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Autologous free tissue transfer in paediatric patient with a univentricular heart

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Abstract

We report on the case of a 30-month-old boy who developed severe deep cervical necrosis after bypass surgery for total cavopulmonary connection, followed by low-cardiac output and extracorporeal life support. As several bedside debridements failed to result in sufficient wound healing, a 2-stage necrectomy followed by autologous reconstruction with a free anterolateral thigh-flap was required. Due to impaired circulation, postoperative flap monitoring was extremely difficult. To ensure flap perfusion, mean arterial pressure had to be raised by catecholamines over 7 days.

Keywords: Univentricular heart • Total cavopulmonary connection • Impaired peripheral circulation • Anterolateral thigh-flap • Central venous line

INTRODUCTION

The anterolateral thigh (ALT)-flap is a fascio-cutaneous perforator flap which causes little donor site morbidity and is suitable for reconstructing large soft-tissue defects. Postoperative flap survival depends on sufficient peripheral circulation. Here, we present the case of a child whose microsurgical free tissue transfer succeeded despite impaired peripheral microcirculation after cardiac surgery due to complex congenital heart disease.

CASE REPORT

This 30-month-old boy (95 cm length, 14 kg body weight) with a univentricular heart caused by a congenital heart disease with unbalanced complete atrioventricular septal defect was admitted to undergo cardiopulmonary bypass surgery and total cavopulmonary connection. Previously, he had received an aortopulmonary shunt (age 17 days) followed by a bidirectional Glenn anastomosis (age 6 months).

Due to post-surgical low-cardiac output syndrome (LCOS) and high venous and pulmonary pressures, weaning from cardiopulmonary bypass failed and extracorporeal life support became necessary. Cardiac function recovered, and 3 days after initial

surgery, we carried out a fenestration between the common atrium and cavopulmonary conduit.

A cervical rash at the site of a central venous line to the superior vena cava dexter manifested while on extracorporeal life support and developed into deep necrosis arising from the carotid vessel sheets and affecting the sternocleidomastoideus muscle (Fig. 1A).

We decided to execute aggressive debridement and immediate soft-tissue reconstruction via a free autologous tissue transfer. A 13 cm-long, 9 cm-wide, spindle-shaped ALT-flap was planned on the right thigh and marked preoperatively by identifying the perforator vessels originating from the descending branch of the lateral femoral circumflex artery via colour Doppler sonography.

After deep necrectomy on the right cervical side, the left facial artery and vein were exposed to create an unaffected and safe anastomosis site. The ALT-flap was raised at the vascular pedicle (Fig. 1B) and microsurgically anastomosed end-to-end to the left facial vessels at their origin at the carotid artery and vein.

Intra- and postoperatively, the flap appeared unusually pale, and the marbled skin made clinical monitoring difficult (Fig. 1C). Furthermore, the implanted Doppler probe's signal was weak, and colour Doppler sonography revealed stable perfusion of the vascular pedicle, but microcirculation was difficult to identify. Under a benefit-risk assessment of the peripheral vasoconstriction versus hypertensive effect, we administered low-dose epinephrine therapy

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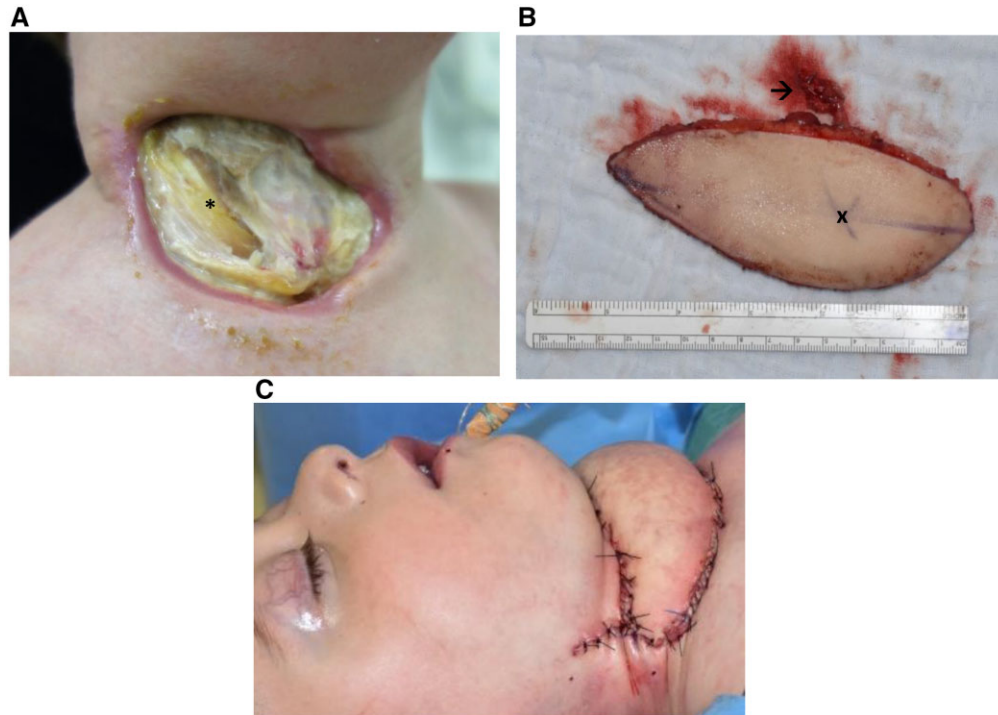


