Cardiac Complications of Non-Cardiac Surgery: Initial Approaches in the General Low-Risk Population in Spain

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Postoperative cardiovascular mortality and morbidity associated with noncardiac surgery is a field in which a great deal of research effort has been invested for many years, due to the fact that it has important implications, both from a clinical and an economic perspective.[1] It is worth noting that cardiovascular events are relatively frequent in noncardiac surgery and their incidence is estimated, depending on the study, at 1% to 5%.[2-5] The impact of these figures can be estimated if we take as an example a country such as the United States, where each year around 30 million surgical interventions are performed and around a third of those patients present coronary artery disease or risk factors for coronary artery disease.[6] Out of all of these procedures, it is calculated that around 1 million may present cardiovascular complications, including perioperative myocardial infarction or cardiovascular death. Some of these patients present especially high risk. This is true for patients who undergo vascular surgery, in which the incidence of cardiovascular events can reach 34% and in which perioperative infarctions can cause rates of mortality ranging from 25% to 40%, at an estimated cost of around 20 000 million dollars.[7] These considerations, among others, have led various scientific societies to prepare guidelines on appropriate treatment in these patients.[8-10]

The complexity of the problem, with the associated costs, has led to various studies being performed in an effort to identify factors that will allow a risk stratification to be developed. The results of these studies have been incorporated in the various clinical practice guidelines, which recommend that the initial approach to stratification of the risk is based on the clinical characteristics of the patients and the procedures.[8-10] Of

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the various indexes proposed (American Society of Anesthesiologists [ASA],[11] Goldman et al,[12] and Detsky et al[13]), the Revised Cardiac Risk Index (RCRI) published by Lee et al[14] in 1999 appears to be the best for predicting the probability of cardiovascular events. This index was developed through multiple regression analysis in a large cohort of patients divided into 2 groups: the first for derivation to identify predictors and the second for validation. The authors identified 6 clinical variables and characteristics of the procedure with the capacity to discriminate the risk of cardiac complications: *a)* high-risk surgery (intraperitoneal, intrathoracic, or vascular suprainguinal); *b)* history of coronary artery disease (excluding previous revascularization); *c)* history of heart failure; *d)* history of stroke (including transient ischemic attack); *e)* diabetes treated with insulin; and *f)* renal failure with creatinine concentrations of greater than 2 mg/dL. This index allows the patients to be stratified into 4 groups according to the number risk factors that they accumulate, with an estimated rate of events (%) specific to each group: 0 (without risk factors), with a rate of events of 0.4% (95% confidence interval [CI], 0.05-1.5); I (single risk factor), estimated rate of 0.9% (95% CI, 0.3-2.1); II (2 risk factors), estimated rate of 6.6% (95% CI, 3.9-10.3); III (≥3 risk factors), estimated rate of 11% (95% CI, 5.8-18.4). Following initial clinical stratification, noninvasive tests should be used to evaluate ischemia in patients at intermediate risk and with high-risk surgical procedures, and invasive tests would be indicated in patients at high risk or in whom the results of invasive tests would alter the treatment.[6,8-10]

Taking these considerations into account, it should be noted that despite the abundance of data from the English-language literature on cardiovascular risk in noncardiac surgery, similar data appears to be limited in Spain. Only 2 large studies are available that specifically evaluate this problem in our country[15,16]; those studies were performed in selected populations that for various reasons already presented an a priori elevated risk. In the study of Sabaté et al,[15] which addressed elective surgery, patients were included if they met at least 1 of the 3 following criteria: history of heart disease, major

surgery, and noncardiac risk factors. The morbidity and mortality was notable: acute infarctions, 3%; myocardial ischemia, 14%; and cardiac mortality, 4%. The factors associated with cardiac morbidity and mortality were ASA classification, prior history of heart disease, administration of cardiovascular drugs, and abnormalities in the preoperative electrocardiogram. The retrospective study published by de la Cruz et al[16] included patients who underwent elective or emergency surgery, with an age of at least 65 years and with a history of ischemic heart disease or with 2 or more coronary risk factors. Once again, cardiac events occurred at an elevated frequency: in the group with known ischemic heart disease, nonfatal cardiac events occurred in 26% of cases and cardiac mortality was 5.5%; in the group with risk factors but without known ischemic heart disease, the rates were 10% and 2.18%, respectively. The differences were statistically significant for nonfatal events but were not significant for mortality, despite the difference in the results. In principle, these results are consistent with results published in the international literature, which report morbidity of 2% to 15% in high-risk patients who undergo noncoronary surgery.[17]

