Tab. 9. *Relative risk of 90-day postoperative all-cause mortality by preoperative heart rate*

		No. of death (no. of pa-tients)	RR (95% CI)	P
Heart rate [bpm]	< 50	1 (14)	1.20 (0.18–8.16)	0.189
	50–59	5 (135)	0.62 (0.25–1.56)	0.312
	60–69	17 (430)	0.66 (0.38–1.17)	0.155
	70–79	37 (623)	Reference	
	80–89	26 (430)	1.02 (0.63–1.66)	0.942
	90–99	26 (310)	1.41 (0.87–2.29)	0.161
	100–109	20 (162)	2.08 (1.24–3.48)	**0.005**
	110–119	8 (63)	2.14 (1.04–4.39)	**0.038**
	120–129	7 (26)	4.53 (2.24–9.19)	**<0.001**
	≥ 130	5 (19)	4.43 (1.96–10.01)	**<0.001**

RR – relative risk; CI – confidence interval

Discussion

This study showed that only a very limited number of patients that underwent a non-elective NCS (approximately 2 out of 1000) required changes in preoperative management due to abnormal ECG or CXR findings. This finding suggested that, for every 500 preoperative procedures, only 1 patient required a significant alteration in preoperative management. Therefore, in most patients, there is little benefit in performing ECG and CXR testing routinely prior to a non-elective NCS.

Similar results were reported in other studies on low-risk patients or patients that underwent an elective NCS (6-10, 16-17). Our results largely confirmed and expanded those results to an unselected patient population.

It could be argued that a preoperative ECG or CXR should be performed to reduce perioperative complications and perioperative and postoperative mortality. However, no randomized controlled trial has shown that preoperative ECGs could reduce postoperative complications or mortality. Conversely, some studies have suggested that a lack of preoperative CXR was not associated with perioperative complications (21-22).

In our study, the absence of changes in preoperative management was largely predictable, with very high sensitivity and a high NPV, based on age, heart rate, and CRP. The cut-off values we identified could provide reasonable tools for limiting unnecessary preoperative testing.

Tab. 10. *Relative risk of 90-day postoperative all-cause mortality by chest X-ray*

		RR (95% CI)	P
X-ray of the lungs	Normal	Reference	
	Abnormal	2.49 (1.83–3.39)	**<0.001**

RR – relative risk; CI – confidence interval

In a previous study on patients with hip fractures, only 0.6% of preoperative CXR findings resulted in a PPCS (24). Moreover, those findings were consistent with the preoperative clinical evaluations. Our data were consistent with the data from that study, but we studied a larger, unselected patient population. We found that 4 out of the 5 patients that had a PCCS due to CXR findings also had abnormal findings on pulmonary auscultation and objective or subjective difficulties during a preoperative clinical evaluation (the one remaining patient had inconclusive auscultatory findings).

In some patients, a preoperative CXR may impact the postoperative management (25). Moreover, some authors have suggested that the inability to compare pre- and postoperative CXRs may result in different postoperative management. In the present study, we could not address this issue, due to the lack of this type of data.

Some previous studies have suggested cut-off values for limiting the number of preoperative ECG and CXR tests. Cut-off values were reported for comorbidities, ASA class, respiratory and cardiac signs and symptoms, but mainly age. The proposed cut-off for age-based ECG and CXR testing ranged between 40 to 65 years (3-4, 7-8, 18-20). However, the results of our study showed that age alone was not a good predictor of PCCS, because it had relatively low specificity in predicting both the ECG and CXR findings (see Tables 7 and 8).

As seen in the results section, relative risk of 90-day postoperative all-cause mortality was significantly higher in patients with heart rate above 100 bpm (when using 70-79 bpm as a baseline reference point). The heart rate over 100 bmp is easily distinguishable during clinical examination. This suggests that we now have simply acquirable risk factor of postoperative mortality even before we proceed to ECG testing. The role that the heart rate should play in preoperative management is discussed below.

Based on our data, we suggest that an HR cut-off value of >100 bpm should trigger preoperative ECG testing. This suggestion is

Diagram 1. *Relative risk of 90-day postoperative all-cause mortality by preoperative heart rate*