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Scoring systems for postoperative mortality in left colonic peritonitis

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A B S T R A C T

Left colonic perforation is associated with high mortality and morbidity. The identification of risk factors for postoperative mortality led to the development of scoring systems with prognostic values that have been used in various clinic situations and some of which were designed specifically for surgical patients.

Severity index allows the mortality and morbidity risk to be quantified and predicted based on physiological, analytical, or clinical factors; its application is a valid and rigorous method to calculate the probability of complications and postoperative death.

The use of a score system that can provide an objective assessment of individual postoperative death risk is an important aid for an accurate planning of treatment and for management of health resources, mainly where patients may need intensive care.

Índices pronósticos de mortalidad postoperatoria en la peritonitis del colon izquierdo

Palabras clave:
Peritonitis cólica
Perforación cólica
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R E S U M E N

La peritonitis secundaria a perforación del colon izquierdo conlleva mortalidad y morbilidad elevadas. La identificación de factores de riesgo de mortalidad postoperatoria ha llevado a la elaboración de sistemas de puntuación con significado pronóstico que han sido aplicados a diferentes escenarios clínicos y alguno ha sido diseñado específicamente para pacientes quirúrgicos.

Los índices de gravedad permiten cuantificar y predecir el riesgo de morbilidad y mortalidad según parámetros fisiológicos, analíticos o clínicos, y su aplicación es una forma válida y rigurosa para medir la probabilidad de complicaciones y mortalidad postoperatoria.

El uso de un sistema de puntuación que pueda proporcionar una estimación objetiva del riesgo individual de mortalidad postquirúrgica del paciente es una gran ayuda para una correcta planificación de la estrategia terapéutica y para la gestión de recursos sanitarios, principalmente ante enfermos que requieren estancia y tratamiento en unidades de cuidados intensivos.

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Introduction

Peritonitis following perforation of the left colon is a clinical issue relating to high mortality and morbidity indexes despite progress made in the management of intra-abdominal infections and improvements seen in the fields of anaesthesiology, surgery, and intensive postoperative therapy.

The availability of new and more precise diagnostic measures, the general improvement in surgical recommendations and improvements to the operative techniques have contributed to a decrease in postoperative complications and mortality. Mortality rates vary between 5% and 35% depending on different publications and in keeping with the aetiology and the type of surgical procedure applied.[1-6]

Short term survival rates in patients with peritonitis following perforation of the left colon depend on the relationship between different factors: age, gender, general health, coexistence of other illnesses, aetiology of the disease, and degree and length of development time of the peritonitis. Due to the higher longevity of the general population these days, emergency departments now see very elderly patients and with more comorbidity, especially of a respiratory and cardiovascular nature, and this increases the occurrence of colonic lesions of ischaemic aetiology. The elderly patient who has come from a rest home or care centre, at times, arrives at hospital days after peritonitis has started and in a dangerous clinical state, with advanced sepsis. A possible state of congenital or acquired immunodeficiency, following substitutive treatment with corticoids, chemotherapy or immune-suppressors after the transplant, leaves a patient more vulnerable to infection: the systemic inflammatory response is defective, the diagnose method tends to be atypical and not very evident and frequently there is a delay in the therapeutic effects.[7] In the case of perforated cancer, the immune disorder induced by neoplasia is added to the metabolic repercussion caused by the sepsis, thereby worsening the prognosis.

The clinical relevance of peritonitis following colic perforation has, over many years, led to the identification of risk factors with postoperative mortality prognosis. The first factors studied are the patients age, concomitant illnesses, septic shock, organ failure, the development time of the perforation and the origin of the peritonitis.[8-10]

Morbidity prognostic indexes

The first indexes for disease severity were developed in the 1960s with the aim of quantifying and predicting the general risk of morbidity and mortality according to physiological and analytical parameters. Different indexes and scoring systems have been developed over the last decades with postoperative mortality prognosis ability. They have mainly been established using patients in a critical clinical state and some have been specifically designed for surgical patients.[11]

Different classifications have been applied for specific clinical scenarios such as the Ranson index[12] for pancreatitis or the Child index[13] for hepatic failure. Many authors have studied variables on an isolated basis and they have seen that septic shock and concomitant illness are factors predictive of postoperative mortality in colic perforation.[8,9] Different postoperative morbidity and mortality-predicting risk factors have been identified and prognostic indexes have been developed for surgical patients, although not specifically for emergency procedures or colorectal diseases.

