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Cardiological assessment of cardiac patients undergoing non-cardiac surgery (usefulness of surveys)

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AIM OF THE STUDY: *The aim of the study was lo considerate the effective usefulness of preoperative stress test and echocardiography in adult patients with coronary artery disease, undergoing non-cardiac surgery.*
MATERIALS AND METHODS: *In the last three years, 200 patients aged 58-85, affected by stable ischemic pathology, undergoing non cardiac surgery, and treated with oral drugs, were enrolled for an assessment orotocol including anamnesis, objective examination, blood pressure, RCG, blood chemistry analysis, and was performed a cardiac risk evaluation. A second 50 patients control cohort of the same class was subjected to the same tests, and preoperative and exercise stress test.*
RESULTS: *All patients showed a good hemodynamic compensation and a quick recovery, and the group of 200 patients for whom the risk was closed without further investigation has concluded the process on average three days before the group underwent echocardiography and exercise stress test.*
DISCUSSION: *The clinical evaluation of cardiac patients waiting for non-cardiac surgery, performed through anamnesis, examinations and the ECGs, is the cornerstone of cardiac risk stratification. It also important the type of surgery, as well as some priority conditions like certain neoplastic: diseases, where it seems appropriate to speed up the diagnostic program.*
CONCLUSIONS: *When patients are hemodynamically stable and their conditions controlled by appropriate therapy, it is sufficient to perform first-level tests for the preoperative stratification of cardiovascular risk. It's recommended to perform echocardiogram and stress test when the first level tests are abnormal, when there is a worsening of the conditions prior to admission, or when the patient is not hemodynamically stable.*

KEY WORDS: Pre-operative cardiac risk.

Introduction

The estimated cardiac risk in surgical patients, has become routine practice. Despite the scientific literature

is full of publications on this, divergent points are still numerous, and often, even the most reliable guidelines are incomplete and not universally valid [1]. After a careful reassessment of the literature of the last fifteen years, we found that the greatest difficulties have arisen in an attempt to combine the risk variables related to the patient, with those related to the surgery to be performed, so that they can develop a generic perioperative risk index [2]. For this reason, more and more often is required to the specialist to perform non-invasive cardiac tests in support of the anamnesis the clinical examination. The main problem, found throughout the scien-

tific literature, is that these investigations have shown little benefit even in patients who had the greatest number of risk factors and have been shown to be not accurately predictive of possible complications related to the perioperative period. It follows, therefore, the difficulty of placing the non-invasive diagnostic cardiology, as a complement of a diagnostic analysis aimed at estimating the operative risk. In particular, the literature reveals that the positive predictive value of the noninvasive test imaging is uniformly low and that these do not provide more informations than the simple clinical assessment of risk variables. In addition, there is no evidence that the test imaging may lead to a non-invasive therapeutic strategy that reduces the risk of perioperative myocardial infarction or cardiac death [3]. In an attempt to provide valuable guidance to the specialists on the conditions in which it was regarded as capable of performing non-invasive cardiac examinations, three guidelines have explicitly credited to their recommendations. The three guidelines are:

– 2003 NICE - National Institute for Clinical Excellence (NICE). Clinical Guideline 3-Preoperative tests - The use of routine preoperative tests for elective surgery;

– 2003, 2006 ICSI - Institute for Clinical Systems Improvement (ICSI), Preoperative Evaluation, 2006, and finally;

– ACC / AHA 2007 - American College of Cardiology / American Heart Association (ACC / AHA) Guidelines on Perioperative Cardiovascular Evaluation and Care for noncardiac Surgery, 2007.

These are the only ones subjected to annual updates from the members of the Research Committee and are those to whom cardiologists typically recur for the cardiovascular evaluation in patients undergoing non-cardiac surgery. These indeed seem to be the most comprehensive and specific about perioperative cardiac risk stratification of patients and their division into degrees of risk Low, Intermediate and High is designed to separate in three major groups all the clinical-pathological variability that reaches the internist-cardiologist. However, even in this case, there are still uncertainties on the recommendations especially regarding the recourse to the use of stress testing and echocardiogram.

The aim of our study was to test the real usefulness of such surveys on a sample of cardiac patients, previously treated with coronary artery bypass graft or coronary angioplasty, hemodynamically stable, undergoing non-cardiac surgery.

