A CASE REPORT: METHODS TO ALLEVIATE REPERFUSION SYNDROME IN AMPUTATED ARM REPLANTATION

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Abstract

Limb replantation has been performed for decades and is being clinically applied more prevalently. Reperfusion syndrome crucially affects the outcome of the replantation and sometimes poses a life-threatening risk to patients, especially in cases with major surgeries like arm amputations. The following report presents methods to mitigate the syndrome in amputated arm replantation.

INTRODUCTION

The anaerobic metabolism occurs in a limb as it gets amputated. Subsequently, some metabolites such as cytokine, IL-6, and lactic acid will flow back into the main circulation briefly after the replantation is performed, which causes reperfusion syndrome leading to many complications, metabolic acidosis, acute renal failure, ventricular fibrillation, etc. The complications potentially impair the success of the surgery and are capable of causing some grave results. Minimizing the syndrome will facilitate the success of the surgery, especially in cases involving arm or leg replantations. The report aims to: *Present a case of an amputated arm that was replanted and the methods applied to minimize the risk of the syndrome.*

CASE REPORT

A 44-year-old male patient with a left middle third arm amputated by a cable tow, the amputated limb was treated and stored medically properly, and the patient was admitted to the Military Hospital 103 at the 2nd hour post-injury. Along with conventional techniques performed to replant the amputated limb, some adjuncts were added to alleviate the syndrome, followed by the passage of the amputated limb being restored.

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- The limb was immediately sent to an operating room and treated by a surgical team. Wound debridement and dissection were being done while administrative formalities were being completed.

- Continuously rinsing amputated limb: Blood vessels of the limb were rinsed with normal saline diluted with heparin at a ratio (500mL NS/5000UI Heparin) following the completion of the debridement, dissection, and the exposure of all blood vessels and nerves. The rinsing was performed until the fluid oozing out of the subcutaneous veins was relatively transparent and was continued until the replantation was commenced.

- Draining residual blood out of the amputated limb via veins after arteries were unclogged: After the brachial artery and satellite veins were anastomosed, the blood flowed through the artery to the amputated limb, but the satellite veins were still clamped, keeping the blood from the main circulation. 30 seconds later, if the hemodynamics were maintained, the veins were unclamped following some subcutaneous veins being completely reattached.

Bio-chemistry tests, arterial blood gas, and complete blood count were administered. The results were in the normal range, especially since there was no hyperkalemia. All vital signs were good, the amputated limb is now viable. The patient is in physical rehabilitation 4-day post-operative.

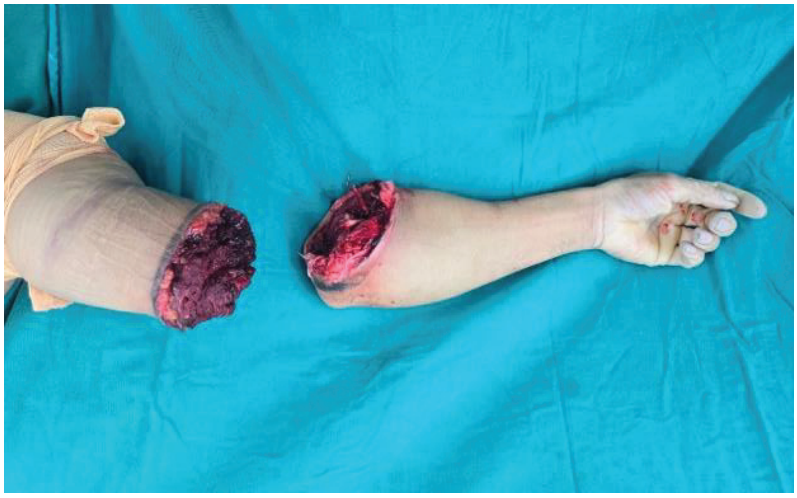

Figure 1. Preoperative amputated arm.

(A) (B)

Figure 2. Post-operative arm after the replantation.
(A): The arm right after the surgery; (B): The arm 14-day post-operative.

DISCUSSION

The amputation cuts off the limb from the main blood source, leading to an ATP loss and the dysfunction of ion-dependent channels of cell membranes. The local ischemia causes acidosis, the accumulation of intra-cellular lactate, and the drainage of intra-cellular calcium. The success of the replantation heavily depends on the severity of the injury and the time of warm ischemia [1]. The longer the time of warm ischemia, the more severe the reperfusion would be. He (2022) reported that the time of cold ischemia within 6 hours for warm limbs or 12 hours for limbs stored in cold can increase the likelihood of surgical success as well as sustain the overall condition. In this case, the amputated limb was treated and stored properly before hospitalization, this early action helped decelerate the anaerobic metabolism in the amputated limb [2]. Nowadays, almost all amputated limbs will be stored properly thanks to communal medical education and media. The patient was admitted to the hospital very soon, 2 hours post-injury. Shortly after the hospitalization, the patient or his legal guardian was fully informed of his injury, potential complications, and how treacherous the replantation could be while the amputated limb and the patient were being prepared and closely monitored for ensuing surgery. This immediate action optimizes the overall state of the patient, enhancing the success rate of the surgery by minimizing the time of warm ischemia.

During the preparation, the limb was rinsed and cleaned with Heparin 5000UI dissolved into 500mL normal saline until the wound discharge through subcutaneous veins was nearly translucent. McCutcheon et al. (2002) reported a case of limb replantation in which the limb was rinsed with normal saline to clear off anaerobic metabolites and not to deteriorate blood vessels' injuries prior to blood vessel reattachment [3]. We assume that rinsing blood vessels with normal saline is a proper approach to eliminate anaerobic metabolites in the

amputated limb and mitigate the blood vessels' injuries, whereby stopping anaerobic metabolites from flowing back to the main circulation, decreasing the chance and the severity of the reperfusion.

Ischemic limb produces anaerobic metabolites, cytokine, IL-6, and lactic acid, and causes hyperkalemia and hypocalcemia [4, 5, 6]. The blood pH will surely be disrupted if these products travel back to the main circulation, impairing the cardiac function, and grave results would be inevitable. Disposing these products by rinsing the amputated limb will reduce the chance of reperfusion syndrome. Nevertheless, the rinsing cannot be performed during the replantation, so the metabolites will keep building up. Therefore, after the anastomosis was done, part of the residual blood in the amputated limb was got rid of by clamping the satellite veins and letting them drain via subcutaneous veins. This action was found efficient and proven by the following blood tests.

CONCLUSION

We concluded that immediate surgery, rinsing the amputated limb before replantation, and eliminating part of the residual blood in the limb before the passage of blood vessels is restored are applicable methods to lower the chance of reperfusion syndrome in cases with amputated limbs, especially major limbs.

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