CHIRURGIE VASCULAIRE / VASCULAR SURGERY

CADAVERIC TRAINING IN OPEN VASCULAR SURGERY

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Objective: A future vascular surgeon should have a good basic knowledge before performing any surgical procedure on a patient. However, surgical trainees now have less dedicated operating time than their predecessors so that changes in trainee formation is need. Cadaveric training has been considered the best substitute for actual live surgery. We expose our experience in training for vascular surgical procedures using human cadavers. **Material and Methods:** From June 2013 to November 2016, we performed 83 vascular surgical procedures on 45 human cadavers, 30 males and 15 women, including 28 children and 17 adults obtained according to the Ivorian laws in force. Cadavers were preserved in formaldehyde 10% and cryopreservation. The death mode was unknown.
Results: After 3 abdominal aortic expositions, we performed 3 surgical aortic repairs via 3 midline laparotomies. After 19 peripheral arterial exposures, and 5 samplings of the internal saphenous vein, we practiced 37 carotid, subclavian, iliac and femoral arterial' revascularizations via 4 cervicectomies, one supralaminar incision and 8 incisions in Scarpa or inguinal area.
Conclusion: Cadaver Training is an important tool to improve technical skills in vascular surgical procedures, for trainees to practise their surgical skills prior to entering operating theatre.
Keywords: Training, Simulation, Vascular, surgery

Introduction

Nowadays, postgraduate surgical training is facing significant challenges[1]. Working time constraints due to limitations on working hours in developed countries [2-4] and the lack of financial resources to access surgery in developing countries [5] creates fewer operations available for trainees. There is an imperative for more efficient and time-effective methods of surgical training. Several models were proposed for the surgical training of surgeons. There are synthetic models, cadavers, animals' models and virtual reality simulators [1]. The most realistic model, from an anatomical point of view, is the human body itself: cadavers' models[6]. Thus, several centers organize cadaveric workshops to train surgery residents[7-9]. Cadaveric training has been an essential part of surgical training for decades and has been considered the best substitute for actual live surgery[1, 10]. To hone our vascular surgical skills, we performed main cardiac surgical procedures using human cadavers.

Material and Methods:

From June 2013 to November 2016, we performed 83 vascular surgical procedures on 15 adults' human cadavers including 10 males and 5 women obtained according to the Ivorian laws in force. Cadavers were preserved in formaldehyde 10% and cryopreservation. The death mode was unknown.

Results:

A total of 83 vascular surgical procedures were performed: 16 regional approaches, 27 vascular exposures and controls and vein samplings and 40 vascular surgical revascularization techniques **(Table1).**

Regional approaches n= 16	Vessel's exposure, control and sampling n= 27	Surgical revascularization techniques n=40
- Cervico-sternotomy (n=4) - Supraclavian incision (n=1) - Laparotomy (n=3) - Inguinal Incision (n=2) - Scarpa area Incision (n=6)	- Carotid, supra aortic trunks,sub clavier, (n=7) - Abdominal aorta exposition (n=3) - External iliac and femoral arteries (n=12) - Internal saphenous vein sampling (n=5)	- Arterials' direct suture (n=25) - end-to-end anastomosis (n=4) - bypass procedure (n=5) - vein graft interposition (n=3) - Abdominal aorta flattening transplant (. n=3)

Table 1: List of vascular surgical procedures (n=83)

In head and neck region, we performed 7 Carotid revascularizations by suture (n=5), end-to-end anastomosis[1], and bypass procedure (n=1) via 4 cervico-sternotomy incisions **(Figure 1).** Three sub clavicular revascularizations by suture (n=2) or by end-to-end anastomosis (n=1) were performed. In thoracic region, we achieved thoracic aortic suture (n=1). In abdominal region, we performed 4 abdominal aortic revascularizations by suture (n=1) and flattening–transplant of abdominal aorta with re-implantation of the inferior mesenteric artery (n=3) via 3 median laparotomy incisions **(Figure 2).** In extremity, we achieved 25 femoral artery revascularizations **(Figure 4, 5)** by direct suture (n=16), end-to-end anastomosis (n=2), bypass procedure (n=4), vein graft interposition (n=3) via 6 Scarpa area incisions **(Figure 3).**

ure 3: Illustration of approaches and vessels e
and thoracic vessels The left cervico-sternotomy **(A)** allow
exposure anterior view of supra-aortic trunks **(B). B**
Brachiocephalic artery. **LCCA :** Left common carotid ar
LSCA : Left subclavian artery. **RA :** Right auricle. IJV : Inte
jugular vein.

