"Live Cadaver"

Is there spare space for cadavers in surgical training?

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OSSAMA AL-MEFTY MICRONEUROSURGERY LABORATORY

Nothing to disclose

See one, Do one, Teach one.

Is not a valid strategy anymore.

There is a need an adjacent methods in addition to the OR experience to teach residents how to do surgery.

Available Training Models

- Virtual Reality/ computer model
- Physical models/high fidelity simulators
- Live animals
- Human cadavers

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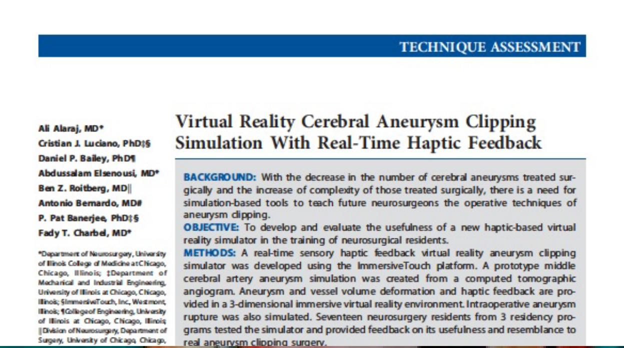
- Virtual Reality/ computer model



TECHNIQUE ASSESSMENT

Virtual Reality Cerebral Aneurysm Clipping Simulation With Real-Time Haptic Feedback

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Daniel P. Bailey, PhD¶
Abdussalam Elsenousi, MD*
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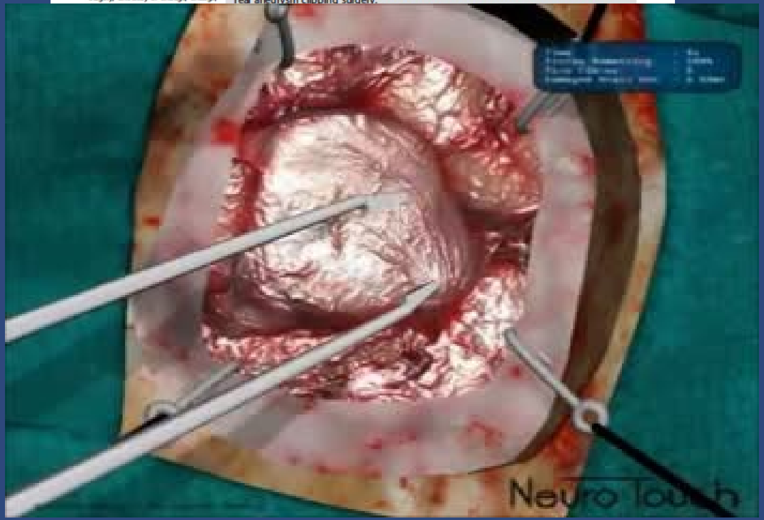
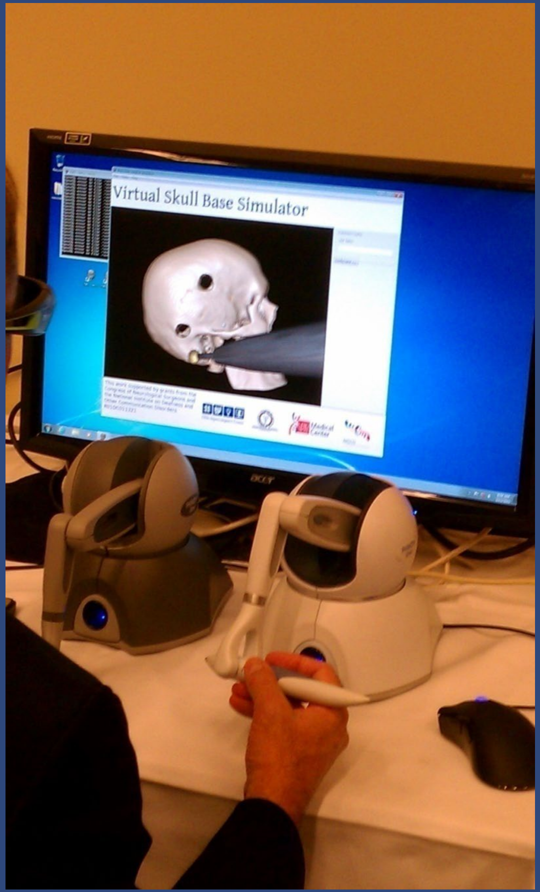
BACKGROUND: With the decrease in the number of cerebral aneurysms treated surgically and the increase of complexity of those treated surgically, there is a need for simulation-based tools to teach future neurosurgeons the operative techniques of aneurysm clipping.
OBJECTIVE: To develop and evaluate the usefulness of a new haptic-based virtual reality simulator in the training of neurosurgical residents.
METHODS: A real-time sensory haptic feedback virtual reality aneurysm clipping simulator was developed using the ImmersiveTouch platform. A prototype middle cerebral artery aneurysm simulation was created from a computed tomographic angiogram. Aneurysm and vessel volume deformation and haptic feedback are provided in a 3-dimensional immersive virtual reality environment. Intraoperative aneurysm rupture was also simulated. Seventeen neurosurgery residents from 3 residency programs tested the simulator and provided feedback on its usefulness and resemblance to real aneurysm clipping surgery.





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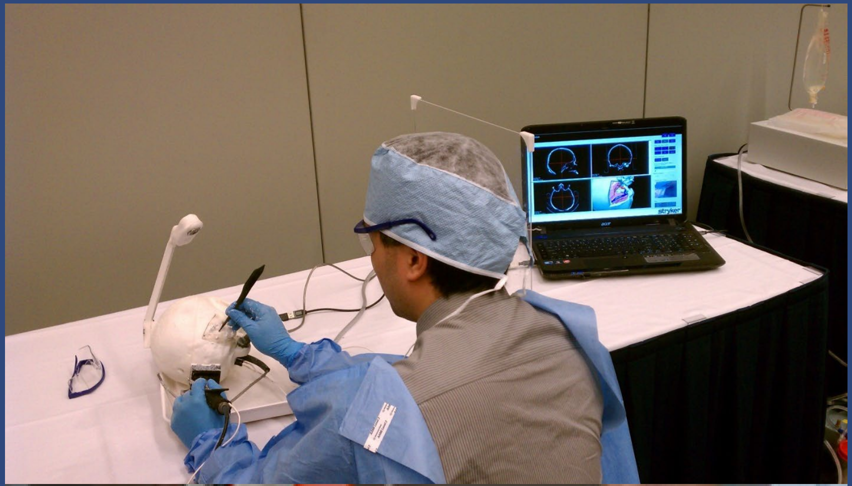

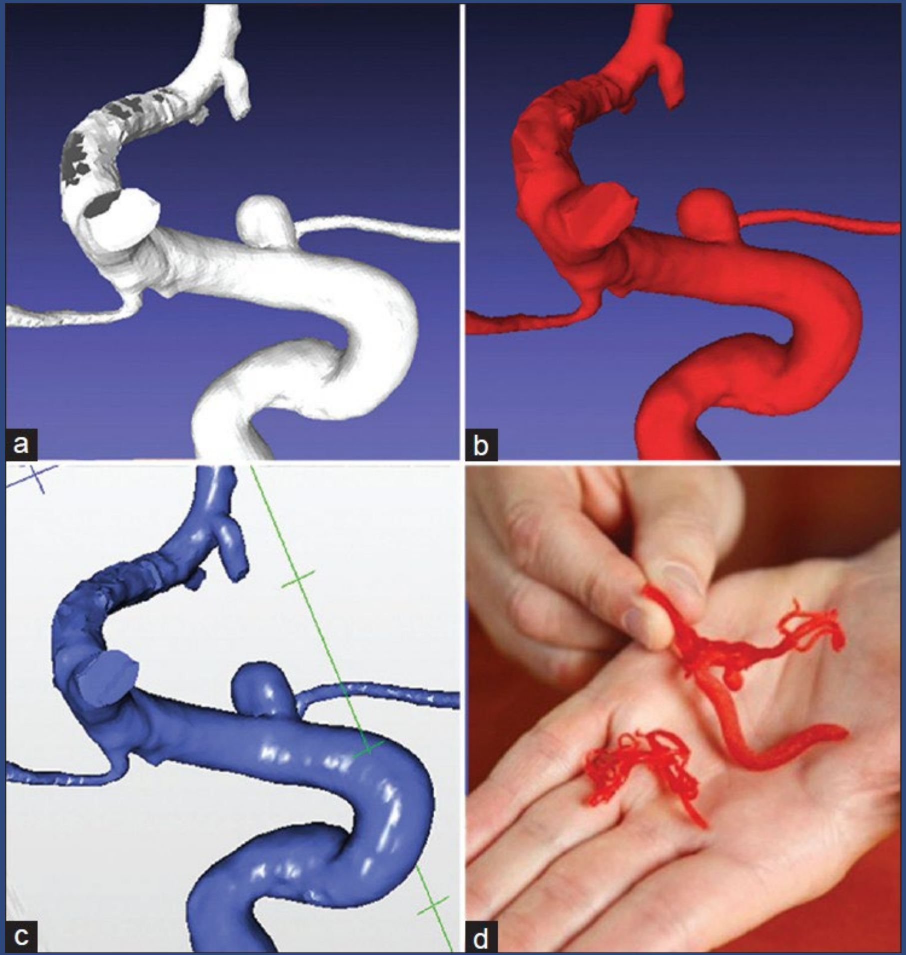

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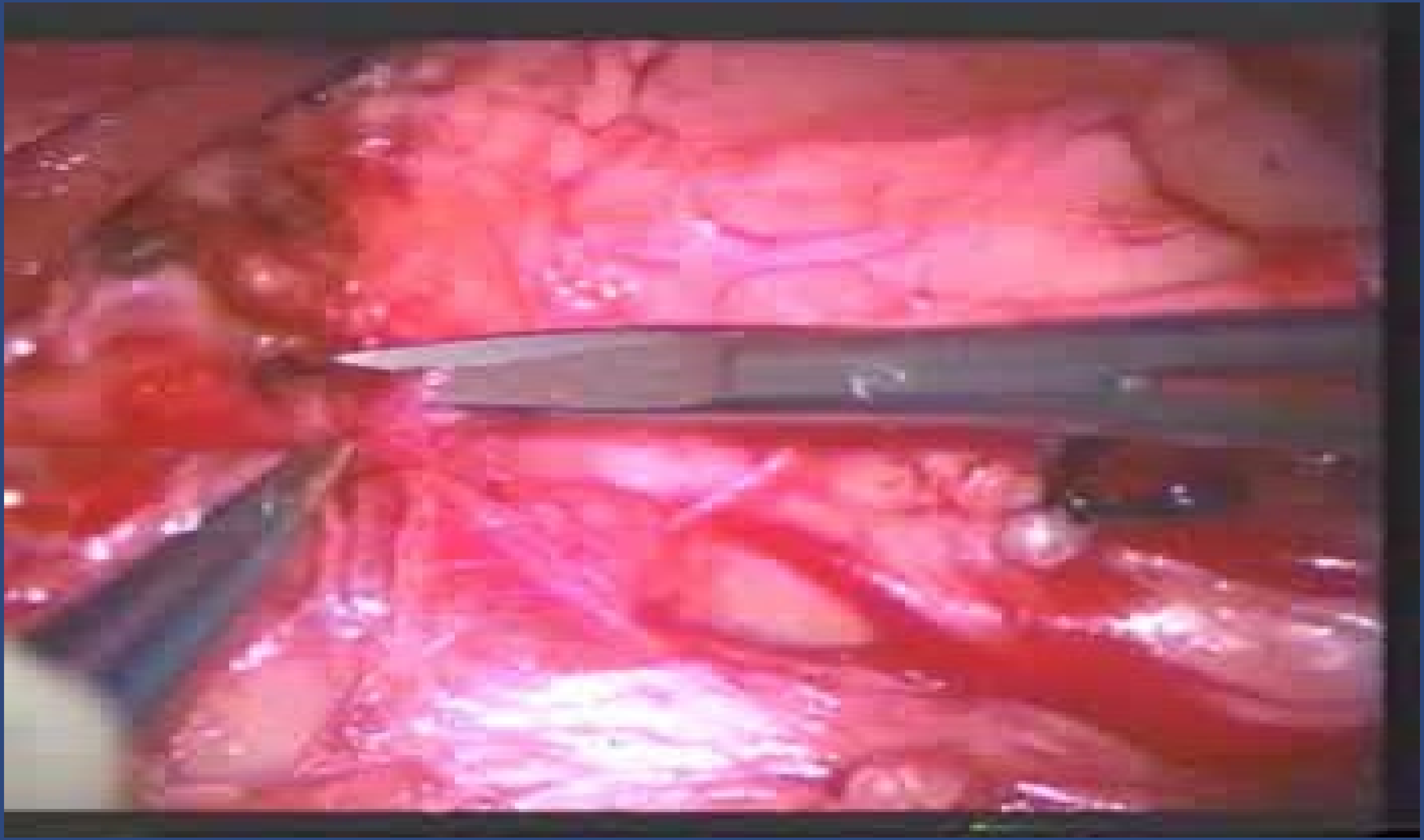


Available Training Models

- Virtual Reality/ computer model
- Physical models/high fidelity simulators
- Live animals
- Human cadavers