The American Society of Anesthesiologists (ASA) classification system has been widely used since 1963.[14] Despite being a poorly defined and subjective classification, different studies have demonstrated the relationship between the ASA's grading and postoperative mortality.[9,15,16] It has also been shown that the ASA's grading and a person's age are directly related with the length of hospital stay, the postoperative complications index and the number of medical visits after being discharged from hospital.[17] The Cardiac Risk Index (CRI) designed by Goldman assesses the probability of cardiological complications in patients undergoing non-cardiac surgery.[18] The Prognostic Nutritional Index (PNI) was developed to predict the risk of postoperative complications according to the preoperative nutritional state: serum concentrations of albumin and transferrin, thickness of the tricipital skinfold and cutaneous hypersensitivity and average response time to the intradermal injection of different antigens are related to the development of postoperative sepsis and death. The PNI can be used to select patients who can receive preoperative and postoperative nutritional support.[19] The Mortality Prediction Model (MPM) was initiated 1985, which considers the following to be postoperative mortality risk factors: age, cardiac frequency, systolic arterial pressure, the type and urgency of surgery, if there has been resuscitation prior to hospital admission, malignity of the process, chronic renal insufficiency, previous history of hospital admission in an intensive care unit, infections, and coma.[20] Subsequently, this index was modified to MPM II for patients with sepsis.[21] Sepsis Score,[22] Sepsis Severity Score,[23] and Prognostic Index[24] are other indexes with mortality predicting values: they were specifically designed for patients with sepsis, but they have not been widely used.

APACHE II (Acute Physiologic And Chronic Health Evaluation)[25] is probably the most well known and used prognostic device in clinical practice. It was specially designed for patients with a severe degree of illness who had been admitted to intensive care units: it uses 12 variables which include physiological, clinical, analytical and haemodynamic parameters and for each variable it considers the worst value registered for each variable during the first 24 hours of hospital admission. APACHE II is a very relevant scoring system and it has demonstrated its utility in patients with intra-abdominal origins who are suitable for surgery, with a high degree of correlation between scores and mortality.[26,27] However, it is not an index specifically for surgical patients, it does not look at the prognostic importance of factors related to surgery such as characteristics of the peritoneal liquid and the origin of the peritonitis and it does not distinguish between urgent and elective surgery. Its management is difficult in the emergency department as it requires obtaining data on some parameters which are hard to achieve, since they

require monitoring which limits their application in patients admitted to intensive care units. There are studies which conclude that this index has better prognostic significance when it is applied to patients undergoing emergency surgery with regards those admitted electively.[28] However, there are those who consider that APACHE II undervalues mortality in non-surgical patients and in high risk surgeries, whilst it overestimates the possibility of death in low risk patients.[28]

APACHE III was developed with the intention of improving APACHE II's mortality risk prediction, which according to various authors, underestimated the impact in hospital mortality of some physiological variables such as arterial hypertension.[29] New parameters were included such as diuresis, serum content of albumin, bilirubin, urea and glucose, the chronic base illness, the location of the patient prior to the intensive treatment (home, another hospital or department, in surgery), the reason for admission and the distinction between urgent and elective surgery. The higher number of variables makes collecting data harder and therefore more subject to errors. The risk of hospital mortality can be estimated only for homogenous groups of patients and not individually, also, it is only applicable for patients with similar illnesses, and in the case of an unusual or rare illness the system cannot offer such an adequate or similarly precise estimation of the risk.

The POSSUM index (Physiological and Operative Score for the enUmeration of Mortality and morbidity) was described by Copeland et al[30] in 1991. They identified 12 physiological parameters and 6 operative parameters such as risk of mortality and morbidity, and they used a scoring system. Estimation of mortality risk was obtained by applying a complex method of exponential statistical regression analysis. The systems received criticism for not using a standard calculation technique, being difficult to evaluate the individual risk of morbidity and mortality[31] and because it overestimated the mortality prognosis in patients of low surgical risk.[32] With the aim of improving these aspects, Whitely et al made some modifications to the calculation methodology of the originating variables and developed P-POSSUM (Portsmouth predictor modification)[32] which uses less complex lineal-type regression analysis. These indexes were considered useful as, in contrast to other systems already in use, they had all the physiological and surgical criteria together. Subsequent studies revealed that both the POSSUM system and the P-POSSUM overestimated the prediction of postoperative mortality in patients undergoing elective colorectal surgery, whilst it underestimated it in patients undergoing urgent colorectal surgery.[33] This lack of precision lead to the development of a more specific index, the CR-POSSUM (Colorectal POSSUM),[33] used in colorectal cancer surgery. However, POSSUM, P-POSSUM and CR-POSSUM have been widely used for studies into mortality and morbidity in different surgical situations and to compare results between different countries and health systems,[34] they are based on systems that are not specific to urgent surgical procedures and they do not look at operative variables such as the type and degree of peritonitis or the cause of the perforation.

