

# LEFT SUBCLAVIAN ARTERY MANAGEMENT IN FROZEN ELEPHANT TRUNK: A NOVEL TECHNIQUE

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## Abstract

Proximilisation of Frozen Elephant Trunk (FET) necessitates the ligation and reimplantation of the left subclavian artery (LSA), the origin of which is distal and posterior, make rerouting difficult and cumbersome. We describe a rather simple technique for subclavian artery exposure and effective anatomical reconstruction in the mediastinum coupled with hybrid FET utilisation for aortic aneurysm in elective and non-elective settings. The division of the sternocleidomastoid coupled with the sandbag behind the left shoulder brings the LSA superficial enabling anastomosis without any difficulty.

## Introduction

Proximilisation of Frozen Elephant Trunk (FET) from zone 3 to zone 2 necessitates rapid evolving surgical skills to match device use and technology application. However, ligation and reimplantation of the left subclavian artery (LSA), the origin of which is distal and posterior, make rerouting difficult and cumbersome. Despite, several methods being described in the literature [1], no single approach has been ascribed to as providing optimal access and ease of use. We describe a rather simple technique for subclavian artery exposure and anastomosis coupled with hybrid FET utilisation for aortic aneurysm in elective and non-elective settings.

## Surgical Technique

The patient is positioned with a sandbag under the left shoulder and head turned towards the right side. The upper end of the sternal incision is extended cranially to the left side of the neck over the sternocleidomastoid muscle. With the neck turned to right side, this extension is almost in line with median sternal incision. The sternal head of the sternocleidomastoid is divided from its origin (Figure 1B) enabling the exposure of the left common carotid artery (LCCA) and the LSA. The aorta is then pulled caudally and the supra-aortic arch vessels are dissected and looped. When the desired body temperature is reached, the hybrid prosthesis is deployed in zone 2 and the supra-aortic arch vessels are connected to the hybrid prosthesis (Figure 1 C, D, E). After achieving haemostasis, the sternal head of the sternocleidomastoid muscle is reattached using absorbable sutures and chest closed in the usual manner.

When required, the following additional manoeuvres can be used to increase the exposure of LSA. (i) Looping, Ligation and division of the innominate vein (Figure 1A) (ii) When the LCCA is used for arterial inflow, both the incisions can be connected (Figure 1B) and (iii) during the antegrade cerebral perfusion, the cross-clamp on the LCCA can be applied in the neck to avoid any paraphernalia in the operative field (Video 1).

## Discussion

Although FET combines the advantage of open and endovascular surgery, it is still major surgery with prolonged ischemia time. The perioperative complication is similar to the classical total arch replacement, with paraplegia proving to be the chink in armour for FET. Several steps taken to reduce the complication include short stent graft, reimplantation of the LSA artery, and reduction of the circulatory arrest.

Reimplantation of the LSA in FET may be challenging in (i) Obese individuals (ii) Patients with a deep chest (iii) Elongated aorta (iv) Large aortic arch aneurysm (v) Re-operative procedures. Several surgeons have tried different techniques to reimplant the LSA including the LCCA-LSA artery bypass, extra anatomic aortic-axillary bypass [1] and, clamping the descending thoracic aorta and compressing the aortic arch to facilitate the exposure and anastomosis of LSA [2]. An additional incision for extra-anatomic aortic-axillary bypass through the left thorax may be cumbersome besides the risk of injury to brachial plexus (1.5%) during exposure of left axillary artery [3]. LSA is often an elastic, thin fragile artery and when involved in aortic dissection, it is even worse. Performing anastomosis on this artery in the deep intrathoracic compartment is technically difficult making future haemostasis further a challenge.

Some centers that perfuse the LSA during the cardiopulmonary bypass, a tube graft can be anastomosed to the artery in an end to end fashion, which can later be connected to the hybrid prosthesis. The advent of Neo-Evita Spielvogel in the market will empower the surgeon for a “no-arch-touch” Zone 0 implantation [1]. The above exposure will facilitate the LSA reimplantation during the same.