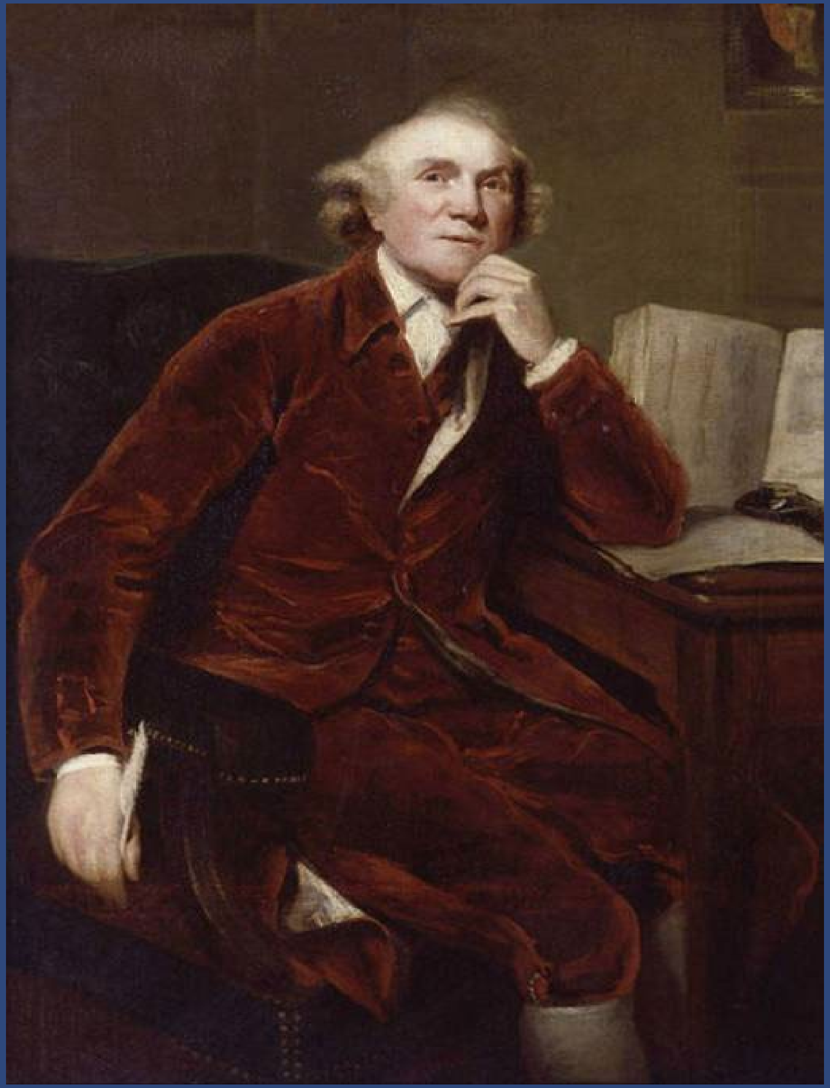
- Human cadavers

We Need a Training Model

conveys a sense of reality **to replicate live surgery,** by providing the **anatomical** characteristics, **life-like** presentation, and **ability to bleed**.

John Hunter

18th Century



Neurosurg Focus 20 (6):E3, 2006

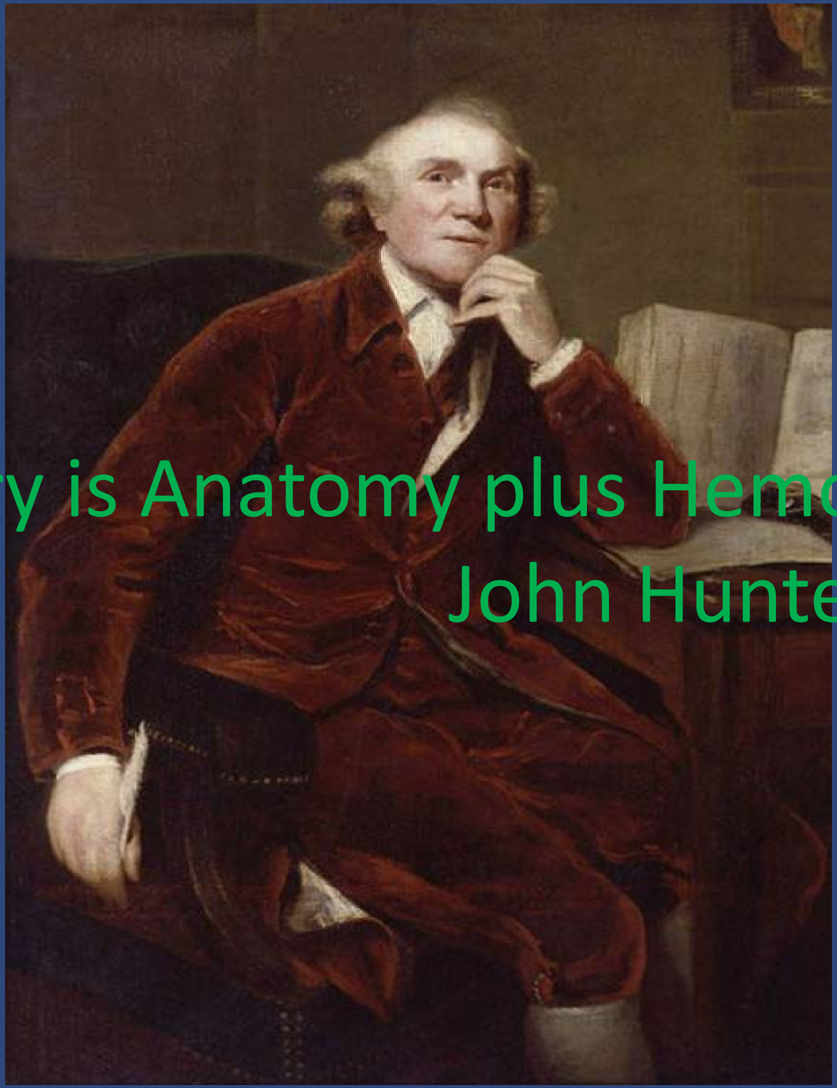
The transition from hunterian ligation to intracranial aneurysm clips: a historical perspective

NIKA V. POLEVAYA, B.S., M. YASHAR S. KALANI, PH.D., GARY K. STEINBERG, M.D., PH.D., AND VICTOR C. K. TSE, M.D., PH.D.

Departments of Neurosurgery and Developmental Biology, Stanford University School of Medicine Stanford, California; and Howard Hughes Medical Institute, Chevy Chase, Maryland

✓ The description of cerebral aneurysms dates back to antiquity. Little was known, however, about the pathological mechanisms of aneurysm formation and treatment options for this disease until 200 years ago. The modern era of aneurysm treatment began with the hunterian ligation of the proximal artery, followed by clip and coil occlusion. In this article, the authors describe the transition from conservative therapy to internal carotid artery (ICA) ligation and gradual occlusion of the ICA to the direct placement of clips on aneurysms. The driving forces and rationale behind each major advancement are summarized, and the authors attempt to predict what these innovations mean for the future of intracranial aneurysm management.

KEY WORDS • **intracranial aneurysm** • **clip occlusion** • **history of neurosurgery**

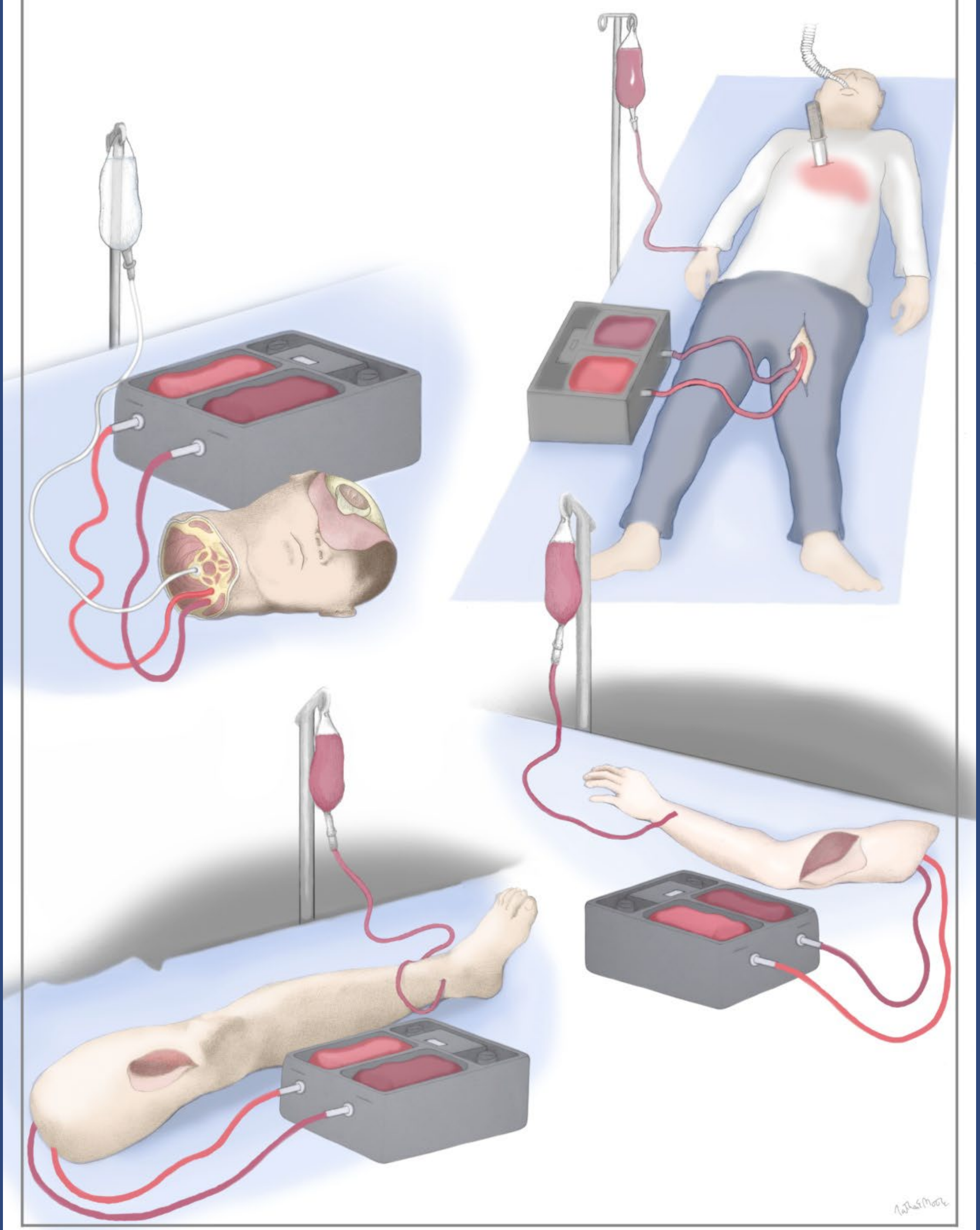


Surgery is Anatomy plus Hemostasis.

John Hunter

LIVE CADAVER MODEL

(ABOUD MODEL)