The study of Puig-Barberà et al[18] in this issue of Revista Española de Cardiología analyzed cardiovascular events in a nonselected group of patients aged above 40 years in whom elective noncardiac surgery was performed in a general hospital. Given the limited data on this problem in Spain, an article of this nature must be welcomed. A prospective observational study was performed in a population in which major programmed surgery was performed, with defined objectives and inclusion criteria. A relevant characteristic, of major importance in the results obtained by those authors and useful for comparison with other studies, is that the population was not selected on the basis of the risk category of the subjects who underwent surgery, but rather, patients were included consecutively. Firstly, this would clearly account for the difference between the results of this study and those of Sabaté et al[15] and de la Cruz et al,[16] which correspond to higher-risk populations, with a higher probability of ischemic heart disease or already with ischemic heart disease. Secondly, perhaps linked to the lower prevalence in Spain of ischemic heart disease compared with Nordic or Anglo-Saxon countries—as mentioned by the authors—a low incidence of events (0.96% cardiac complications in total and a mortality of 0.27%) would seem to be justified, even lower than that published in other studies[2,14] and a recent review reporting a range of 1% to 5%.[19] In any case, the prevalence of symptomatic coronary artery disease in the study of Puig-Barberà et al[18] was low in relation to published results. It is possible that this was also affected by the inclusion of relatively young patients, since individuals aged between 40 and 50 years were included. However, a careful examination of the conditions for inclusion in the study and the characteristics of the surgery performed reveals a clear bias towards a population with a much lower risk than in other published studies. In fact, it would correspond to a population with an RCRI class of less than II according to Lee et al.[14]

In terms of the selection of patients, it is noteworthy firstly that patients were excluded if they presented complete left bundle branch block (LBBB) or had a pacemaker implanted; in other words, patients who are potentially candidates to have a higher probability of presenting heart disease.[20] In the study of Dorman et al[21] a tendency was observed towards greater mortality in patients with LBBB and the authors attributed this to intolerance of stress caused by noncardiac perioperative complications. Nevertheless, in the absence of more information regarding the structural and functional situation, the fact that a heart cannot tolerate postoperative complications and presents LBBB indicates that this could be associated with some type of heart disease. This is supported by the finding that such a tendency was not present in patients with complete right bundle branch block, which would not have the same prognostic significance as LBBB.[20] Secondly, it is noteworthy that Puig-Barberà et al[18] did not provide a definition of the criteria used for the diagnosis of acute myocardial infarction. It is not clear whether they used enzymatic criteria, which are fundamental for the diagnosis of this event.[22] The analysis of specific cardiac enzymes (isoenzyme MB of creatine kinase and, more specifically, the troponins) would have allowed diagnosis—or at least suspicion leading to subsequent tests for confirmation—of myocardial infarction independently of conduction disorders. This would have removed the need to exclude patients with LBBB and those requiring an implanted pacemaker. It should be remembered that in the context of noncardiac surgery analysis of enzymes is fundamental in the diagnosis of infarction, since other conditions, such as typical symptoms or electrical changes, are relatively infrequent, or at least clearly less frequent than in other clinical settings.[17] It is worth remembering that *a)* recent guidelines recommend their use, although in the context of clinical practice they propose a certain restriction of criteria,[9] and *b)* in a study setting it seems essential to be able to use enzymatic tools in order to assess the proposed diagnostic objectives as accurately as possible and these tools are in widespread use in published studies.[2-4,14,15] The final conclusion is that, without doubt, ischemic events and infarctions are probably underestimated: only 2 infarctions are described in 1456 patients (0.14%), clearly substantially below that reported in other studies and reviews.[2,14,17] It is also possible that if enzymatic analysis was not used systematically some episodes of pulmonary edema could have been associated with myocardial necrosis without correct diagnosis or classification of the pathophysiology, especially in patients who were already known to present ischemic heart disease. In this case,

there would also be an increase in the total number of cardiac events, since more events would be accumulated in the same patient.