A common disadvantage of the aforementioned indexes is that they include laboratory data or analytical parameters and organ function data that does not always have a direct correlation with the beginning and progression of an intra-abdominal infection process, with the development of peritonitis and the initiation of a sepsis situation. Another disadvantage is that its design and variables are aimed at determining results in groups of patients with similar clinical characteristics, whilst they do not allow for the individual patient's risk of mortality to be observed.[35]

An ideal scoring system should be able to be applied equally in intensive medical departments such as emergency departments and in conventional hospitals with different levels of care. It should be practical and easy to use, reproducible and its calculation procedures should be fast and agile. The variables to consider should be objective and contain specific data or factors so that results can subsequently be shared between surgeons and different hospitals. An element that contributes to the improvement of a severity scoring system is its specificity in relation to the illness and the clinical context, urgent or elective.

The Mannheim Peritonitis Index (MPI) was the first severity scoring index designed aimed at assessing and providing prognosis of individual postoperative mortality for patients with peritonitis who could receive surgical treatment. First described in 1987 by Wacha et al,[10] the index was developed using analysis of 20 potential factors of pre-surgical and intra-operative risk of which only 8 had significant relevance. The severity of intra-abdominal sepsis is in relation to variables such as age, gender, organ failure, presence of neoplastic lesion, duration of the peritonitis, extra-colonic origin of the perforation, extent of the peritonitis and characteristics of the peritoneal liquid. The multivariate analysis showed that the most clinically relevant factors were pre-operative organ failure and purulent or faecal peritonitis. The MPI has been widely used in numerous centres and applied to different surgical scenarios and its efficiency has been assessed in multiple studies, some multicentric.[36] Comparative studies have shown that its predictive ability for postoperative mortality exceeds that of APACHE II.[36,37] The main advantages are due to the fact that it is an easy-to-apply system as it offers estimates of individual mortality risk: each variable can be calculated in regular clinical conditions, rapidly and without technical assistance, and it records only during the intervention. This index is specific for patients with peritonitis for urgent surgical treatment and it attributes importance to operative parameters such as the characteristics and extension of the peritoneal exudate and the development time of the peritonitis. However, with regards the variables that the systems takes into consideration, it is surprising that the colonic origin of the peritonitis is not considered as a severity factor as it does not increase the scoring, and consequently, it is not related to higher mortality. For this very reason, it is difficult to understand the wide use that is made of this scoring system in mortality studies of mortality in peritonitis of a colic origin.

A new peritonitis scoring system was unveiled in the year 2000; the Left Colonic Peritonitis Severity Score (PSS), developed specifically for perforations of the left colon and based on physiological and surgical objective parameters.[38] Univariate logistic regression analysis was used to assess the

relationship between different prognostic factors studied and described by previous authors, and postoperative mortality. The variables that were statistically significant in relation to higher mortality were >70 years of age, the degree of ASA III-IV, presence of preoperative organ insufficiency, ischaemic colitis, diffuse purulent or faecal peritonitis and the possible state of immunodeficiency. The multivariate analysis identified factors of a bad prognosis such as the degree of ASA IV and preoperative organ failure, therefore these conditions increase the scoring, which can vary between 6 and 14. Recently a prospective study, which compared the mortality-predicting ability of the PSS system and the MPI system in patients operated on due to perforation of the left colon, analysed the prognostic significance of the PSS.[39] Both systems were adequate for identifying patients with higher risk of postoperative mortality, although the descriptive analysis of the results has shown that the PSS is more precise than the MPI in predicting postsurgical mortality, especially in patients with intermediate scoring. In certain cases, before PSS scores between 6 and 8, resection with primary anastomosis would be indicated as the procedure of choice, whilst high PSS values (12-14) would require less aggressive surgery, such as Hartman's Procedure. There is some debate over which type of operative technique to use with intermediate PSS scores of 9 and 11.