Figure 1: (A) Cervical necrosis affecting the sternocleidomastoideus muscle (*). (B) Raised anterolateral thigh-flap; vascular pedicle (→) and preoperatively marked Doppler signal site (x). (C) Intra- and postoperative paleness and marbled skin depicting impaired flap perfusion.

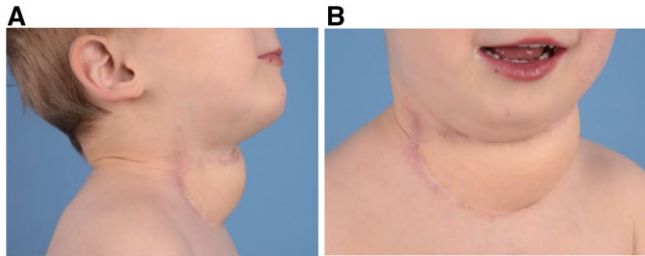


Figure 2: (A and B) Six months postoperative.

(0.02–0.06 $\mu\text{g}/\text{kg}/\text{min}$) for 7 days, aiming at a mean arterial pressure >70 mmHg. The flap exhibited consistent microcirculation and could be monitored by capillary refill time. This patient's further postoperative recovery was uneventful (Fig. 2A and B).

The patient's parents consented to having this information and pictures disclosed in this report.

DISCUSSION

In this young patient with LCOS after total cavopulmonary connection using bypass surgery, several systemic haemodynamic factors impacted wound healing and flap integration. Initially, the cervical lesion potentially appeared due to extravasated catecholamines. Ongoing extracorporeal life support therapy and prolonged LCOS leading to lower arterial pressure impaired the necrotic area's healing. Fontan circulation can cause higher pressure in the systemic venous system, venous congestion and reduced venous backflow from peripheral tissue [1]. This impedes the flap's perfusion, as it is mainly achieved by the difference in mean arterial and venous blood pressure. In our patient, intracardiac pressures were not elevated before initial surgery. Fenestration of the cavopulmonary

conduit was performed to increase ventricular preload 3 days after. In our centre, fenestration is not performed routinely but only in selected high-risk patients with high transpulmonary gradients and/or underfilling of systemic ventricle.

Local tissue transfer, such as pedicled pectoralis flap or random pattern flaps, is considered a workhorse of reconstruction of cervical defects. However, they are limited in range and orientation. Free tissue transfer is challenging in children, mostly due to small vessel diameter [2]. Nevertheless, microanastomosis can be done safely due to reliable vascular anatomy in the paediatric population as children usually have no compromising pre-existing conditions such as atherosclerosis or diabetes [3]. Donor vessels should be chosen outside the zone of injury. Postoperative flap care can be complex despite the use of Doppler probe or colour sonography. We monitored the flap by capillary refill time, which revealed strong dependence on the mean arterial pressure.

With this report, we highlight the potential of free tissue transfer in children with complex haemodynamics. Univentricular circulation with total cavopulmonary connection, venous congestion and LCOS after cardiac surgery all affect the circulation in peripheral tissue, and make flap monitoring more difficult. Despite small vessel diameters, microsurgical free tissue transfer is a safe procedure and should be considered in cases of complex wound situations to accelerate the ambulation of paediatric patients.

The comprehensive interdisciplinary management of children with complex congenital heart disease is a valuable advantage that institutions combining cardiac, plastic surgery and other disciplines offer.

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