Ischaemic Preconditioning Attenuates Haemodynamic Response and Lipid Peroxidation in Lower-Extremity Surgery with Unilateral Pneumatic Tourniquet Application: a Clinical Pilot Study

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ABSTRACT

Introduction: The harmful effects of ischaemia-reperfusion on skeletal muscle during extremity surgery can be diminished by using medications or ischaemic preconditioning.

Methods: Twenty patients undergoing lower-limb surgery with use of a tourniquet for at least 1 hour were included in the study and randomised into two groups: a control group with only tourniquet application (T group; n=10); and an ischaemic preconditioning plus tourniquet group (IP-T group; n=10). Blood samples were obtained from the femoral vein of the relevant extremity before tourniquet application (baseline), immediately after tourniquet deflation (TD), at 10 minutes after the tourniquet deflation (TD_{10min}) in the T group and additionally after ischaemic preconditioning in the IP-T group. Venous blood pH, partial oxygen pressure (P_{vO2}), partial carbon dioxide pressure (P_{vCO2}), lactate, potassium, sodium and glucose levels were analysed using a blood gas analyser. Plasma thiobarbituric acid reactive substances (TBARS) level, an index of lipid peroxidation and oxidative stress, was measured. Heart rate, noninvasive mean arterial pressure (MAP) and spontaneous breathing rate (SBR) were recorded at baseline, at TD, and TD_{1min}, TD_{5min} and TD_{10min}.

Results: MAP decreased and SBR increased significantly at TD, TD_{1min} and TD_{5min} compared with baseline, and venous blood TBARS level significantly increased at TD and TD_{10min} compared with baseline in the T group (all P<0.05). No significant changes were observed in the IP-T group. Ischaemic preconditioning caused a rise in P_{vO2} and a decrease in venous blood pH, P_{vCO2} and lactate levels, which was significant compared with baseline (P<0.05).

Conclusion: Ischaemic preconditioning attenuates haemodynamic response and lipid peroxidation during lower-extremity surgery with unilateral tourniquet application.

Keywords: ischaemic preconditioning; ischaemia-reperfusion; lipid peroxidation; lower extremity; tourniquet

INTRODUCTION

Surgical procedures with pneumatic tourniquet application to the lower extremity subject the limb to prolonged ischaemia followed by reperfusion. Reperfusion injury has been shown to initiate a systemic inflammatory response syndrome which is characterised by pro-inflammatory mediator production and circulatory polymorphonuclear leucocyte (PNL) activation. Pulmonary microvascular leucosequestration is central to the development of acute lung injury, witnessed after limb ischaemia-reperfusion (IR), and indeed polymorphonuclear depletion has been shown