Material and method

In the Surgical Institutes of our Hospital, where we provide daily preoperative cardiology consultations, we have taken into account, over the past three years, two hundred patients between the ages of 50 and 85 years, with ischemic heart disease, previously treated with coronary

angioplasty or aortal-coronary by-pass, waiting for non-cardiac surgery. We excluded from the study the ischemic patients suffering from any type of arrhythmia or affected by heart failure. The surgery included: 1) abdominal surgery, 2) thoracic, 3) thyroid, 4) orthopedic. Deliberately for the purpose of risk stratification, it was not diversified the type of surgery. Each test was carried out thorough anamnesis, physical examination, previous audits, ECG, blood pressure (BP) at the beginning and end of the audit, was controlled for the blood-chemical tests and on the basis of the clinical status, the specific cardiac risk was formulated. In a second step we took into account other 50 patients (control group) with the same characteristics. In this second group, in addition to the clinical diagnostic exams reserved for the previous group, we have prescribed an echocardiogram and a stress test, before stating the risk index. All patients in both groups were in good hemodynamic compensation, and all were treated with oral medication, that was substituted when necessary and as required for surgical treatment, with a similar IV therapy. We have provided a clinical monitoring to fifteen days after surgery. The audit was performed in I and II post-operative day and two days since the restoration of oral therapy, through cardiological examination and ECG in addition to haematological tests. All patients showed good hemodynamic compensation and a quick recovery. The group of 200 patients for whom the risk was closed without further investigations, had concluded the process on average three days before the group underwent echocardiography and exercise stress test (DST). There was no difference between the two groups with regard to the both surgical and post-surgery course, except for one small complication suffered by three patients in the second group who had sporadic extrasystolic arrhythmias, probably determined by the prolonged waiting for the surgery. This complication, which has moved further the surgery, was resolved in a short time with the prescription of anti-arrhythmic.

Statistical analysis

To establish the significance of a second level test, such as echocardiography and exercise testing, we applied the criteria of descriptive statistics. Recalling that the descriptive statistics collects information on the population, or part of it (Pattern), in simple or complex distributions (at least two characters), and descriptively sums them over families of indexes: mean values, indices of variability, statistical reports, statistical relationship; the indexes we have considered are: the arithmetic mean and standard deviation. This gives us an idea of the dispersion index of the experimental measurements (i.e. a measure of variability of a population of data) and has the same unit of measurement of the observed values. The standard deviation measures the dispersion of data

around the expected value, and in the absence of other information coincides with the arithmetic mean value of a random variable.

$$\sigma_{\mathbf{x}} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n}}$$

Where

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

is the arithmetic mean of the measured parameter.

In our development we calculated the descriptive statistics for four variables: age, min. blood pressure, max. blood pressure and heart rate, and we reported the outcome of surgery. The following table provides the values obtained from statistical processing of data recorded in the sample of 200 patients and the control group (Tab. I, II).

TABLE I - *Statistical processing of data (200 patients-Pattern)*

Parameter	Age	Pressure min	Pressure max	Heart rate
Arithmetic Mean	68	69.91	125.765	64.96
Standard Deviation	0.67	0.66	1.22	0.64

TABLE II - *Statistical processing of data (50 patients-Control)*

Parameter	Age	Pressure min	Pressure max	Heart rate
Arithmetic Mean	66.9	69	124.63	64.24
Standard Deviation	9.01	8.98	16.49	8.51

From the relative dispersion Index, that is the ratio between standard deviation and arithmetic mean of about 0.13, we have been able to verify the correlation in terms of statistical variables recorded, which then were not influenced by particular systematic factors.

At this point, we verified our hypothesis, that is the null hypothesis, by comparing the results of post-operative control group (50 patients) with the group under study (200 patients). We recall that the null hypothesis suggests a general condition, where it is assumed that there is no relationship between two observed phenomena, or in medicine, when a potential treatment has no effect on the outcome of a surgery. In other words, we measure the probability of a given outcome, just as experimentally observed, assuming that the null hypothesis is true. In our case, if the difference between the observed frequencies (probability) to have complications after surgery is statistically significant, that is highly improbable that the differences are due to randomness, then the null hypothesis is rejected, otherwise is confirmed. In our case, since there is no difference between the two groups as p (c1) $\approx$ (c2) $\approx$ 0, i.e. the probability of having postoperative complications is the same in both groups, in particular is almost zero, we can say that the null hypothesis is true, and then any additional II level imaging tests are not helpful.