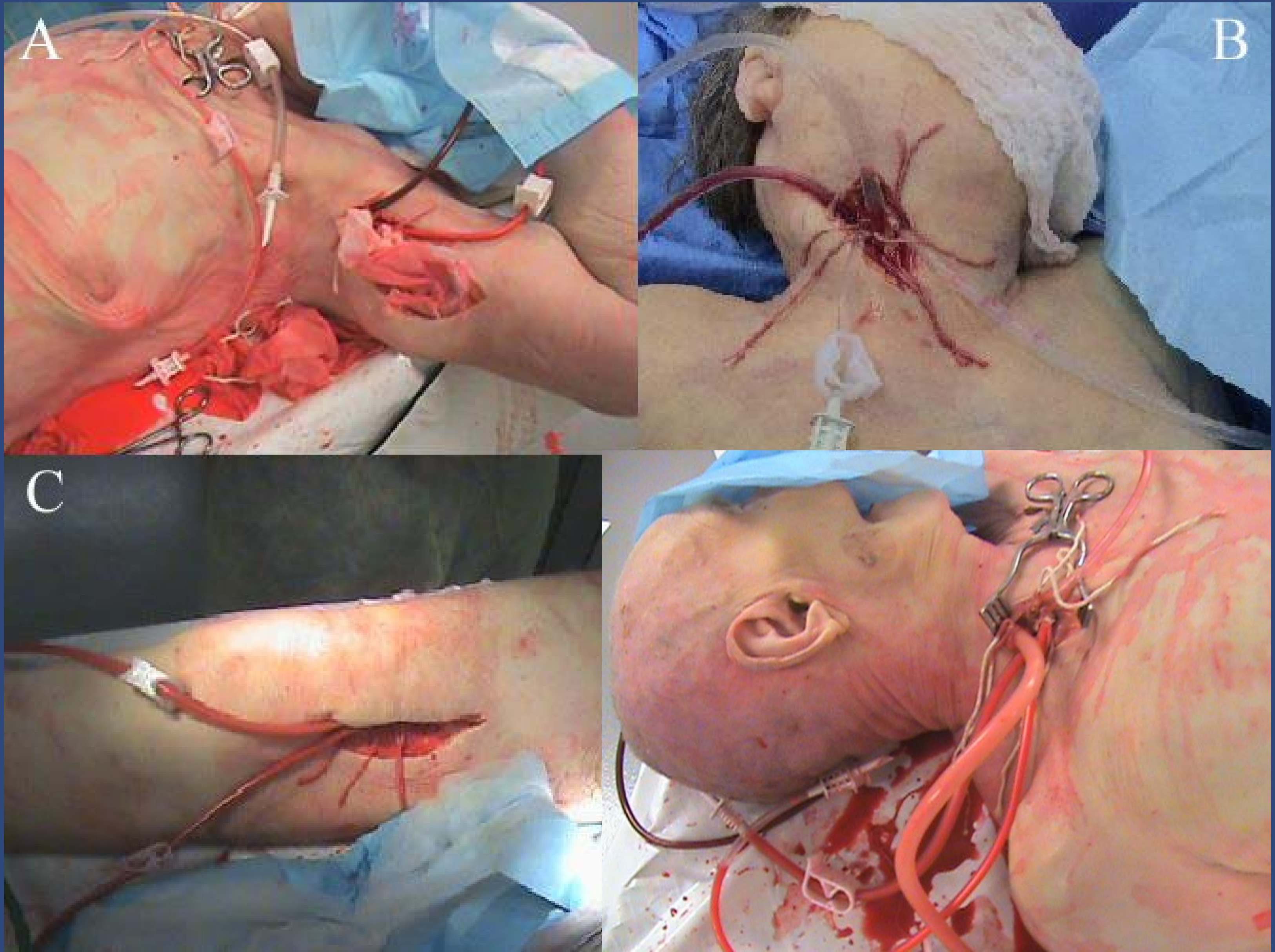
A Cadaver based model

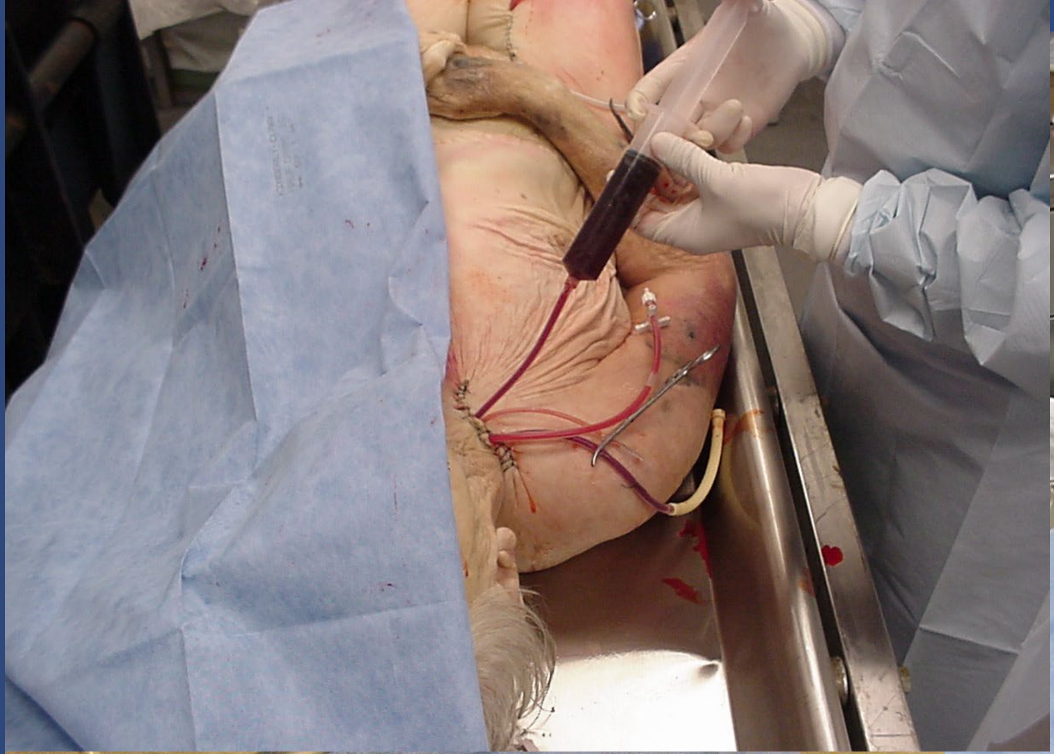
that combines the Real Human Anatomy

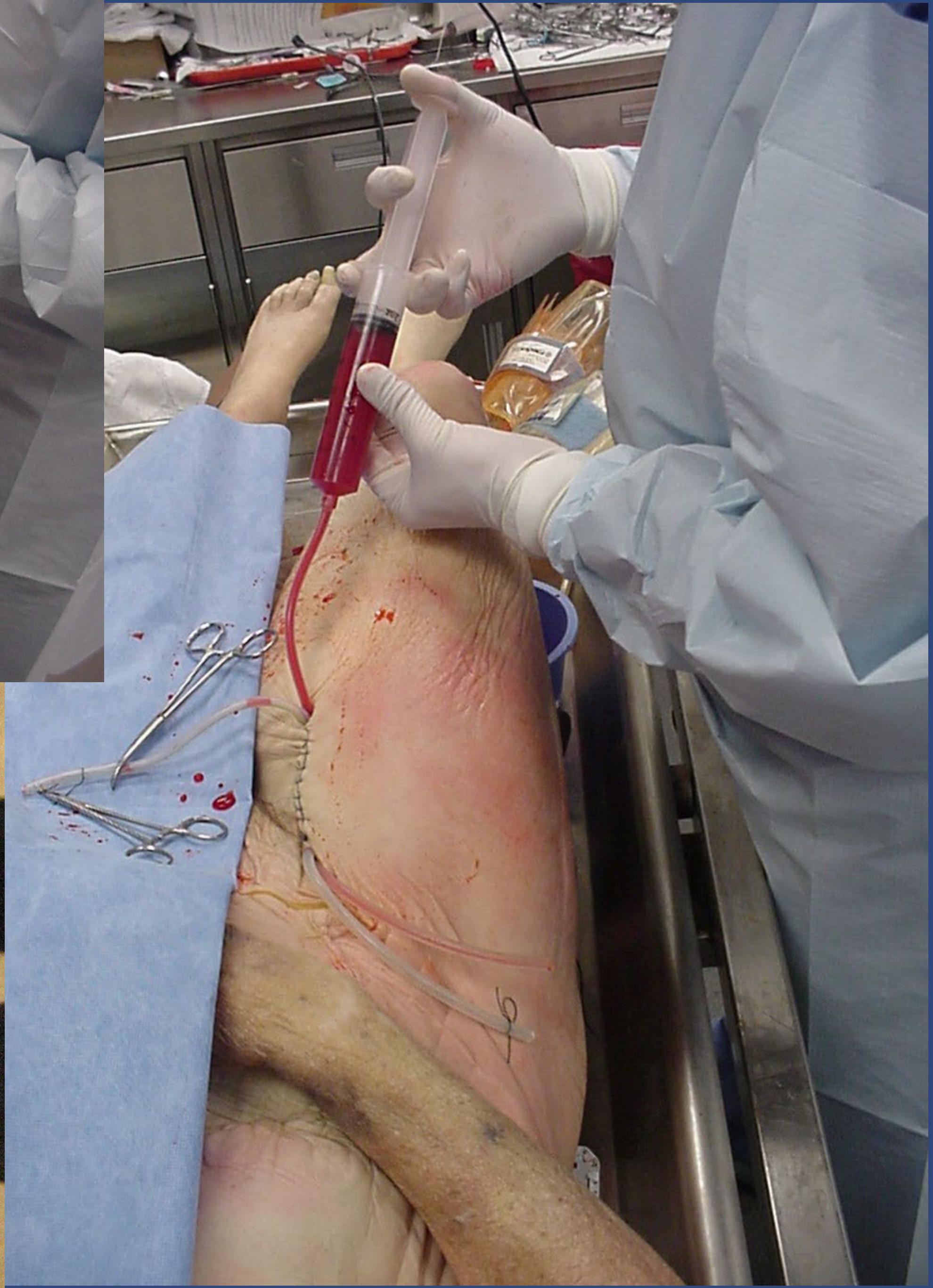
with the

life like condition of the living body

Canulate the vessels using any possible route
We usually use the neck or the groin on one side