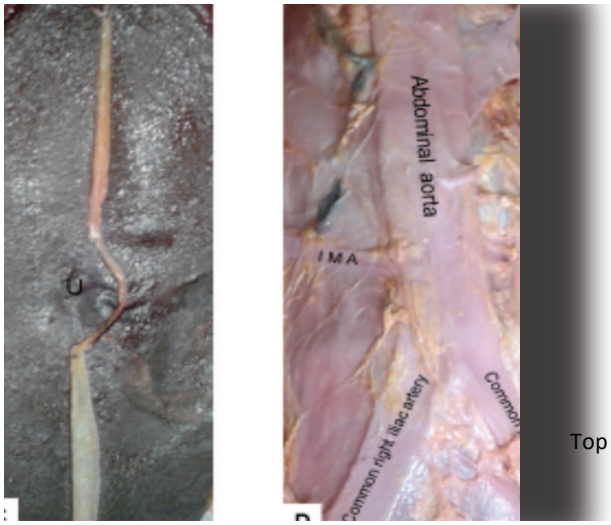
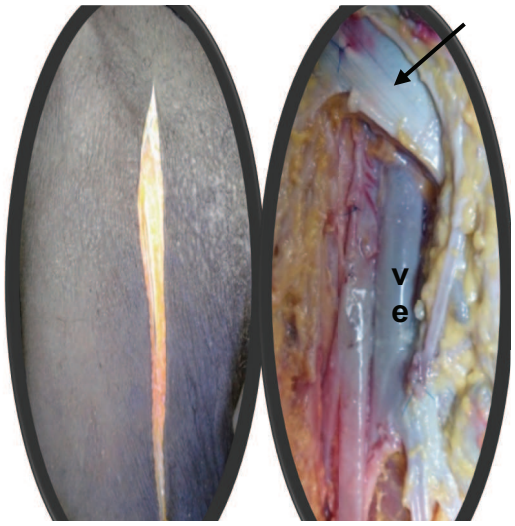
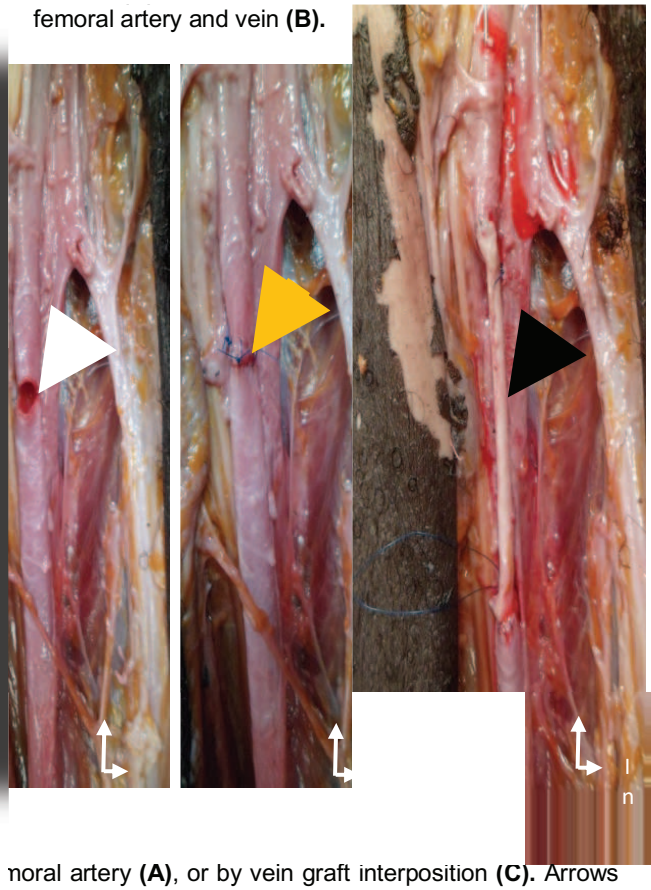


Figure 2 : Illustration of approaches techniques of abdominal vessels. The median laparotomy **(A)** allows to exposure anterior view of abdominal aorta **(B). U :** Umbilicus. **IMA :** Inferior mesenteric artery.

Inguinal ligament



femoral artery and vein **(B).**



noral artery **(A)**, or by vein graft interposition **(C).** Arrows
esent the different lesion and vascular surgical techniques
in each case.