Discussion

In the recent scientific literature, the ACC / AHA guidelines are the ones that best define the conditions under which the stress test or, alternatively the echo-stress, should be used. Through a progressive reduction of the strength of recommendations, such investigations are indicated in: patients undergoing vascular surgery (aortic interventions in emergency and others scheduled for major vascular surgery, even peripheral) with 3 or more clinical risk factors and poor functional capacity (<4 METs), patients with at least 1 or 2 clinical risk factors and poor functional capacity (<4 METs) candidates for urgent vascular surgery with intermediate risk, patients with at least 1 or 2 clinical risk factors and good functional capacity ($\geq$ 4 METs) candidates for vascular surgery, where the results may modify the management[4]. These tests are not useful in patients without clinical risk factors, candidates for surgery at low-intermediate risk. The cardiological assessment, made up with the support of echocardiography, however, is indicated in patients with dyspnea of unknown origin, in patients with previous or current heart failure and with worsening dyspnea or with other changes in the clinical conditions. It is doubtful, however, in clinically stable patients with previously documented cardiomyopathy. It is not recommended in all other cases. The presence of a progressive reduction in the strength of the recommendations, as well as dubious indications, though justified by the need to face a considerable variability of clinical conditions, however, are due to uncertainty and lead to excessive reliance on such investigations. Conversely, the literature, is more in agreement when defining the conditions under which the clinical examination and ECG are already sufficient to define the preoperative cardiac risk. According to the ICSI guidelines, more than 95% of patients undergoing elective surgery without acute or chronic and unstable conditions (documented by medical history and clinical evaluation) would not need preoperative tests[5]. These should be requested only in case of abnormal findings during the baseline assessment, in the case of certain interventions or specific, age-related risks[5]. The Nice guidelines consider the possibility of direct intervention in the case of asymptomatic patients candidates for Low Risk surgery[6]. The same view shows the ACC / AHA algorithm, which

excludes the need for second level investigations in minor surgery (eg, ophthalmic interventions on the surface) or in patients who have good functional capacity (assessed by the ability to perform normal daily activities). On the latter point in particular, several recent studies seem to linger. The presence of a good functional compensation ($\geq$ 4 METs) in fact, although there are risk factors related to both the patient and the surgery itself, is proving to be the discriminating factor which refer to whether or not the preoperative non-invasive cardiological diagnostic investigations [7]. The discrepancies in the literature observed about cardiac risk estimation, may depend in part because the available literature consists almost exclusively of case series that have provided mixed results. Another limitation is that none of the available studies compared the frequency of complications in patients carrying or not carrying out tests, and this prevents to establish the possible prognostic implications. Moreover, the fact that not all EC-graphic anomalies are associated with an increased surgical risk and not all require a change in management in the absence of clinical findings, further increases the margin of discretion in interpreting the evidence available at the time of formulate recommendations. Such variability of scientific positions has is justified by the fact that the predictability of a test is only a probability. Although a negative test reassures the anesthesiologist, it does not completely rule out the complications. It should be emphasized, in fact, that each diagnostic test holds itself benefits and drawbacks and currently there is no test that can accurately simulate the physiological response to surgery. This response assumes a prolonged sympathetic stimulation, increased vasomotor tone, hypercoagulability, hypothermia, tachycardia, possible rupture of a plaque, blood loss etc [8]. The presence of these limitations in diagnostic tests, coupled with the unpredictability of major cardiac events themselves, often in seemingly favorable conditions, is shifting the attention from the prediction of which patients are at high risk of having a perioperative cardiac event, to the strategies to minimize the probability of such an event, through the use of a specific perioperative drug therapy [3]. In particular, both the ACC / AHA guidelines and other studies in literature, identified treatment with beta-blockers when they are demonstrated to be effective, the best strategy to reduce the rate of cardiac complications in patients with or at risk of, coronary disease [8-11]. The use of drug therapy (beta-blockers, alpha2-adrenergic antagonists, statins) in the perioperative prophylaxis of patients with coronary artery disease candidates for non-cardiac surgery, has proven effective in stabilizing the plaque and, without doubt more secure than the risks posed to the execution of the aortal-coronary bypass or coronary revascularization before surgery[12,13]. In fact, there are conditions in which patients who have suffered a recent myocardial infarction, or having a new onset of ischemia, or who have recently undergone coronary revascularization, and therefore specified as high risk, are hav-

ing to be subjected to emergency surgery because of such rupture of an aneurysm or the presence of a tumor with rapid growth, rather than an infection that required drainage, or a fracture. In these cases it is considered appropriate the use of perioperative beta-blockers [8]. Other studies, however, support the thesis that the best approach to patients with coronary artery disease candidate for non-cardiac surgery, is to associate the drug therapy, with continuous ECG monitoring after surgery, considering this as a potential detector of silent myocardial ischemia and defining it as a powerful predictor of postoperative cardiac complications, especially after vascular surgery [14].