In relation to the characteristics of the surgery performed, the relatively low proportion of high-risk surgical interventions is clear. If we review the definition of high-risk surgery described by Lee et al,[14] that is, intraperitoneal, intrathoracic, or suprainguinal vascular surgery, we can conclude that the percentage that meet those criteria in the study of Puig-Barberà et al[18] is around 12% (orthopedic and prostate surgery would have an intermediate risk). In addition, the proportion of vascular surgery is very low (2.7%) and we do not know the percentage of those that are suprainguinal, which carries greater risk. We can also see that they did not perform intrathoracic surgery, which is also high risk, and nor did they include head and neck surgery, which can carry greater risk than other described interventions.[9] In contrast with these data, in reference series such as those of Gilbert et al,[2] Lee et al,[14] or Reilly et al,[23] the proportion of surgery classifiable as high risk would exceed 35%, and could reach 40%. Thus, it is worth pointing out that the authors themselves indicate an accumulation of events in patients who meet the criteria for high-risk surgery: 80% of these events occurred in abdominal visceral surgery or peripheral vascular surgery, at a rate of 3.6% and 15%, respectively. This finding is also repeated in the studies and reviews mentioned here. All of this suggests that the difference in the distribution of surgical procedures—clearly less surgery considered high risk per se—has also played an important role in the final results of the study by reducing the overall risk in the series and, therefore, the final rate of events.

The considerations mentioned earlier and some others could help to explain the differences in the risk factors found in a low-risk series, such as that of Puig-Barberà et al,[18] compared with others.[12-14] However, it should be noted that there are factors which even in this study remain predictive, such as the presence of ischemic heart disease, type 1 diabetes, and visceral or vascular surgery, and even under these circumstances allow an initial clinical approach to the evaluation of cardiac risk. It is noteworthy that other important factors, such as heart failure, cerebrovascular disease, and renal failure (creatinine >2 mg/dL) are absent. It is possible that this result is linked to both the low rate of events and to the low prevalence of such conditions in the series (5.6%, 3%, and 2%, respectively), clearly lower than in other reported series.[2,14,23] Since these diseases are more prevalent with age, the low frequency could also be related to the selection of the patients, since individuals aged less than 50 years were included. In fact, in the subgroup aged less than 50 years no complications were presented. This probably accounts for the appearance of age above 75 years as a predictive factor when in classic indexes and the ACC/AHA guidelines it has little or no weight.[9,12-14] Finally, the most difficult result to explain is the observation of poorly controlled hypertension as a risk factor, since this has not been observed in any other study. Perhaps it is a specific factor that must be taken into account in lower risk populations; however, more information is necessary.

The temporal appearance of the complications deserves special consideration. As can be seen in Table 3 of their study, although 43% of the events take place in the first week, up to 50% occurred between day 8 and the third month, and the first 30 days represented those that accumulated the highest risk (78%). In this respect, the study is consistent with the results of other authors[17] and highlights that operative risk is prolonged over time and is not restricted to the procedure or the first few days. In fact, some researchers indicate that complications can be more frequent after the third day, especially in terms of ischemic complications.[17] We can also conclude from the study of Puig-Barberà et al[18] that the risk period for presentation of cardiovascular events is prolonged over time, independently of the risk classification of the study population.

In conclusion, bearing in mind the limitations mentioned, the study published in this issue of REVISTA ESPAÑOLA DE CARDIOLOGÍA shows that the incidence of cardiovascular events in a low-risk population is low. In addition, it shows that risk can be evaluated preoperatively using clinical variables, although those variables differ in part from the variables recognized for higher risk populations from different geographic locations. However, subgroups associated with a higher rate of complications can continue to be identified. These are, essentially, high-risk surgical interventions (visceral abdominal and, especially, vascular), patients with demonstrable ischemia in the electrocardiogram, elderly patients, and insulin-dependent diabetics. Since the majority of authors advocate the use of beta-blockers in the prevention and treatment of cardiac complications following noncardiac surgery,[1,6,8,9,19] their use in the subgroups mentioned should also be of therapeutic benefit. However, more studies will be necessary in Spain to determine whether the prediction models published by other authors are directly applicable to our patients or if, alternatively, we can define factors or groups with distinct risks. Until such information is available we must obviously continue applying the published recommendations. This practice must necessarily be based on appropriate preoperative clinical evaluation of cardiac risk, in an exhaustive control and a modification of cardiovascular risk factors, and in the use of appropriate techniques for cardiologic diagnosis in an effort to obtain appropriate stratification and treatment of patients. However,

according to the results presented by Puig-Barberà et al,[18] treatment of patients does not end when they leave the operating room, or even when they are discharged from hospital. In our opinion, an additional important conclusion from the study stimulating the writing of this editorial is that a system of follow-up should be implemented that allows evolution to be assessed for at least the first month and, ideally, the first 3 months following the intervention, particularly in high-risk surgical interventions.

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