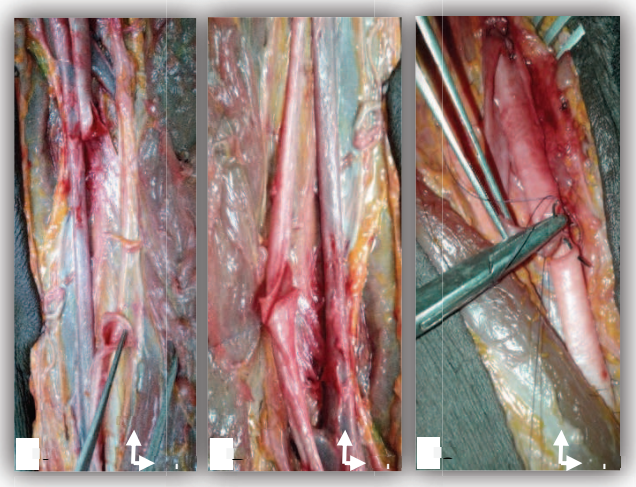


Figure 5: Open femoral artery revascularization techniques by end-to-end anastomosis **(A, B)**, or by bypass procedure **(C).** Blue arrow shows the suture technique of the distal arteriovenous anastomosis and yellow arrow indicates the inverted saphenous vein graft.

The idea of simulation in medical education has been well described in the literature. Indeed, according to Widmer and colleagues[2], simulation originates from research in other professions (e.g. training of pilots in aviation). Furthermore, Krampe [11] affirm that research in music showed that professional pianists were separated from amateur musicians by their amount of training, which exceeded 10,000 hours of practice. According to Ericsson[12], the same principle applies to surgical procedures where complex parts should be trained repeatedly, without the need to perform the whole operation, to reach and maintain expert performance. Deliberate practice includes the motivation to improve performance through regularly repeated similar tasks, build on existing knowledge and followed by immediate informative feedback[12]. This form of practice helps juniors to become experts and experts benefit from the possibility to train rare conditions such as intraoperative complications and emergency procedures. Most surgical training models are available including synthetic models, virtual reality, live animals, and human cadavers[14]. Synthetic models use synthetic material[15], live animals models required living animals [16]. In virtual reality models, surgical procedures training are performed using virtual reality surgical simulator[17]. In human cadavers' models, surgical procedures training are performed using human cadavers[18]. Each training model has its advantages and disadvantages. According to Gambhir RP[19], the best training tool is cadaveric training, and it is heartening to see more and more centers adopting this modality. In our practice, the performing of vascular surgical procedures allowed us to improve our knowledge of anatomy, to perfect our surgical basic procedures, to increase our surgical volume exposure. As in the United Kingdom, it is imperative to opt for the development of clinical skills centers in Africa and elsewhere in the world; and it is understandable that every institution engaged in postgraduate surgical training has a skills laboratory[20]. This will be one of challenges of Bouake Cardiology Institute construction in Cote d'Ivoire, which aims to be a reference center for the training of future cardiovascular and thoracic surgeons and even for trainees in general surgery in the West African Region. In this field, the practical guide on the development of a clinical skills center published by Dacre[21] will be a very useful support. Those types of surgical skills center would not only be reserved for trainees' surgeons, but, it would also offer an opportunity for senior surgeons because cadaveric

surgery is a safe way to practise new procedures for junior surgeons as well as difficult or challenging procedures for their seniors[22]. Regarding to the training in open vascular surgery, cadavers provide an excellent opportunity to teach basic principles[9]. In this cadaver training, there is no risk of bleeding associated with every vascular surgery procedure in the operating room. However, the repetition of the procedures and the dexterity that it provides, allow to minimize per and post- operative bleeding risk. Vascular societies in Africa and elsewhere in the world have to follow the lead shown by the European Society for Vascular Surgery and have dedicated training for the vascular surgery residents during the annual meetings[20,22]. These training could take place on all models as synthetic models, virtual reality, live animals, and human cadavers. However, the cadaveric model should be favored as far as possible because unlike the anastomosis, dissection is more difficult to simulate and use the cadaver's model more realistic[20].

Conclusion:

Cadaver Training is a important tool to improve technical skills in vascular surgical procedures, for trainees to practise their surgical skills prior to entering the operating theatre

Perspective Statement

In the future, cadaveric training in surgery residency should be integrated and building and equipping cadaveric surgery training laboratory should be implemented.

Limitations of the study

Further studies are to be carried out in the future, regarding the effectiveness of skills transfer from laboratory to operative room.

Conflict of Interest:

The authors declare no conflict of interest

Acknowledgements

I'm very grateful to my Master, Prof Koffi Herve Yangni-Angate who initiated and directed me in this training.

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