The incidence of direct aortic origin of left vertebral artery (LVA) from the aortic arch varies from 2.4 - 5.8% in different studies and in 50% of individuals the LVA is dominant [4,5]. The LVA has to be reimplanted directly or using an autologous vein, either to the LCCA or the LSA to protect the posterior cerebral circulation and the spinal cord [5,6]. Given the delicate nature of the LVA, meticulous handling without stretching is essential to avoid intimal damage. We believe, our technique will provide adequate exposure of the LVA for a meticulous anastomosis to the LSA or LCCA.

Our technique provides excellent exposure of LSA for an effective anatomical reconstruction in the mediastinum. The division of the sternocleidomastoid coupled with the sandbag behind the left shoulder brings the LSA superficial enabling anastomosis without any difficulty. Additional manoeuvres described above will further aid in the exposure and rerouting. The division of the sternal head of sternocleidomastoid will not cause any functional disability [7]. We agree that the scar of the wound is a bit long and extends to the neck. In our experience, there were no problems in wound healing.

## Declarations

**Disclosures:** None of the authors have anything to disclose

**Ethical Statement:** An approval from the Institutional Review Board was obtained

**Informed Consent:** All the patients were explained about the procedure and oral consent for the same was obtained.

## Reference

1. Jakob H, Idhrees M, Bashir M. Frozen elephant trunk with straight vascular prosthesis. *Ann Cardiothorac Surg.* 2020;9(3):164-169. doi:10.21037/acs-2020-fet-60
2. Matalanis G, Koirala RS, Shi WY, Hayward PA, McCall PR. Branch-first aortic arch replacement with no circulatory arrest or deep hypothermia. *J Thorac Cardiovasc Surg.* 2011;142(4):809-815. doi:10.1016/j.jtcvs.2011.01.020.
3. Sabik JF, Nemeh H, Lytle BW, et al. Cannulation of the axillary artery with a side graft reduces morbidity. *Ann Thorac Surg.* 2004;77(4):1315-1320. doi:10.1016/j.athoracsur.2003.08.056
4. Yuan SM. Aberrant Origin of Vertebral Artery and its Clinical Implications. *Braz J Cardiovasc Surg.* 2016;31(1):52-59. doi:10.5935/1678-9741.20150071.

5. Brasiense LB, Albuquerque FC, Spetzler RF, Hanel RA. Advances and innovations in revascularization of extracranial vertebral artery. *Neurosurgery* . 2014;74 Suppl 1:S102-S115. doi:10.1227/NEU.0000000000000218
6. Imparato AM. Vertebral arterial reconstruction: a nineteen-year experience. *J Vasc Surg* . 1985;2(4):626-634
7. Santoro GP, Luparello P, Lazio MS, Comini LV, Martelli F, Cannavici A. Myotomy of sternocleidomastoid muscle as a secondary procedure in laryngectomized patients. *Head Neck*. 2019;41(10):3743-3746. doi:10.1002/hed.25852.

## Legends

Video 1: Surgical technique for exposure of Left subclavian artery: Animated video explaining the surgical steps followed the surgical procedure.

Figure 1:

Black dotted line: *Cranial extension of the sternal incision* . White dotted line: *Skin between the sternal and neck incision*. White arrow(>>): *Innominate vein*. Yellow arrow(>>): *7mm arterial inflow to the carotid artery*. M: *Muscle- sternal head of sternocleidomastoid* . C: *Left common carotid artery*. S: *Left subclavian artery*

(A) Left side cranial incision exposing the supraaortic arch vessel (B) The sternal and the neck incision united. Note the division of the sternal head of sternocleidomastoid muscle (C) Note the clear visibility of the LCCA and LSA after implantation of the FET hybrid prosthesis (D) Anastomosis of the LSA to the hybrid prosthesis (E) Anastomosis of the LCCA to the hybrid prosthesis .