PSS and MPI are objective scoring systems and they are easy to use under common conditions, allowing the selection and classification of patients according to the individual risk of mortality. However, an important differentiating characteristic between them is that the PSS system has been designed specifically for application on patients with septic complications of the left colon as a consequence of a perforation, whilst the MPI system is an index which is valid in peritonitis of any aetiology. This prerogative, together with the inclusion of variables that reflect the physiological-pathological state of the patient at the time of surgery, increases the clinical significance of the PSS system as a predictive index of postoperative mortality. Factors such as advanced age and generalised peritonitis are not absolute contraindications for colonic resection with primary anastomosis, whilst preoperative organ insufficiency, possible state of immunodeficiency and the presence of ischaemic lesion of the colon are factors of bad prognosis.

Discussion

The possibility of achieving an objective estimation of the individual risk of postoperative morbidity and mortality using preoperative clinical assessment is of great help for the correct planning of a therapeutic strategy and for the management of high-cost health, technological and pharmaceutical resources, principally faced with patients requiring treatment and a stay in intensive care units. The gross mortality rates are commonly used resources for comparing surgical results amongst different centres and health systems, but they represent limited and potentially misleading indicators of quality of care.[40,41] The use of a scoring system for mortality prognosis provides a more objective and rigorous way of measuring the probability of complications and death following hospital admission, medical treatment or surgery. The use of scoring systems such as the PSS system is a useful tool when choosing and modulating surgical treatment in keeping with the clinical characteristics of the patients and their illness. The application of one of these systems allows identification of patients that, due to their low risk of postoperative mortality, can benefit systematically from urgent surgery with primary anastomosis. They also facilitate the selection of patients who are suitable for receiving a process of preoperative clinical optimisation that could contribute to improving their short term survival rate. In the field of urgent surgery, when sudden therapeutic decisions need to be made frequently in the same surgical act, the ability to carry out a rapid and easy prognostic assessment which is also exhaustive and mindful of the patient, is hugely important.

An ideal mortality-predictive index or scoring system should be based on objective parameters which reflect the clinical conditions of the patient at the time of the surgery and which consider the physiological-pathological state prior to surgery: often the laboratory results do not correlate with the severity of the peritonitis. In addition to this, the system should be easy to use and calculate, reproducible in common conditions and should be highly specific and sensitive. The aetiology of the perforation is a variable which must be taken into consideration as there is evidence that immunodeficiency related with cancer and ischaemic lesion of the colon increase the mortality potential of the process.

The surgical technique does not relevantly influence the survival of patients with perforation of the left colon.[42] The morbidity and mortality of the patients with Hinchey peritonitis (grade 3 and 4) treated with Hartmann procedure is no less than that of patients undergoing resection and primary anastomosis: existing literature mentions rates that oscillate between 15% and 20%, although recent studies have published values of up to 40%.[39,43-46] This data indicated that Harmann intervention cannot be considered to be a safer procedure than resection with primary anastomosis and that less aggressive surgery does not always offer more guarantee of survival or better overall results. Probably the high mortality rates associated with Hartmann are due to the inclusion of a large proportion of very high surgical risk patients due to their age, significant co-morbidity due to cardiovascular, respiratory or renal illness, or an illness secondary to a precarious immunitary state due to the coexistence of another neoplasia, concomitant chemotherapy treatment or corticoid substitution. However, in patients with a low postoperative risk of mortality chosen via the use of severity indexes, it is possible to carry out surgery during a period of resection and anastomosis, even in the presence of diffuse purulent or faecal peritonitis.[47,48]

Conclusions

Despite their undoubted clinical use, the use of scoring systems with prognostic ability should be very flexible and well thought out: the choice of the surgical technique will

also depend on other factors such as the haemodynamic state of the patient during the surgical procedure, their family and social environment, the surgeon's experience and the working conditions in which he/she is operating. In the management of abdominal sepsis of a colonic origin, the application of a scoring system should be seen as a useful working tool at the time of choosing the most suitable therapeutic strategy for each patient and planning surgical interventions that are more or less aggressive depending on the individual risk of postoperative death.

In view of the current tendency of the different health systems to classify hospitals in accordance with parameters such as mortality rates and length of hospital stay, it is very important to ensure that these data are adjusted by severity of illness and therapeutic procedure.

The prognostic indexes are a valid method for comparing results and studies between different hospitals and surgeons, as they allow for stratification and classification of patients depending on objective parameters of severity. Other useful applications are for research purposes, the proposal and evaluation of new therapeutic strategies and the assessment of the use and distribution of resources.

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