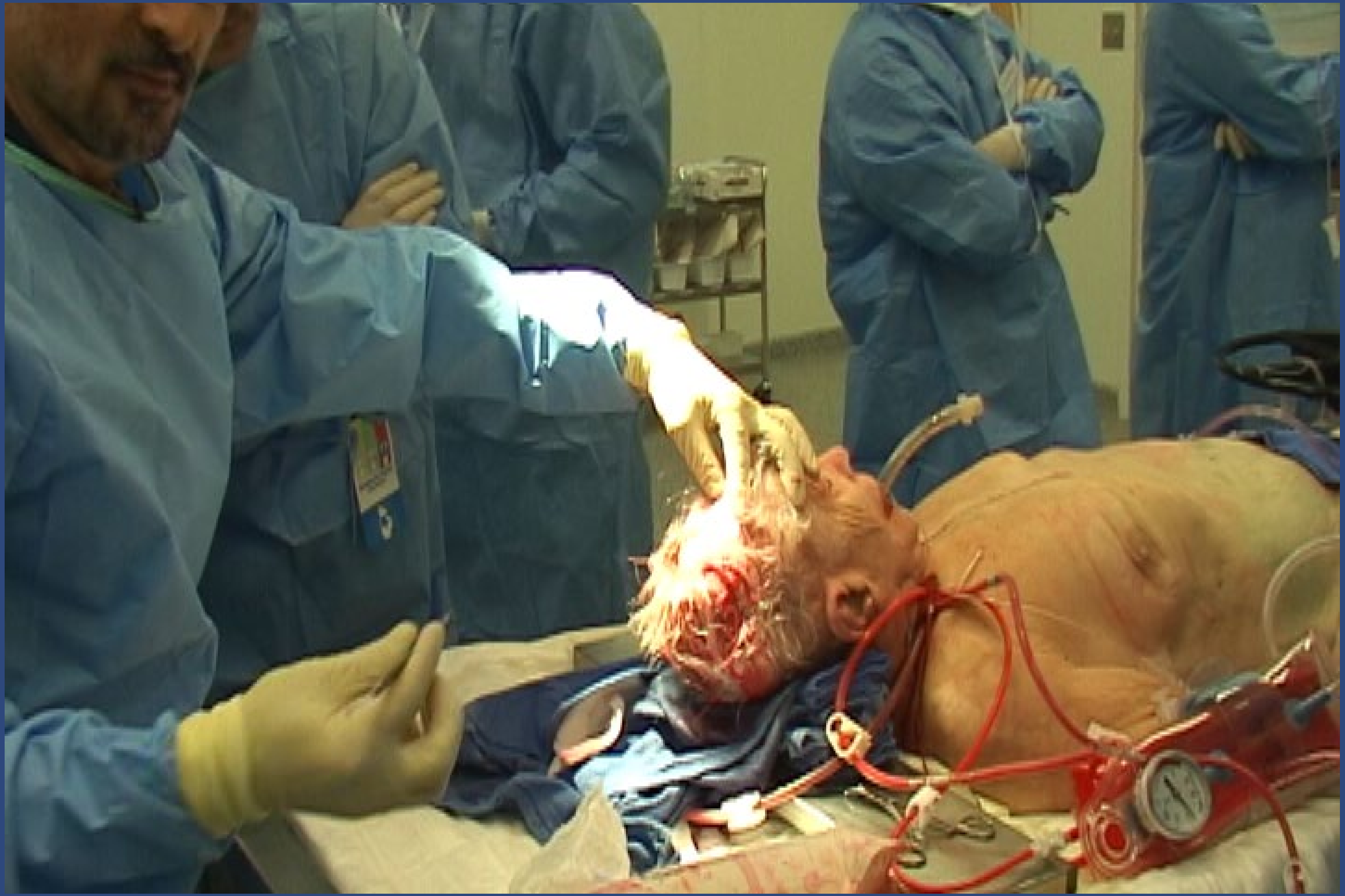


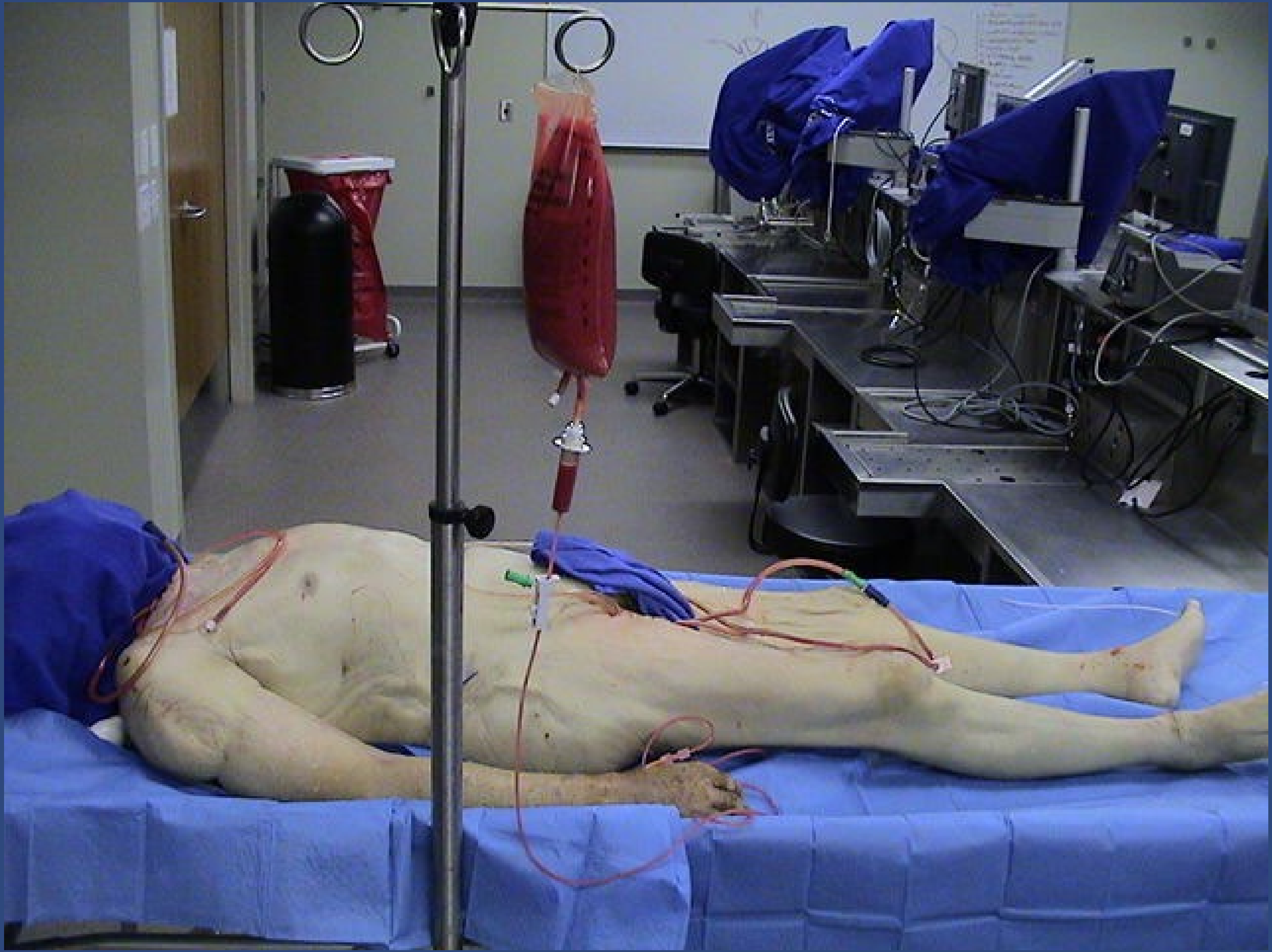


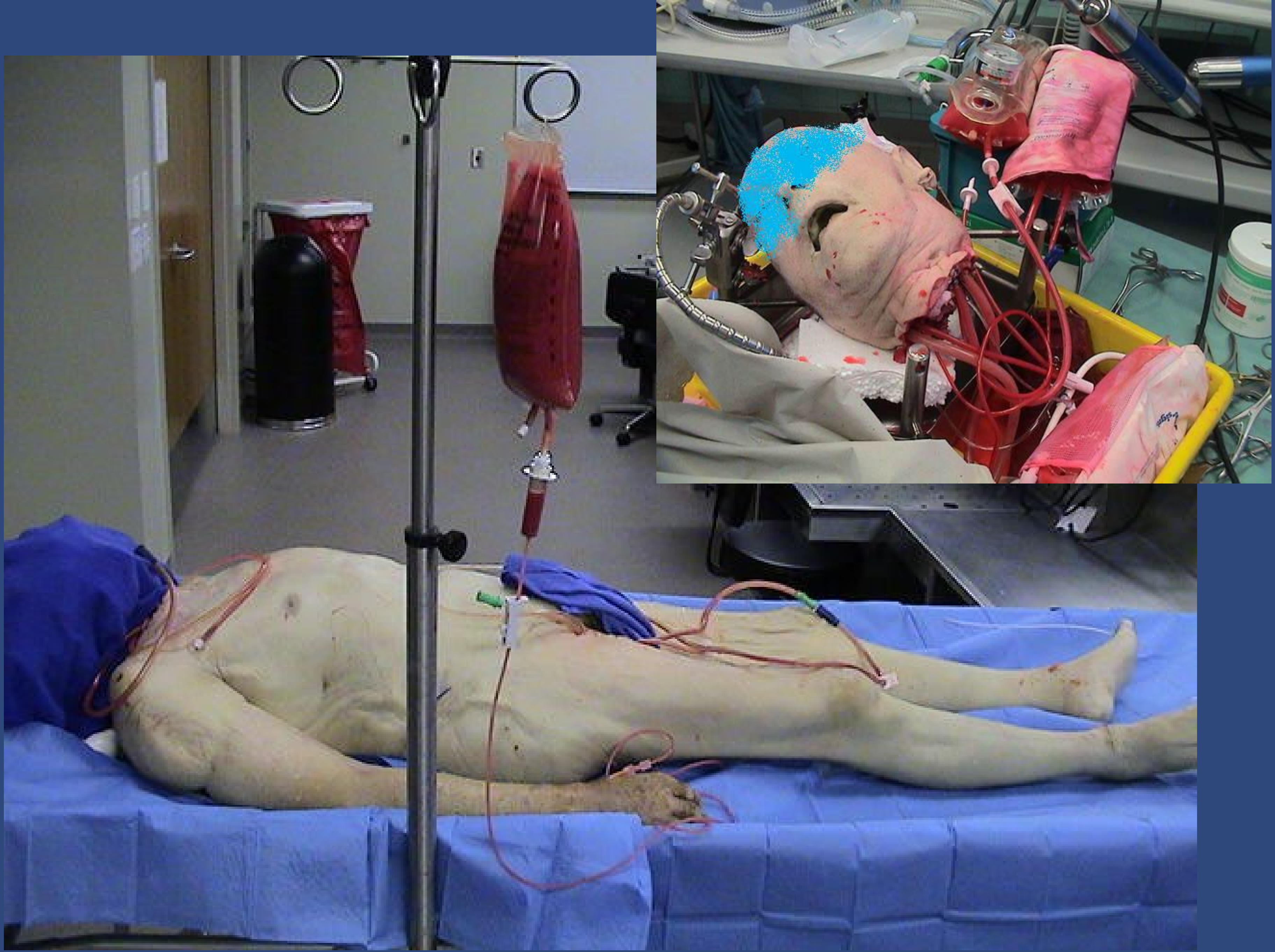


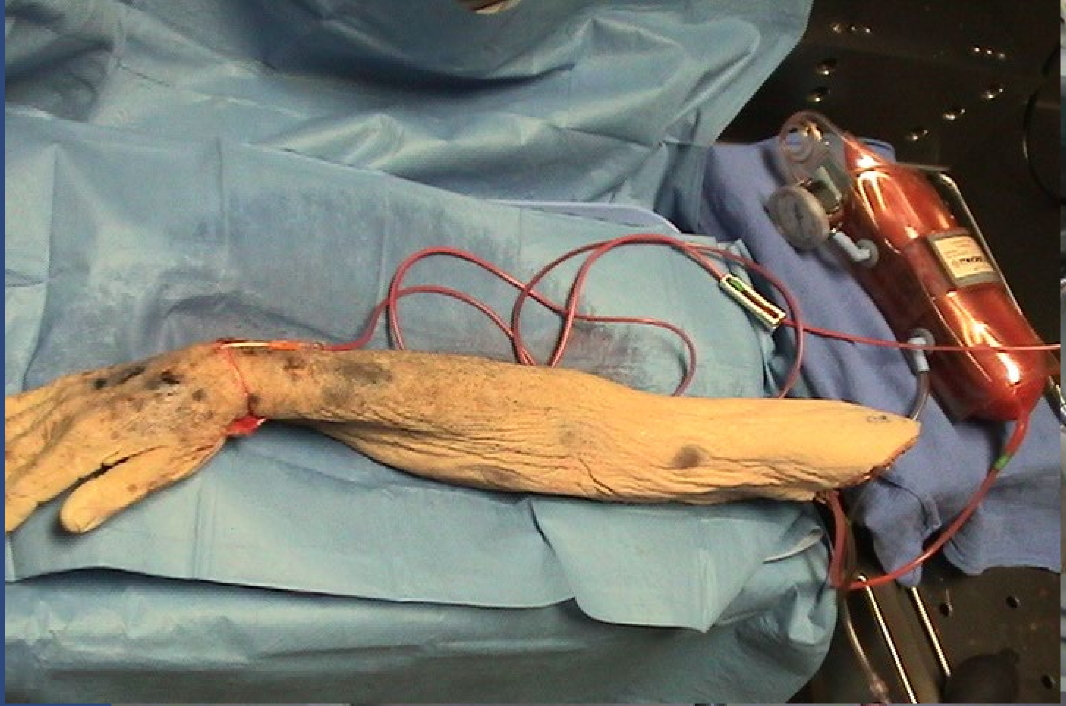
connect the cannulated vessels
To artificial blood reservoirs and a
machine that provides pulsating pressure

