluster A used them, while cluster B showed clear scepticism or were unaware that they existed. Once again, when asked to provide detailed opinions, cluster A clearly considered that they reduced hospital stays and postoperative complications, and improved the patient's wellbeing, without increasing risks. Many of cluster B's responses revealed that there was a lack of knowledge about fast-track protocols, given that they considered that they increased risks. As a result, cluster A surgeons considered it very useful, whereas those in cluster B did not consider it useful.

Conducting a comparative study of the overall sample's different variables, we were able to conclude that the attitudes firstly of European Board-accredited surgeons, and secondly of those that performed the most rectal resections, were most in line with current SE. However, age, university education, type of hospital, among others, did not influence this (Table 3).

Table 1 – General characteristics of the answers obtained according to the cluster

	Cluster A	Cluster B
Using mechanical bowel preparation (MBP)	No	Yes
Using MBP in right colon surgery	No	Yes
Using MBP in left colon surgery	No	Yes
Using MBP in rectal surgery	Yes	Yes
Using drainage	Selectively	Routinely
Using drainage in colic surgery	Low	Mid-high
Using drainage in rectal surgery	Mid-high	High
Using nasogastric intubation	Never	Selectively
Oral tolerance in open surgery	Day 0 to 1	After peristalsis
Oral tolerance in laparoscopic surgery	Day 0 to 1	After peristalsis
Fast track protocol	Very useful	It is not safe.

Table 2 – Statistical analysis of the answers according to the cluster

	Cluster A	Cluster B	P value
Using mechanical bowel preparation (MBC)	43	99	<.0001
Using MBP in right colon surgery	8	73	<.0001
Using MBP in left colon surgery	48	100	<.0001
Using MBP in rectal surgery	92	100	.044
Routinely using drainage	11	53	.00016
Using drainage in colic surgery	31	59	.0076
Using drainage in rectal surgery	68	89	.0073
Routinely using nasogastric intubation	0	28	.0003
Early oral tolerance[a] in open surgery	67	25	.00031
Early oral tolerance[a] in laparoscopic surgery	74	38	.00043
Fast track protocol is considered to be very useful	86	25	<.0001

Values are percentages.
[a]Days 0 to 1.

Discussion

Data mining has helped us classify the use of certain perioperative care methods for a group of Spanish surgeons, allowing us to relate them with certain relevant facts that were not previously evident.

Objectives of clustering analysis are very varied and include a wide range of activities such as searching "natural" groups and generating hypotheses. Similarity is one of the most essential objectives, i.e. proximity between each of the objects in a given cluster, meaning that dissimilarity is employed to explain the differences between them. Databases contain different types of variables, and they should be treated correctly so that the similarities can be calculated,[16] otherwise bias may result. Clustering algorithms that are able to manage different types of attributes are therefore needed, and some, such as PAM or others, are not able to do so. This type of analysis is not very common in medicine, where statistics is more frequently employed and groups are decided *a priori*. However, specific mathematical analysis allows clusters, which would otherwise remain hidden, come to the surface. For many partitional algorithms, a number *k* of clusters can be fixed *a priori*. However, to perform a correct partition, a function must be formulated which assesses the partition in line with the data group.

Evidence-based medicine is a very important tool for improving medical care quality and efficiency. However, it seems very difficult to ensure that the SE available has a practical impact on to the patient.[17,18] This study shows that recent changes in perioperative management of colorectal surgery (CLS) patients needs to be more deeply understood and applied to clinical practice, to be able to offer patients a more efficient, comfortable, safer and quicker recovery. Only two clear profiles were found in the database cluster analysis: one of them was formed mostly of accredited surgeons which had EBSQ-C qualification issued by the European Union of Medical Specialists, based on curricular guidelines and experience, and a peer review. The cluster analysis did not identify any subsets for age, experience, profession, academic level, university education or work place. Nor were any clusters found for the number of laparoscopic interventions or colon resections performed. However, statistically speaking, coloproctology specialisation and the number of rectal resections performed were associated with SE-supported behaviour. Therefore, experience itself is not conclusive in this respect, nor does it guarantee that professionals have knowledge of perioperative care methods. Therefore, professionals should be encouraged to change routine practice by accessing knowledge sources, which is without a doubt much easier than in the past. Cluster A members did however have a higher academic level than cluster B, suggesting greater scientific interest.

Therefore, the role of specialised education and accreditation to update knowledge and understanding of SE-based protocols is generally highlighted. When the database was statistically analysed, it showed that this accreditation was once again significantly in line with the best evidence available, mostly being grade I.[19,20]

We must consider the fact that most Spanish surgeons, as many others worldwide, continue to follow traditional habits with regards postoperative care. Although multimodal rehabilitation and fast-track surgery have a significant impact and positive effect on postoperative recovery, they are gradually, although slowly, becoming more widely used in surgery because scientific associations and important specialist work clusters are promoting these methods. Their results should encourage us to adopt these new techniques and health authorities should participate in developing specific training programmes to improve the health system's efficiency, being more cost effective and achieving better results.

Conflict of interest

The authors affirm that they have no conflicts of interest.

Table 3 – Percentage of use of different perioperative methods for the whole sample

	MBP, %	D, %	NGI, %	EF, %
Age				
<45 years	89.6	41.3	18.9	32.8
45 and over	84.7	36.9	26	32.4
P value	ns	ns	ns	ns
Years of professional experience				
<15	89.4	45.6	24.5	25.4
15 or more	84.5	34.7	22.2	36.1
P value	ns	ns	ns	ns
University education				
Yes	87.8	36.4	18.2	24.2
No	87.5	39.6	23.4	21.9
P value	ns	ns	ns	ns
Type of hospital				
District	89.5	31.6	21	15.8
University	93.1	43.1	20.7	19.3
P value	ns	ns	ns	ns
Colorectal surgery experience				
<75%	94.9	44	27.1	15.2
75% or more	80.3	33.8	18.3	39.4
P value	0.009	ns	ns	0.001
European Board[a]				
Not certified	91.9	44.6	25.9	20.5
Certified	55.5	0	0	77.7
P value	0.002	<0.0001	0.007	<0.0001
% laparoscopic surgery				
<30%	87.2	40.4	30.3	28.1
30% or more	85.3	35.7	7.1	28.6
P value	ns	ns	0.001	ns
No. of colon resections per year				
<40	88.9	38.8	26.7	22.2
40 or more	77.2	37.5	12.5	42.5
P value	ns	ns	0.037	0.018
No. of rectal resections per year				
<12	98	48	34	14
12 or more	80	32.5	15	37.5
P value	0.001	0.077	0.011	0.002

D indicates routine drainage; EF, routine early feeding (start at 0 to 1 days postoperation); MBP, routine mechanic bowel preparation; NGI, routine nasogastric intubation; ns, not significant.
[a]European Board on Coloproctology, EBSQ-C.

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