Concluding remarks

The clinical evaluation of cardiac patients waiting for non-cardiac surgery, performed through clinical history, examination, and the ECG is the cornerstone of cardiac risk stratification. It's also important to consider the type of intervention. Very often there are conditions that require priority interventions such as certain neoplastic diseases, where the speed is absolutely necessary. In these cases it seems appropriate to speed up the diagnostic program. Any use of second level investigations, most often an echocardiogram, but also the stress test, is aimed mainly at improving the assessment of two main pathophysiological aspects: left ventricular function and myocardial ischemia. But it also said that such investigations are only useful if they are really capable of modifying the therapeutic procedure. The study conducted, showed that among patients undergoing the clinical diagnostic tests involving only the first level investigations (careful clinical history, physical examination, vision of previous inspections, BP measurement at the beginning and end of the examination, haematological tests, and ECG at rest) and also those submitted to echocardiogram and exercise testing, there are no differences regarding the frequency of occurrence of adverse events postoperatively. In particular, since no patient after surgery, in both groups studied, presented major events and all were discharged in a short time, we can assume that when patients are treated in a state of good hemodynamic compensation and with medical conditions controlled by appropriate drug therapy, it is sufficient to perform first-level tests for the preoperative stratification of cardiovascular risk. It's proposed to reserve an echocardiogram and exercise testing in cases where the first-level tests proved to be altered,when there is a worsening of the conditions prior to admission, or when there is not good hemodynamic compensation . Therefore, in this clinical-diagnostic approach, it's taken into account the significant role of the clinical examination, performed by the physicians at the time of admission, whom, on the basis of their professional skills may demonstrate patients

with heart failure and all those situations in which it seems to be appropriated the integration of the echocardiogram and the stress testing. As demonstrated by our study, patients whose risk was stratified by the only first-level investigations, not only had the same postoperative outcomes of patients in the second group, but have also completed the whole survey on average three days before patients that also underwent echocardiography and stress testing. Today, unfortunately, is becoming established in the medical profession, a tendency to take these tests in a routine, probably with the aim of not only fall on their shoulders any responsibility for their career choices. This behavior too "conservative" by the medical profession, expression of an attitude typical of "defensive medicine", has inevitable repercussions both the crowding of the waiting lists for diagnostic examinations and the length of stay. In this regard, considering that, according to a report made in 2006 about the daily cost of hospital stay in Italy, a patient admitted to a hospital in Lazio (the region of Rome) has a cost to public health amounted to euro 630, our study demonstrates that the surgical patient with a history of coronary ischemia, when stable, does not require level II investigations that would lead to unnecessary loss of time, in addition to a substantial increase in regional and national health spending.

Riassunto

Il numero di pazienti sottoposti a procedure chirurgiche sta crescendo in tutto il mondo ed internisti e cardiologi sono sempre più impegnati a stimare il rischio operatorio in pazienti che si sottopongono ad interventi di chirurgia non cardiaca. La stima di tale rischio in un singolo paziente è difficile e complessa. Occorre infatti tenere conto di numerose variabili connesse sia al paziente, intese in termini di età, fattori di rischio clinici e morbilità associata, sia alla complessità dell'intervento chirurgico stesso. Ad oggi, nonostante la letteratura scientifica sia ricca di pubblicazioni al riguardo, i punti discordanti risultano essere ancora numerosi. In particolar modo emerge una notevole incertezza nelle raccomandazioni soprattutto per quanto riguarda l'esecuzione dell'ecocardiografia e del test da sforzo. Per tale motivo, al fine di valutare l'impatto di tali indagini sulla stratificazione del rischio cardiologico preoperatorio, è stato condotto negli ultimi tre anni uno studio su 250 pazienti di età compresa tra i 50 e gli 85 anni, affetti da cardiopatia ischemica, precedentemente trattati con by-pass aorto-coronarico o angioplastica coronarica, in attesa di intervento chirurgico non cardiaco. Abbiamo escluso dallo studio i pazienti ischemici affetti da qualsiasi tipo di aritmia o in fase di scompenso. Gli interventi comprendevano: 1) chirurgia addominale, 2) toracica, 3) tiroidea, 4) ortopedica. Dalle indagini effettuate non sono emerse differenze nel management tra i pazienti il cui rischio

