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# Elevation of serum phosphorus, an early biomarker of acute kidney injury after cardiac surgery?

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## Introduction

Acute kidney injury (AKI) is common after cardiac surgery and is a strong predictor of morbidity and mortality [1]. Hyperphosphatemia following AKI, by renal excretion defect, has never been studied in this context and could be a simple marker of AKI.

## Objectives

The aim of this study was to assess the predictability of serum phosphorus (Ph) for AKI monitoring after cardiac surgery.

## Methods

In this retrospective diagnostic validation study of 547 patients admitted in our institute between January 2012 and December 2012, we excluded patients with end stage renal disease (clearance < 15mL / min / 1.73m<sup>2</sup>) or dialyzed, solitary kidney or nephrectomy, lack of data. Serum creatinine (Cr) and Ph were measured preoperatively and postoperatively specifically (H0, H12, H24, H48, H72). The percentage of maximum elevation of Ph (%EPH = [(maximum - minimum) / minimum] \* 100) was calculated. AKI was defined as an increase Cr more than 26.5 mmol / L in 48 hours according to KDIGO criteria [2]. The diagnostic performance of postoperative Ph thresholds were analysed by elaborating area under the receiver operating characteristic curves (AUC-ROC) with sensitivity (Se), specificity (Sp), positive predictive value (PPV), negative predictive value (NPV).

## Results

From the 386 patients included, the mean Euroscore II was  $4.2 \pm 6.3\%$ , SAPS II score,  $26.4 \pm 10.8$ . Among

them, 21.2% developed AKI (grade 1: 13.2%, grade 2: 4.1%, grade 3: 3.1%) and 2.6% required renal replacement therapy (RRT). Patients with AKI had Euroscore II, duration of cardiopulmonary bypass, transfusion needing and mortality higher than those without AKI ( $p < 0.001$ ). The %EPH and the Ph at 48 hours (Ph<sub>48H</sub>) were significantly higher in AKI patients than in no AKI patients:  $81 \pm 79\%$  and  $1.47 \pm 0.46$  mmol/l vs  $25 \pm 23\%$  and  $0.99 \pm 0.2$  mmol/L, respectively ( $p < 0.001$ ). A value of Ph<sub>48H</sub> > 1.19 mmol/L (Se 72% (60-82), Sp 84% (71-92), PPV 84%, NPV 72%) and a %EPH > 49 % (Se 73% (61-81), Sp 83% (76-88), PPV 66%, NPV 86%) were predictive of AKI. In AKI patients, the %EPH and Ph<sub>48H</sub> significantly increased with the severity of AKI (Table 1). In these patients, a Ph<sub>48H</sub> < 1.53 mmol/L and a %EPH < 77% predicted the non use of RRT (Se 100% (62-100), Sp 85% (77-91), PPV 35% NPV 100%), respectively (Table 2).

## Conclusions

After cardiac surgery, serum phosphorus seems to be a simple, reliable and inexpensive biomarker at bedside for AKI monitoring. A value less than 1.53 mmol/L at 48h may predict the no-initiation of RRT in case of AKI and may guide the clinician to a non-invasive-AKI therapeutic. Obviously, these results should be interpreted with caution regarding the retrospective nature of the study.

**Table 1**

AKI severity	%EPH	Ph <sub>48H</sub> (mmol/L)
Grade 1	60 ± 45	1.25 ± 0.4
Grade 2	74 ± 58	1.73 ± 0.4
Grade 3	159 ± 132	1.80 ± 0.5

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**Table 2**

	Thresholds	AUC (IC95% )	p value
AKI diagnostic			
Ph <sub>48H</sub>	1.19 mmol/L	0.813 (0.735-0.890)	< 0.0001
%EPh	49%	0.830 (0.772-0.889)	< 0.0001
RRT requiring			
Ph <sub>48H</sub>	1.53 mmol/L	0.924 (0.879-0.970)	< 0.0001
%EPh	77%	0.818 (0.683-0.952)	< 0.0001

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