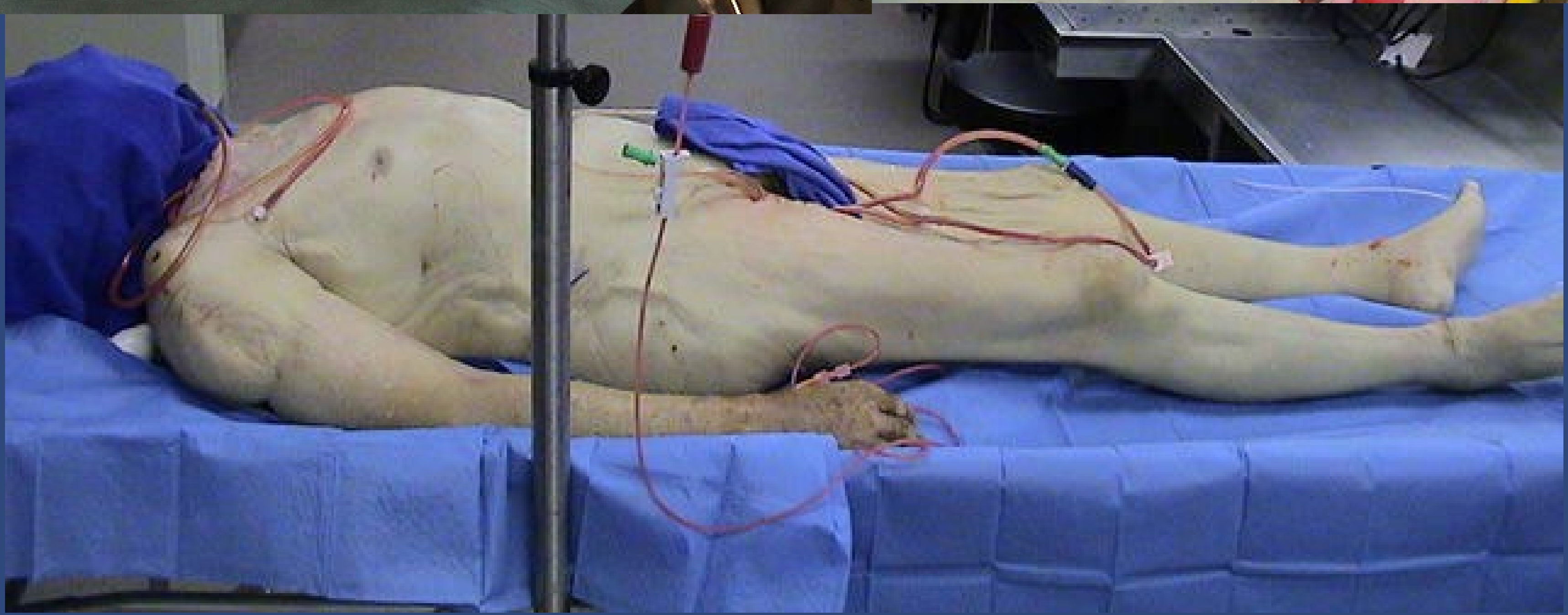
Intubation

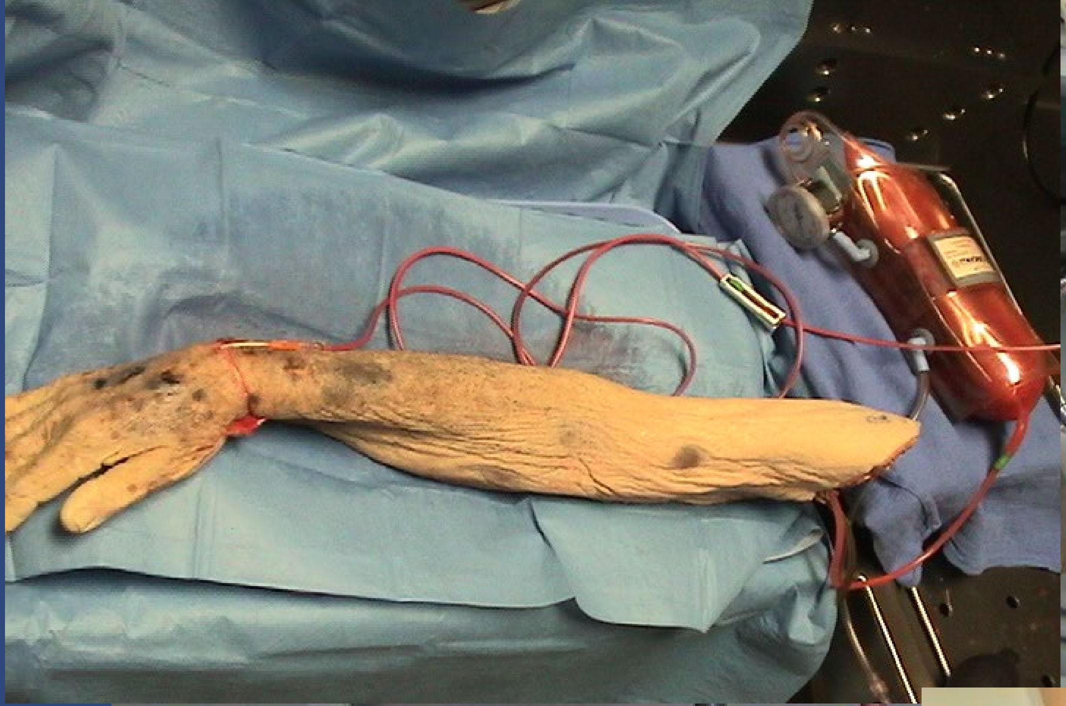


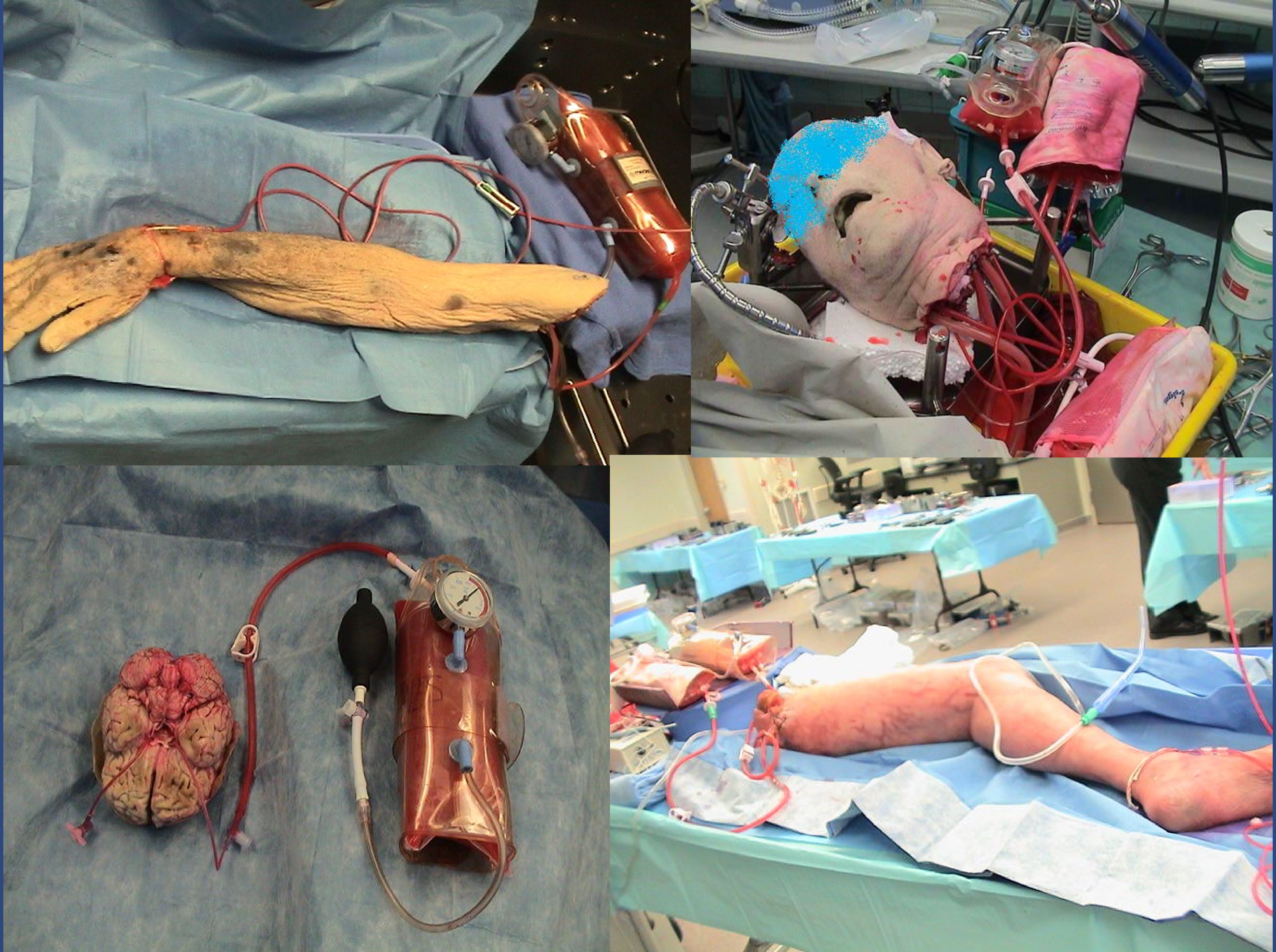


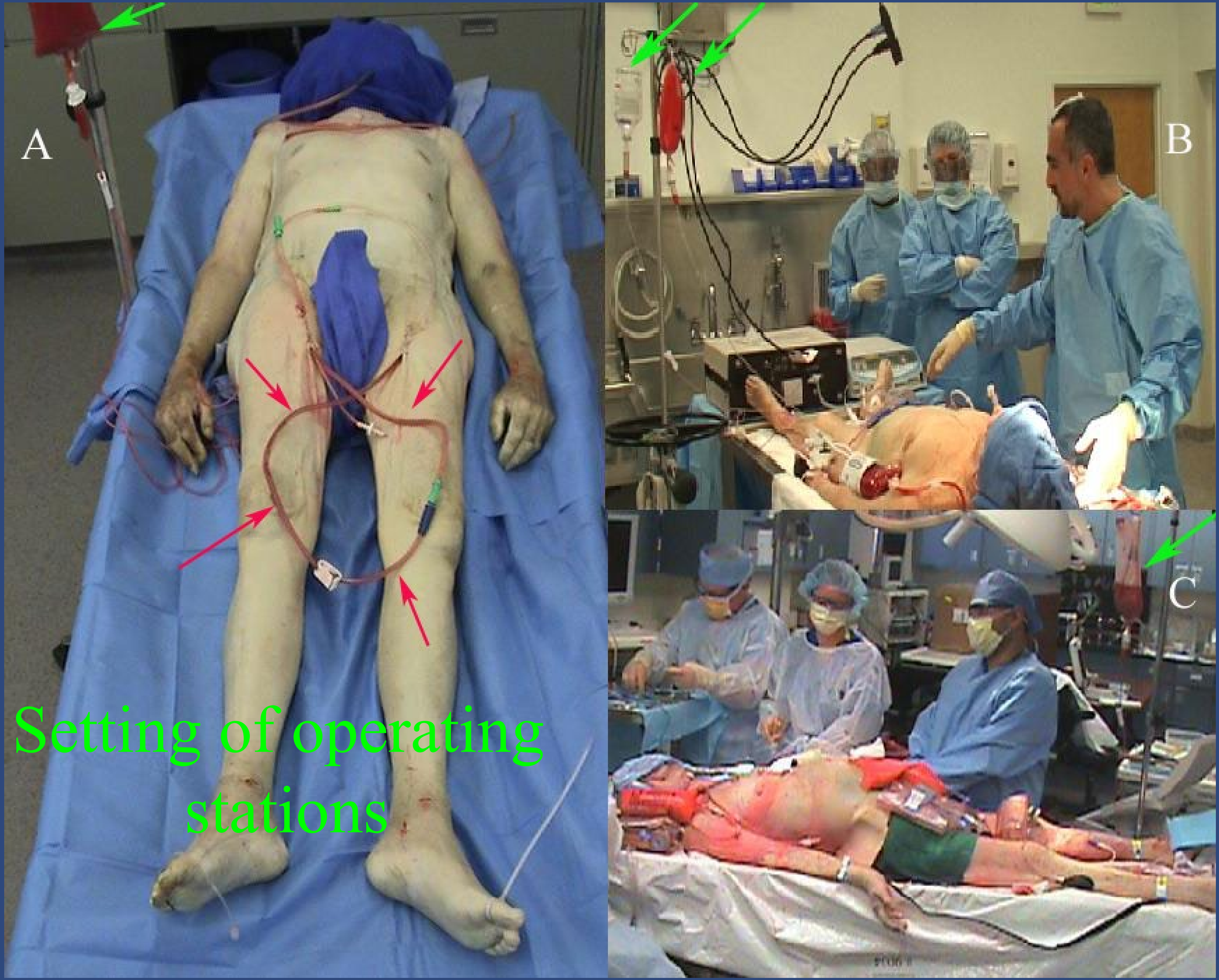


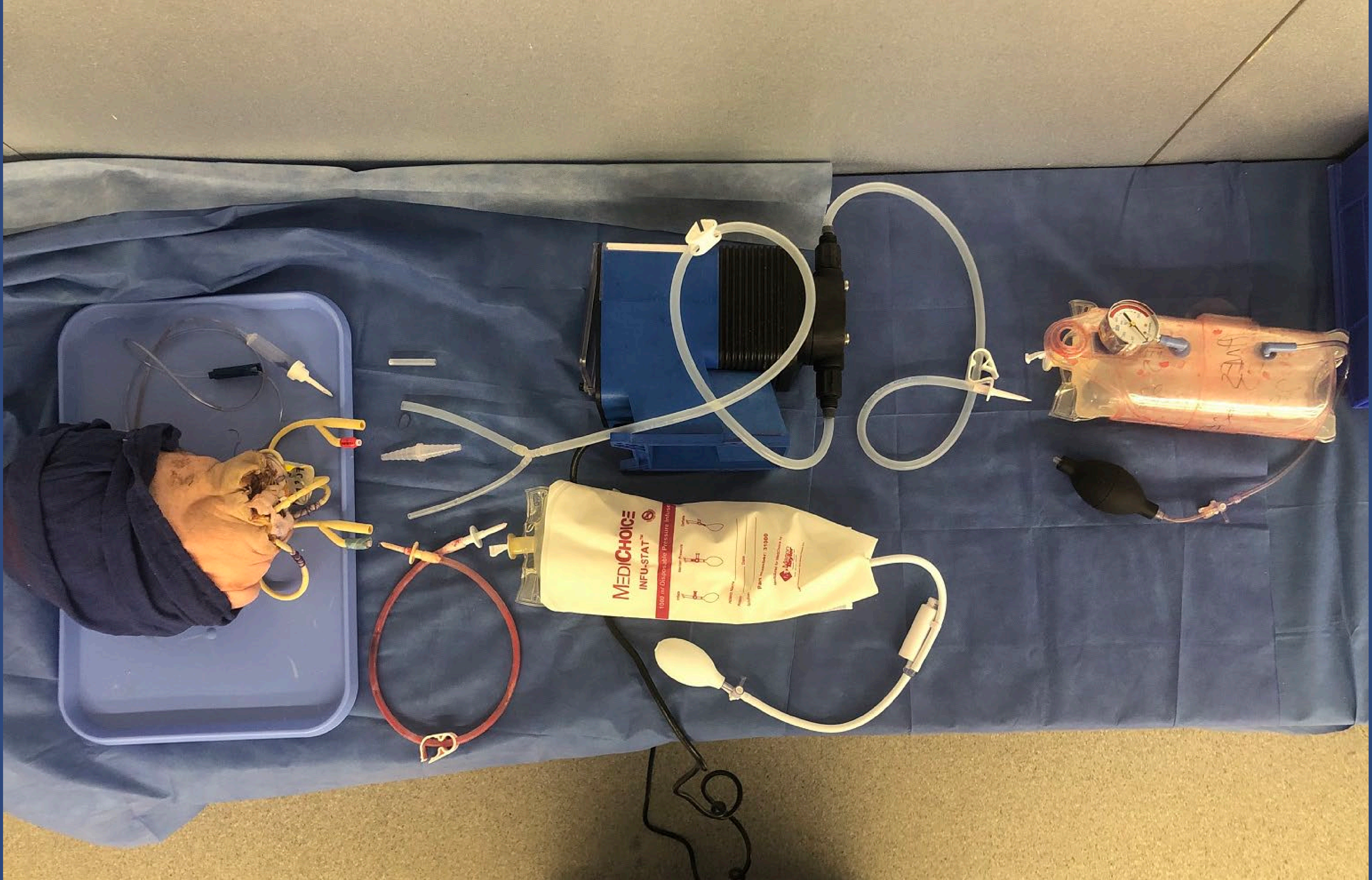


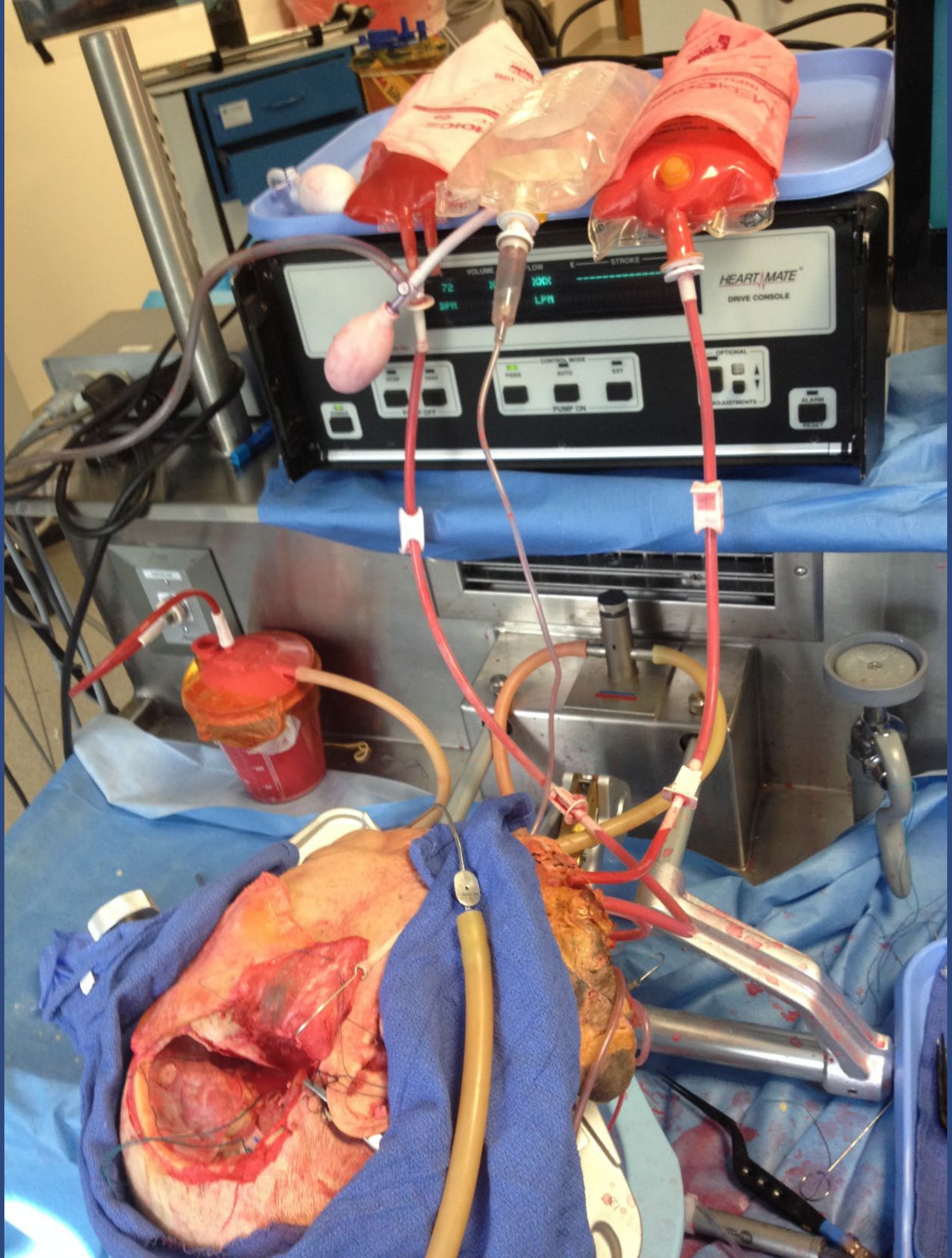


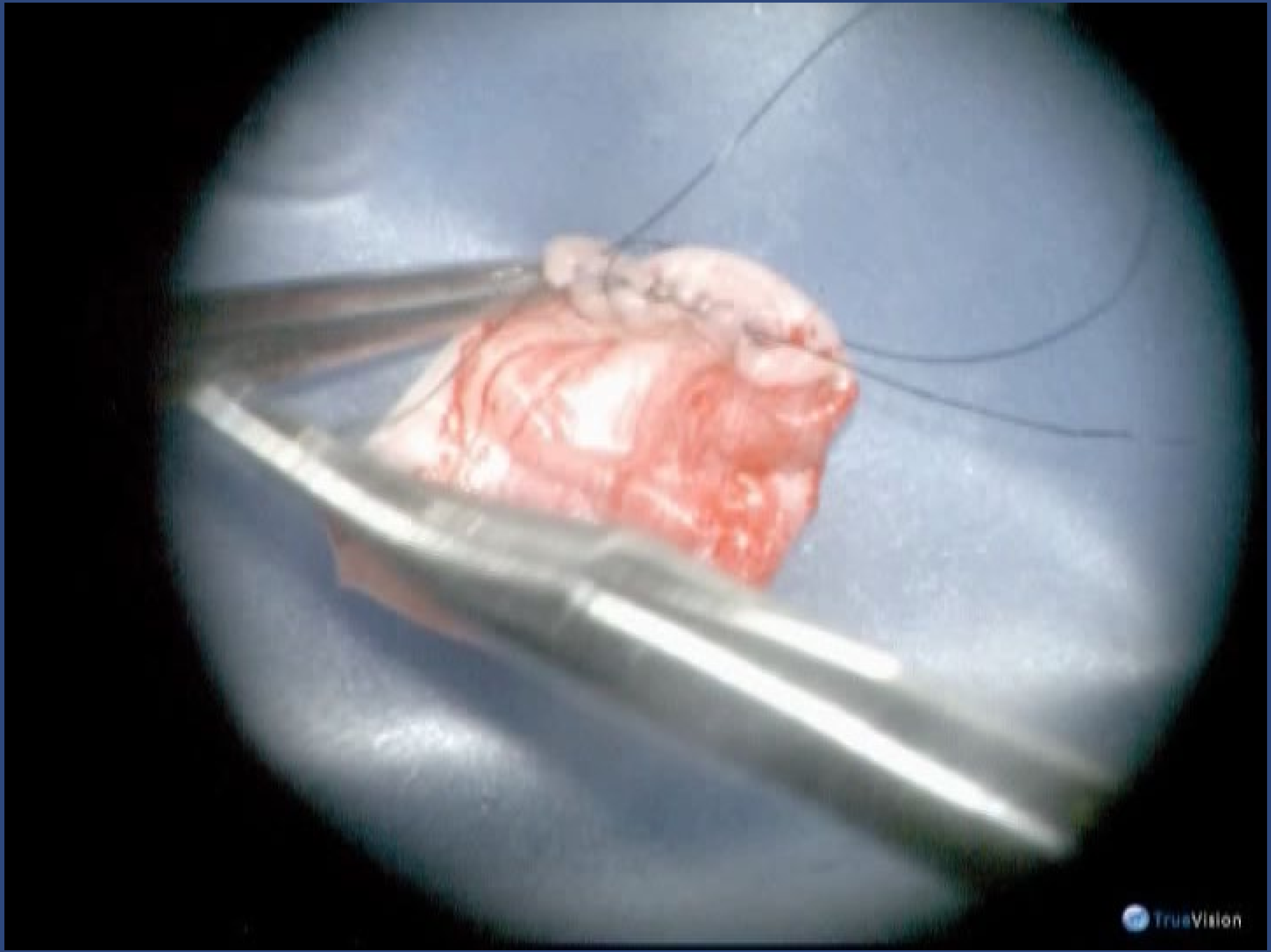


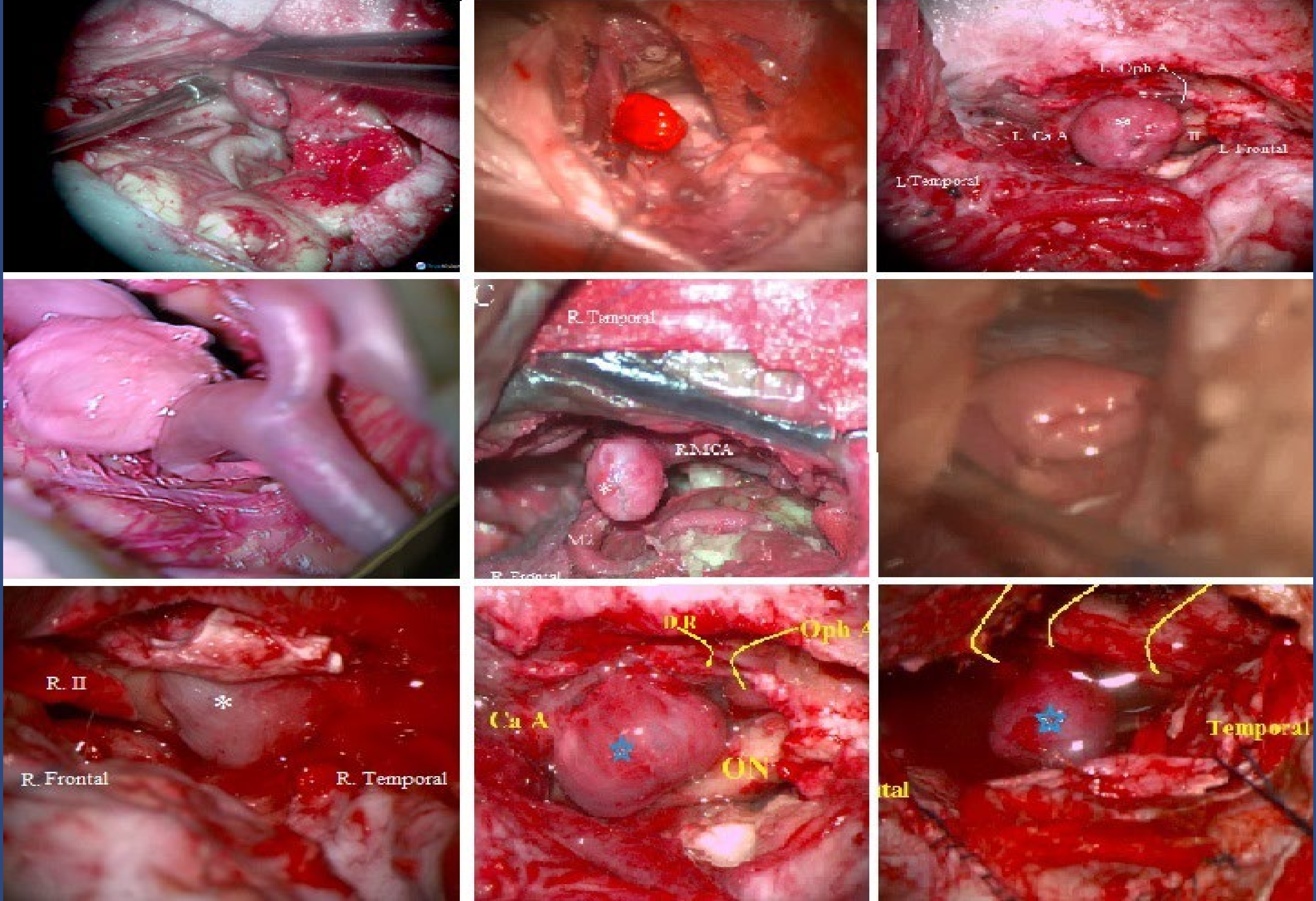



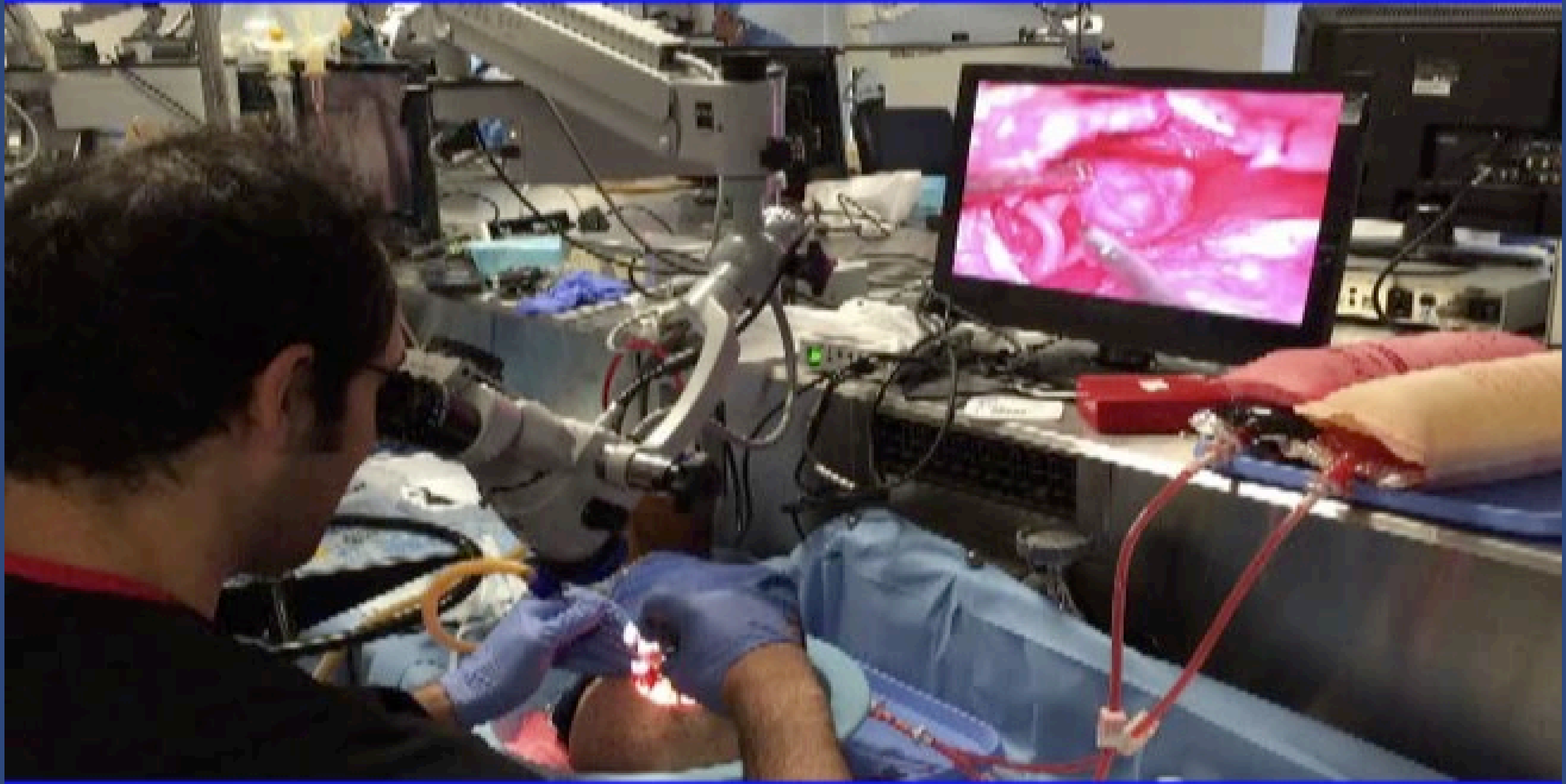

A
B
C
Setting of operating stations

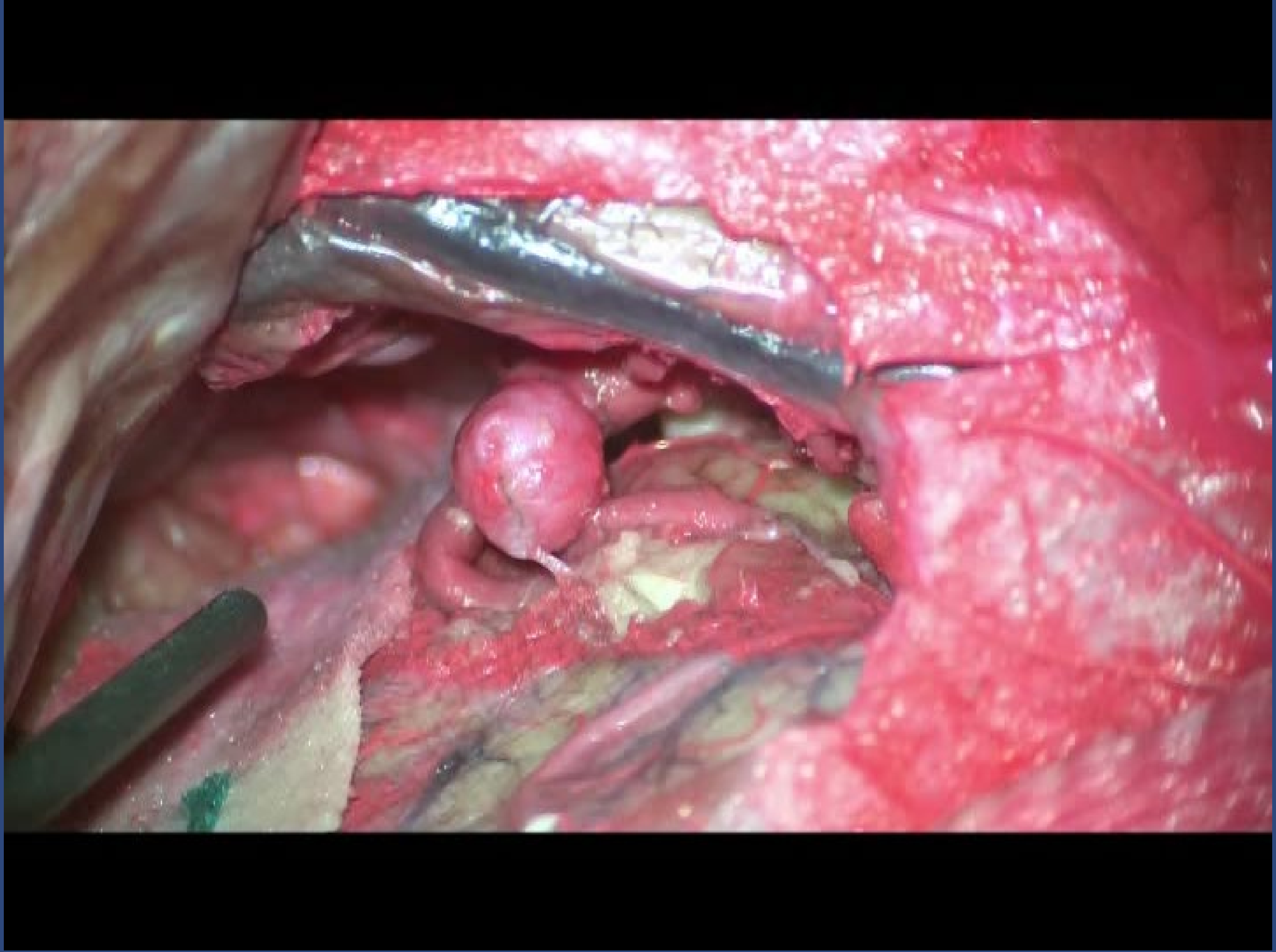

MEDICHOICE
INFU-STAT™

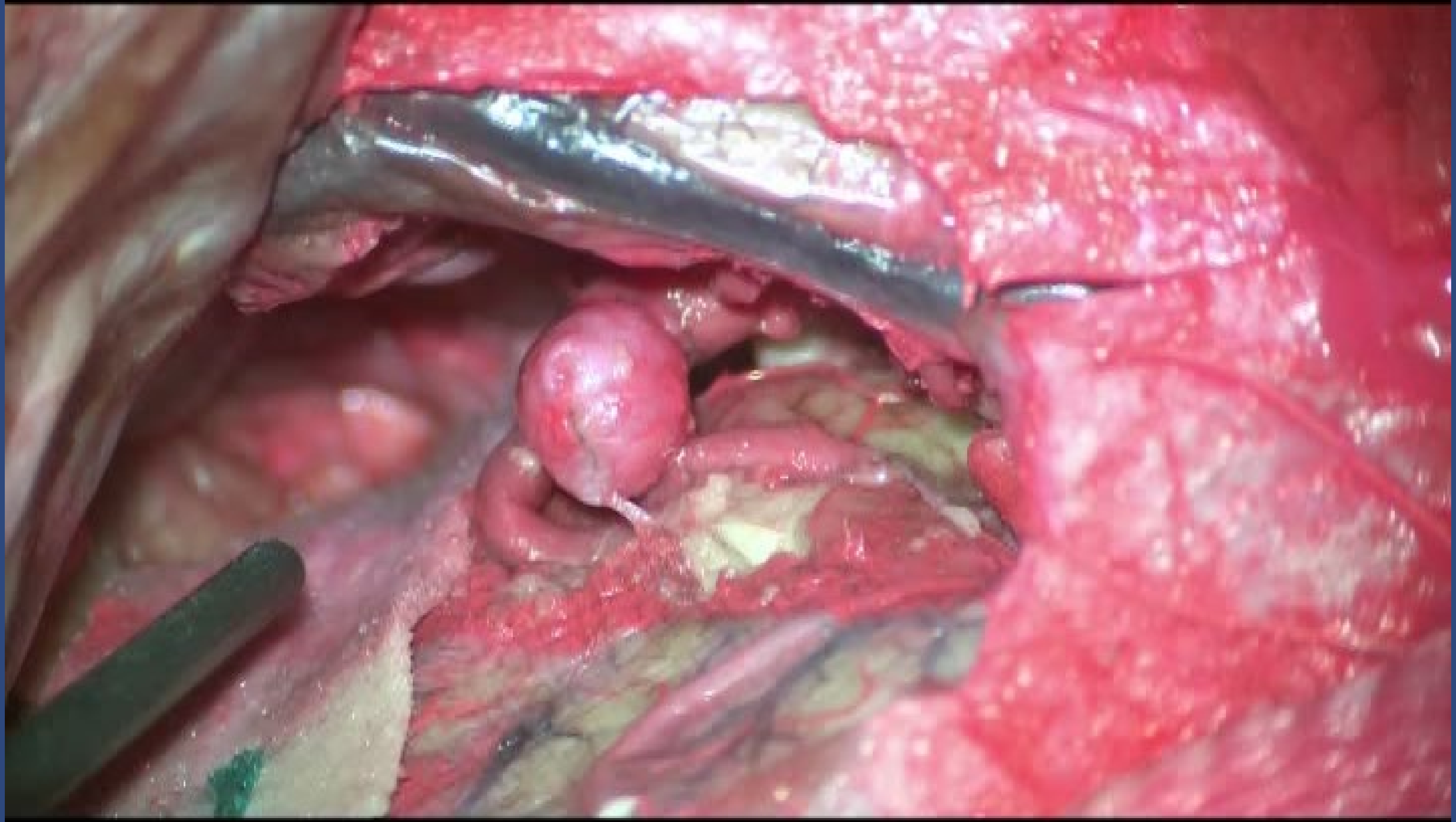

HEART MATE
DRIVE CONSOLE




L. Oph A.
L. Ca A
II
L. Frontal
L Temporal
C
R. Temporal
R.MCA
R. II
R. Frontal
R. Temporal
Oph A
Ca A
ON
Temporal

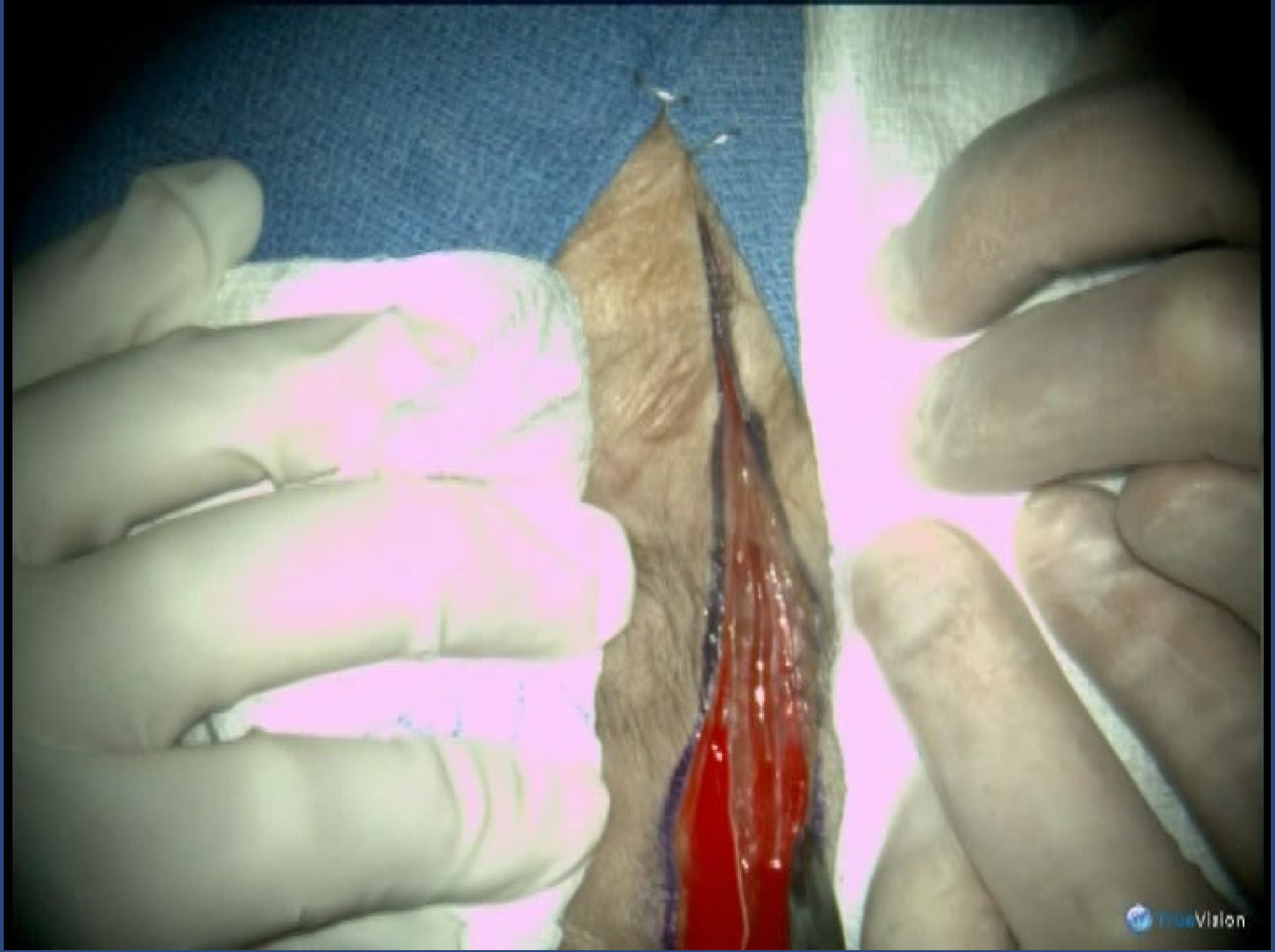


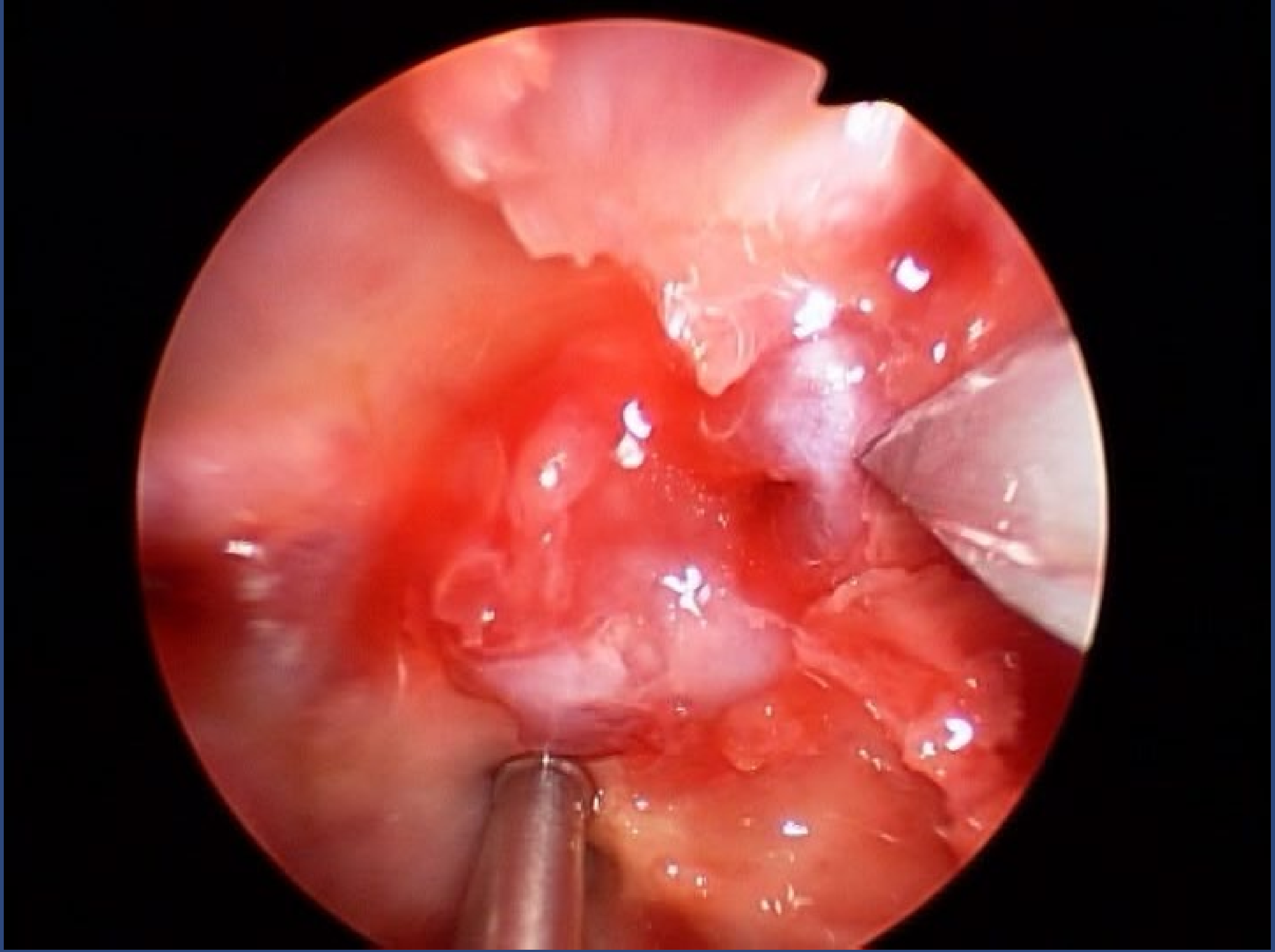




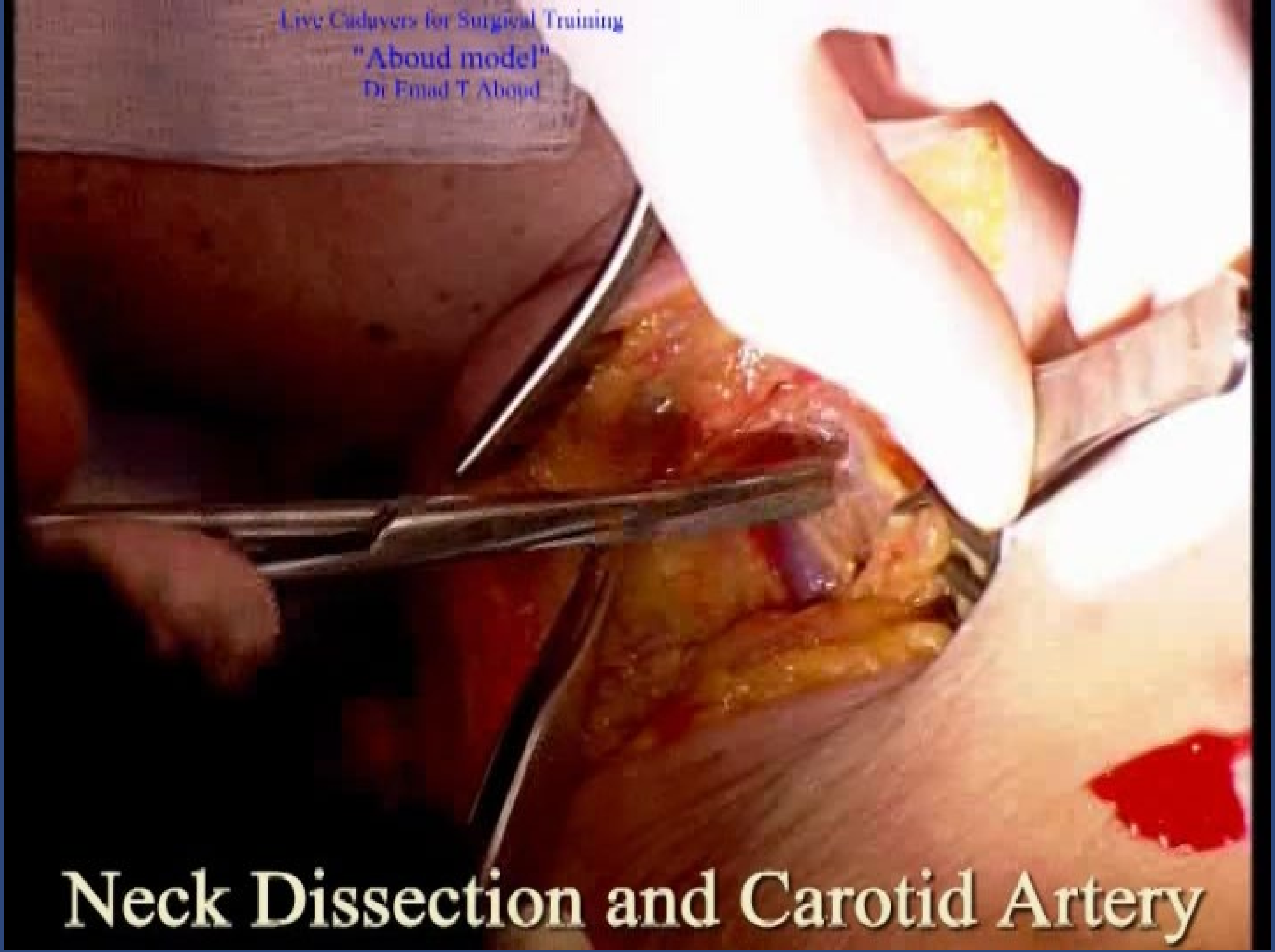

CAD ANGIO MODEL
OEC

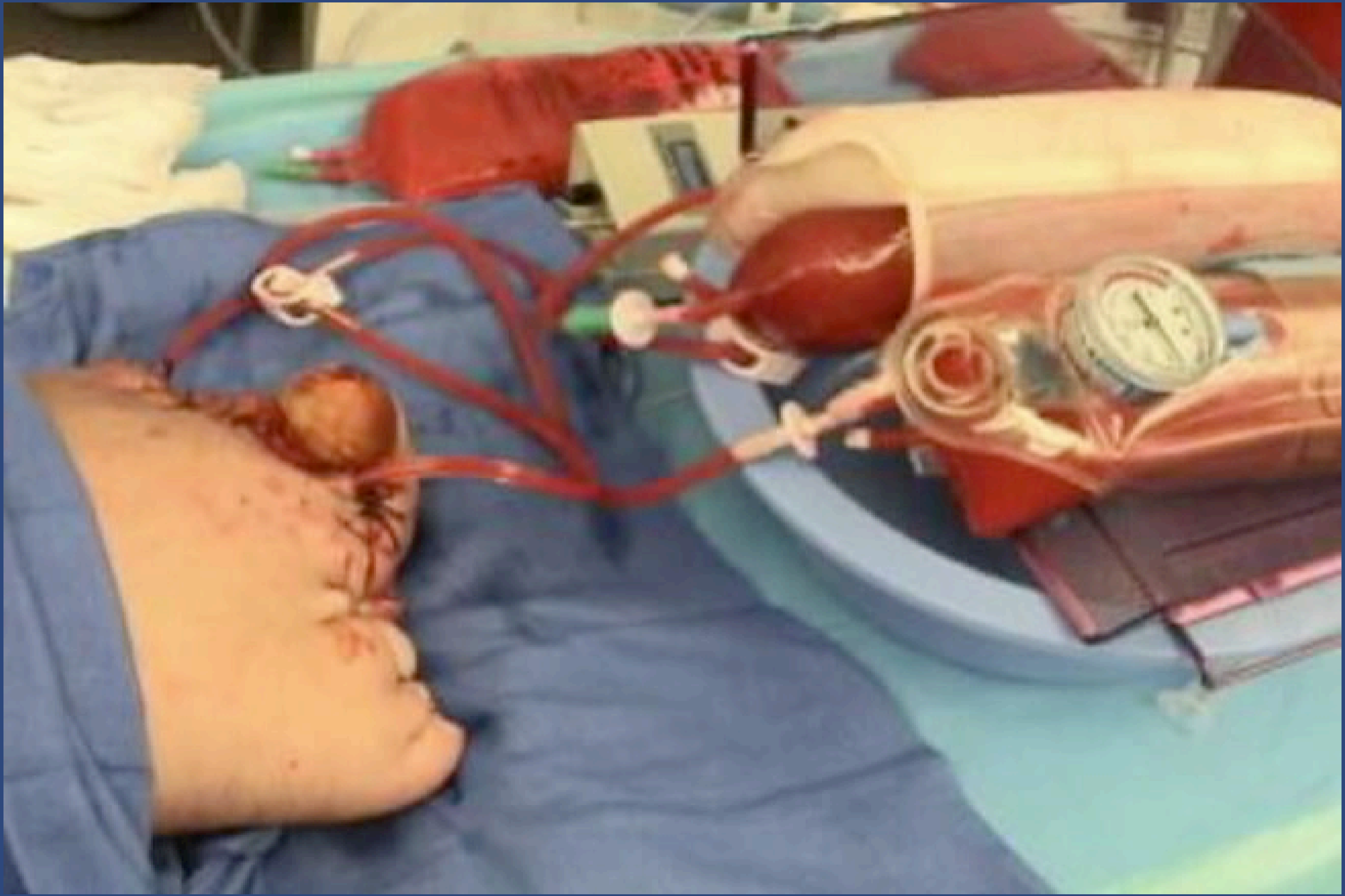

Applying Echo Doppler
to test and Identify the STA






Skull1 Base Society
4th annual meeting
Memphis Feb 03


Live Cadavers for Surgical Training
"Aboud model"
Dr Emad T Aboud
Neck Dissection and Carotid Artery



The cost of cadaver specimen is variable:

whole body	7000$
Cephalous	1800$
accessories: (Tubing and artificial blood) up to	500 $
pulsatile pump or a secondhand heart pump	1500$