veniva stratificato con l'ausilio dell'ecocardiografia e del test da sforzo, da quelli il cui rischio veniva stratificato solo attraverso indagini di primo livello. Pertanto si può affermare che il buon compenso emodinamico risulta la discriminante alla quale fare riferimento per ricorrere o meno alle indagini diagnostiche preoperatorie di secondo livello.

References

1) Devereaux PJ, Goldman L, Cook DJ, Gilbert K, Leslie K, Guyatt GH: *Perioperative cardiac events in patients undergoing non cardiac surgery: A review of the magnitude of the problem, the pathophysiology of the events and methods to estimate and communicate risk.* CMAJ, 2005; 173(6):627-34.

2) Cagirici U, Nalbantgil S, Cakan A, Turhan K: *A new algorhitm for preoperative cardiac assessment in patients undergoing pulmonary resection.* Tex Heart Inst J, 2005; 32:159-62.

3) Graybum PA, Hillis LD: *Cardiac events in patients undergoing noncardiac surgery: Shifting the paradigm for noninvasive risk stratification to therapy.* Ann Intern Med, 2003; 138:506-11.

4) Fleisher LA, Beckman JA, Brown KA, Calkings H, Chaikof E, Gleishrnann KE, Freernan WK, Froelich JB, Riegel B, Robb JF: *A CCIAHA 2007 guidelines on perioperative cardiovascular evaluation and care for non cardiac surgery: Executive summary.* Circulation, 2007; 116:1971-996.

5) Danielson D, Robrock J, Stultz J, Bjork K, Hunternan T, Foremann J, Marshall M: *Preoperative evaluation (ICSI).* 8th edit. ICS Institute for clinical systems improvement. 2008.

6) Emberton M. Thorns G, Taylor P, Freedrnan D, Galloway M, Reeves B, Langharn J, Phillips N, Sharpin C, Wonderling D: *Preoperative tests. The use of routine preoperative tests for elective surgery.* NICE Guidelines, 2002.

7) *Corrections to Fleisher et al.* J Am Coll. Cardiol, 2007; 50:1707-732. J Am Coll Cardiol, 2008; 52:794-97.

8) Chassot PG, Delabays A, Spahn DR: *Preoperative evaluation of patients with, or at risk of, coronary artery disease undergoing non cardiac surgery.* Br Journ Anaesth, 2002; 89(5):747-59.

9) Bemard M, Kamath MD: *Preoperative cardiac risk assessment.* Am Fam Physician, 2002; 66:1889-896.

10) I Ofleisher LA, Becrnan JA, Brown KA, Calkins H, Chaikof E, Fleishmann KE, Freernan WK, Froehlicj JB, Riegel B, Robb JF: *ACCIAHA 2006 Guidelines Update Perioperative Cardiovascular evaluation for noncardiac surgery: Focused update on Perioperative betablocker therapy: A report of the American College of Cardiology/American Heart Association Task Force for on Practice Guidelines (Writing Committee to Update 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery: Developed in collaboration with the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovasculare Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society for Vascular Medicine and Biology.* Circulation, 2006; 113:2662-674.

11) Bauer SM, Cayne NS, Veith FJ: *New developments in the preoperative evaluation and perioperative management of coronary artery disease in patients undergoing vascular surgery.* J Vasc Surg, 2010; 51(1); 242-51.

12) Deveraux PJ, Goldrnan L, Yusuf S., Gilbert K, Leslie K: *Surveillance and prevention of major perioperative ischemic cardiac events in patients undergoing non-cardiac surgery: A review.* CMAJ, 2005; 173(7):779-88.

13) Priebe HJ: *Perioperative myocardial infarction-aetiology and prevention.* Br Journ Anaesth, 2005; 95(1):3-19.

14) Potyk DK: *Cardiac evaluation and risk reduction in patients undergoing major vascular operations.* West J Med, 1994; 161:50-56.