Remote ischaemic preconditioning attenuates kidney injury perioperatively in patients undergoing surgical lower limb revascularisation

Kepler T^{1,4}, Kuusik K^{2,4}, Lepner U¹, Starkopf J³, Zilmer M⁴, Eha J², Lieberg J¹, Kals J^{1,4}.

¹ Department of Surgery, Institute of Clinical Medicine, University of Tartu.

² Department of Cardiology, Institute of Clinical Medicine, University of Tartu.

³ Department of Anaesthesiology and Intensive Care, Institute of Clinical Medicine, University of Tartu.

⁴ Department of Biochemistry, Institute of Biomedicine and Translational Medicine, Centre of Excellence for Genomics and Translational Medicine, University of Tartu.

Introduction

Perioperative acute kidney injury has been found to occur in 12% of patients undergoing lower limb revascularisation [1]. Remote ischaemic preconditioning (RIPC) of short cycles of distant tissue ischaemia followed by reperfusion is a promising technique to reduce tissue damage from ischaemia-reperfusion injury. In a recent meta-analysis, RIPC was shown to reduce kidney injury in patients undergoing cardiac surgery [2]. It has also been found to reduce serum creatinine postoperatively in patients undergoing abdominal aortic aneurysm repair [3] and endovascular aneurysm repair [4]. However, there are many uncertainties regarding clinical benefits from RIPC during vascular surgery. The aim of the current double-blinded, randomised and sham-controlled pilot study was to determine the effect of RIPC in perioperative renal damage in vascular surgery.

Figure 1 Patients' flow chart

Methods

The current study is a part of larger trial assessed the effect of RIPC in vascular surgery (Figure 1). Patients undergoing elective lower limb revascularisation surgery between January 2016 and February 2018, who gave full informed consent, were recruited. Stratified randomisation with a block design was used. Patient, patient's physician and surgical team were blinded to study intervention. Four episodes of 5 minutes of upper limb ischaemia were performed preoperatively. In the sham group, pressure equal to venous pressure was applied instead of ischaemia. Between all episodes, there was a 5-minute period of reperfusion. Blood samples were collected preoperatively and 20–28 hours after surgery for assessment of biomarkers of acute kidney injury. Data were compared by means of t-tests, Wilcoxon's tests or Chi-squared test. The study was approved by the Research Ethics Committee of the University of Tartu and registered in the ClinicalTrials.gov database (NCT02689414).

Results

Twenty-eight patients were enrolled in the RIPC group and 29 patients in the sham group with a dropout of 1 patient (Figure 1). The baseline characteristics did not differ between the groups except for gender (Table). The surgery resulted in significant increase of creatinine and trends toward increases in urea, cystatin C and beta-2-microglobulin in the sham group (Figure 2). In contrast, significant decline in creatinine and cystatin C together with trends towards reduction in urea and B2M was noted in the RIPC group (Figure 2). Changes in creatinine, urea, cystatin C and B2M between the groups were statistically significant (Figure 2).

Conclusion

This pilot study demonstrates that RIPC reduces the levels of biomarkers of acute kidney injury in patients undergoing surgical lower limb revascularisation. This phenomenon may offer renoprotection during vascular surgery.

Table Baseline characteristics

	RIPC (n=28)	SHAM (n=29)	p-value
Age	67 (±10)	66 (±10)	0.625
Females (%)	3 (11)	10 (34.5)	0.038
Smokers or ever smoked (%)	26 (93)	26 (89.7)	1
BMI*	23.7 (21.0–27.2)	24.4 (21.3–28.1)	0.823
ASA II/ASA III	12/16 (42.9/57.1)	15/14 (51.7/48.3)	0.686
Diabetes (%)	2 (7.1)	6 (20.7)	0.252
Creatinine (µmol/L)	79 (±14)	78 (±16)	0.850
eGFR (ml/min(1.73 m ²))	85 (±12)	81 (±18)	0.363
Urea (mmol/L)*	5.5 (4.4–6.1)	5.4 (4.1–6.9)	0.513
Cystatin C (mg/L)*	1.08 (0.95–1.24)	1.18 (0.99–1.38)	0.144
Beta-2-microglobulin (µg/L)*	2195 (1865–2982)	2250 (2020–2870)	0.300
Time from the end of intervention to the beginning of the surgery	40 (±25.3)	33.3 (±20.4)	0.257

Data with normal distribution are presented with mean values (standard deviation) and data with non-normal distribution* are presented with medians (1st and 3rd quartile). BMI – body mass index; ASA – American Society of Anaesthesiologists' physical status score; eGFR – estimated glomerular filtration rate

Figure 2 Postoperative changes in creatinine, urea, cystatin C and beta-2-microglobulin

Data are presented with mean values. *p-value for the change in the RIPC group; **p-value for change in the sham group; ***p-value for the changes between the groups

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