Preparation, creating aneurysm models etc.	1500$

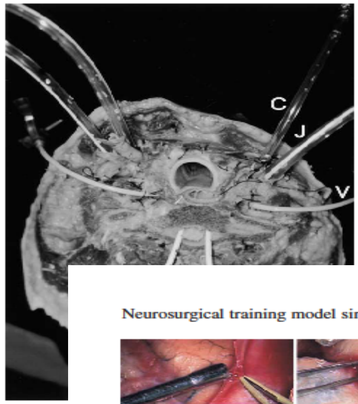


FIG. 2. Photograph demonstrating the connections between the cadaveric head and the reservoirs.

rate of 60 pulses per minute was selected; the machine provided a rate of 40 to 120 pulses/minute. Pressures up to 150 mm Hg can be applied through the pressure bag to the source of the red fluid. For our purposes, we applied a pressure of 80 mm Hg as a baseline be-

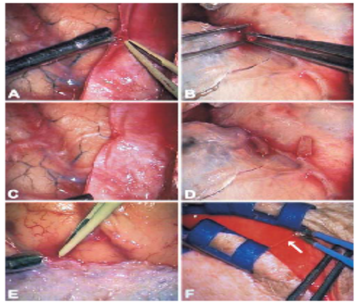
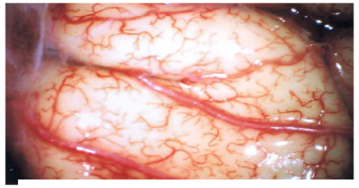


FIG. 3. Training session photographs showing opening and hemostasis. A and B: Bleeding meningeal arteries. C and D: The same arteries after coagulation. E: Coagulating pial vessels. F: Scalp hemostasis achieved using Raney clips and coagulation of vessels. *Arrow* indicates a bleeding jet.



agulated, or clamped using Raney clips. According to the intended procedure, a variety of craniotomies were performed, with care taken to preserve the underlying dura mater. The edges of the bone were waxed to prevent a fluid leak. The dura mater was opened and leaking vessels were coagulated (Fig. 3).

