

based on the risk probability for PCCS and 90 day postoperative mortality data. Any patient with HR above 100 bpm is at increased risk of postoperative mortality as seen in the results. It would be most convenient to distinguish between patients with increased relative risk of mortality and patients with increased risk of PCCS, which is significantly higher in patients with HR above 124 bpm. The difference between normal rhythm and tachycardia (i.e., an HR >124 bpm) is easily distinguishable during routine clinical physical examinations. Alternatively, HR can be detected during automatic blood pressure measurements or with pulse oximetry. 294/2362 (12.4%) patients had HRs over 100 bpm; thus, with cut-off values even as low as 100 bpm, 87.6% of unnecessary ECG tests could be prevented - saving valuable resources in today's medicine - healthcare professionals. HR over 100 bpm should give the information of increased risk of 90-day postoperative all-cause mortality, but not necessarily predict the change in the course of action in preoperative management. However closer monitoring of patients with increased risk of mortality should be emphasized.

Based on the results, ECG should also be performed in patients with previously known chronic coronary syndrome and atrial fibrillation, which also increase the risk of PCCS.

The results show, that patients with abnormal CXR have an increased risk of 90-day postoperative all-cause mortality (RR=2.49) compared to patients with normal CXR findings. These results should not be very surprising, as older patients and patients with comorbidities tend to have higher probability of abnormal CXR changes. Question remains, whether CXR holds additional information to patient history and clinical findings. Another question is, how to use this information. We now know, that abnormal CXR increases risk of postoperative mortality, but only handful of CXR are actually used to change preoperative management.

Despite the fact that abnormal CXR predicts increased risk of postoperative mortality, we suggest that a CRP cut-off value of >61 mg/l should trigger preoperative CXR testing. Due to the very low CRP levels we observed in the entire group of patients that underwent a non-elective NCS, this cut-off value could potentially avoid a vast number of unnecessary CXR procedures. Only 431/2362 (18.25%) patients had CRP levels above 61 mg/l; thus, this CRP cut-off value might prevent 81.75% of unnecessary CXR tests. Indeed, nearly half of the patients (1169/2362 [49.49%]) had CRP levels even lower than 10 mg/l, which suggested that a CXR was highly redundant. As a conclusion to this discrepancy, we think that preoperative CXR (if available) should be used to predict the need for better postoperative monitoring (keeping in mind that actual additional value to patient history and clinical finding is not known), but should not be performed in order to potentially change preoperative management, unless there is

another indication such as breathlessness, pathological auscultation, low blood oxygen saturation or CRP >61 mg/l.

We identified no cut-off value for low heart rate, as there was not enough patients with low enough heart rate to make a difference in the preoperative management - no patient had any severe kind of bradycardia. Moreover, the empirical data display very low probability of bradycardia in patients before non-elective preoperative management. Rare cases of preoperative bradycardia must be dealt with on the individual basis.

This study and its results have no interest in diminishing the value of clinical evaluation prior to non-cardiac surgery, in fact the opposite. We believe that HR and CRP should be used as cut-off values for triggering additional preoperative testing in those cases, where clinical examination is normal or inconclusive, thus avoiding unnecessary tests in otherwise healthy patients. Clinical evaluation still remains a cornerstone of any preoperative management and all patients with positive clinical findings (such as breathlessness, pathological auscultation, low blood oxygen saturation) should have CXR before non-cardiac surgery.

The main limitations of our study were its single-center focus and retrospective design. The results may not be generalizable to other hospitals. On the other hand, the large number of enrolled patients in our study and the enrollment of consecutive patients within the given time period suggested that the results are statistically solid. Moreover, the simple design of our study provided the potential for easy reproduction on a larger scale.

Conclusion

We concluded that, based on our findings, both ECG and CXR are of a very limited value in the routine preoperative management of hospitalized patients undergoing a non-elective NCS. We recommend using the HR and CRP cut-off values we identified for triggering ECG and CXR testing, as an addition to positive clinical findings. These cut-off values should be more effective than the previously identified age cut-offs, which have lower specificity and, overall, lower accuracy. The ECG should be limited to patients with HR >100 bpm during clinical examination (to bare in mind that relative risk of mortality increases above 100 bpm, but the risk of PCCS increases only with HR above 124 bpm), or to patients with previously known chronic coronary syndrome and atrial fibrillation. CXR should be limited to patients with CRP levels >61 mg/l and patients with positive clinical findings (breathlessness, positive auscultation, low blood oxygen saturation). If performed, CXR could be used to predict the need for better postoperative monitoring (keeping in mind that actual additional value to patient history and clinical finding is not known).

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