

disorders [4, 5]. Mediastinal bleeding in heart surgery is multifactorial [2, 4]. Perioperative bleeding is related to surgical damage to blood vessels and defects in haemostatic mechanisms. The majority of haemostatic defects are related to the exposure of blood elements to the cardiopulmonary bypass circuit [2, 4]. Excessive administration of protamine is a proposed mechanism of bleeding [2]. It has been proved that CBP causes a reduction in the levels of coagulation factors, stimulates fibrinolysis and induces thrombocytopenia and platelet dysfunction [4]. The effects of circulating heparin and protamine must be considered [4]. Heparin rebound may be associated with postoperative bleeding [2]. The mechanism of the reappearance of heparin is the differential elimination of protamine vs. heparin [2]. On the basis of our results, we considered that patients undergoing valve procedures were more likely to undergo re-sternotomy (40.1%) for bleeding than patients undergoing coronary grafting (35.5%). We expect the influence of early postoperative use of warfarin—a vitamin K antagonist (warfarin, Orion Corporation, Espoo, Finland)—and Fraxiparin to cause early bleeding. On the basis of our experience, our current management in patients after aortic valve replacement with bioprosthesis is using a 100 mg aspirin per day (acidum acetylsalicylicum, Zentiva, Slovak Republic) per os from the first postoperative day without higher risks of valve-related complications or valve thrombosis.

CONCLUSION

In this paper, we presented our institutional experience of an acceptably low rate of re-exploration for bleeding/tamponade after cardiac surgery (3.4% of all procedures—this was equivalent to that reported previously by others) [1].

We think that the most important message of our paper is that a delay in re-exploration >12 h is associated with a worse clinical outcome and an increase in mortality. We think that the high mortality which we observed after re-sternotomy (37.5%) could be associated with more severe preoperative status of the patients, with higher rates of comorbidities, higher proportions of patients with more complex procedures and reoperations with longer cardiopulmonary bypass times and, last but not least, with delayed revision.

Conflict of interest: none declared.

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eComment. Postoperative bleeding without re-exploration may increase operative mortality

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The article by Canadyova *et al.* [1] showed expected results in the area of re-exploration for bleeding in cardiac surgery, with an emphasis on the time to carry out the re-exploration for chest bleeding. Indeed, they found that a delay in re-exploration of > 12 h was associated with a worse clinical outcome and an increase in mortality. Similar results were displayed by Karthik *et al.* [2] after analysing a total of 2898 patients undergoing coronary artery bypass surgery (CABG).

In addition to the considerations just mentioned, it is generally recognized that the in-hospital mortality is higher in patients requiring re-operation for bleeding than in those who do not. A meta-analysis by Metha *et al.* [3] evaluated 528 686 CABG patients in >800 hospitals of the Society of Thoracic Surgeons National Cardiac Database. They demonstrated a 4.5-fold higher operative mortality in patients undergoing revision for postoperative bleeding. This is understandable when one considers that the circumstances surrounding this scenario often involve more blood transfusions, a hypovolemic status, and systemic hypotension with all the catastrophic consequences such as secondary organ failure, especially renal and respiratory failure. Vivacqua *et al.* [4] found a direct relationship between the greater need of blood transfusion and the elevated mortality in patients re-explored for bleeding.

Rather interesting data concerning the postoperative bleeding have been published by Christensen *et al.* [5]. Postoperative haemorrhage exceeding 200 ml/h in any single hour or part thereof, or 2 ml/kg/h for 2 consecutive hours in the first 6 hours after surgery, or > 495 ml in the first 24 hours was associated with a higher 30-day mortality and morbidity.

It is important to underline the need to heighten awareness about postoperative bleeding, which may represent an increased risk in operative morbidity and mortality even when the patient does not require re-operation for bleeding.

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eComment. Re: Re-exploration for bleeding or tamponade after cardiac operation

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I read with great interest the article by Canadyova *et al.* [1]. They showed that a delay in re-exploration >12 h was associated with a worse clinical outcome and that the high mortality observed after re-sternotomy (37.5%) could be associated with a more severe preoperative status of the patients, with higher rates of comorbidities, higher proportions of patients with more complex procedures and

reoperations with longer cardiopulmonary bypass times. Other risk factors associated with a higher in-hospital mortality after re-exploration for bleeding and tamponade include delayed re-sternotomy, higher levels of lactate and lower levels of haematocrit before revision and other well-known risk factors such as older age, more complex cardiac procedures, redo operations, longer cardiopulmonary bypass, renal failure and diabetes mellitus. Patients who needed re-exploration were at a higher risk of complications, and morbidity and mortality, if the time until re-exploration was prolonged.

It is important to state that there are other factors that contribute to increased mortality in delayed re-exploration. In the study by Mataraci and co-workers, they observed that delayed re-exploration was associated with a higher infection rate, which was responsible for high mortality [2]. Delayed re-exploration was followed by the need for excessive use of allogeneic blood products as a result of the continuous blood loss, and in most cases with a resultant increase in morbidity and mortality as shown by Ranucci *et al.* [3]. The significance of a negative re-exploration for excessive postoperative haemorrhage after cardiac operation is not only advantageous in excluding surgical bleeding, a cause that can be readily controlled by ligation and suturing or application of clips. Also, various haematologic abnormalities that cause continued bleeding or oozing could co-exist with the pooled blood or clot, which can be removed during re-exploration. Thus even in situations of negative intraoperative findings, Pelletier and colleagues showed that the removal of clots and consequent reduction in fibrinolytic activity in the mediastinum was therapeutic on its own [4]. Evacuation of the clots, which are rich culture media for proliferation of bacteria, is known to help reduce infection rates. They also stated that the suspicion of the cardiac tamponade was confirmed by echocardiographic examination. It is noteworthy that an overdependence on this investigative parameter, which is widely considered the gold standard for the diagnosis of

tamponade, may not really be so useful as the haemodynamically significant pericardial collections occurring early after cardiac surgery rarely cause the classical clinical or echocardiographic findings of tamponade. The recognition of this fact is necessary to ensure that appropriate surgical intervention was not delayed as observed by Price *et al.* [5].

Thus from the moment such clinical suspicions are harboured, an earlier intervention instead of waiting for the 'classical signs' is advised as a delay may be followed by dire consequences.

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