Cisternal and Vascular Dissection. The exposed brain was extremely lifelike (Fig. 4); the arteries were light red and pulsating, the veins were dark red and filled, and a clear fluid simulated the release of cerebrospinal fluid when the arachnoid was opened. We split the sylvian fissure and followed the branches of the MCA down to the carotid and basal cisterns, dissecting the branches of the circle of Willis and exposing all neurovascular structures in the skull base.

Vascular Suturing and Anastomosis. A variety of exercises were performed, starting with the establishment of an STA–MCA bypass (end-to-side anastomosis) and including repair of a longitudinal incision or a partial arterial defect and a transected artery (end-to-end anastomosis), as well as segmental arterial replacement. These procedures were performed on the cortical branches of the MCA and the M_2 and M_3 branches deep within the fissure. We used various segments of these branches. Each segment was dissected for approximately 1 cm of its length from the overlying arachnoid membrane. Small branches were coagulated and disconnected to free the segment. Two vascular clips were applied on both sides of the segment and arteriotomies were performed according to the kind of repair or anastomosis desired. After suture completion, the temporary clips were

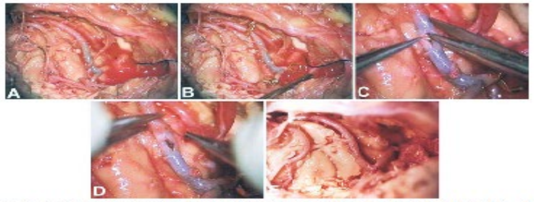


FIG. 6. Training session photographs showing thrombectomy and arterial repair of one of the M_2 branches. A: Thrombosis in the MCA branch. B: Temporary clipping. C: Arteriotomy. D: Removal of the thrombus. E: Establishment of flow through a patent vessel after arteriography.

Resection of Artificial Tumors and Other Procedures. Gelatinous material was injected into different locations of the basal cisterns and within the parenchyma to represent a tumor mass so that the trainee could practice resection of these masses while preserving neurovascular structures (Fig. 8). Skull base approaches, intraparenchymal resections, and other procedures that we usually practice in cadavers prepared using traditional methods were practiced as well.

Endoscopic Procedures. After a frontal burr hole had been made, the sheath of the endoscope was introduced toward the lateral ventricle. The optic apparatus was introduced after the introducer had been pulled out, and the choroid plexus and the septal and thalamic veins led the way to the foramen of Monro. The endoscope passed the foramen into the third ventricle and the mammillary bodies and the infundibular recess were identified. The floor of the third ventricle was perforated in front of the BA bifurcation in the area of the tuber cinereum. The BA trunk and branches, which were filled and pulsating, were identified in the interpeduncular cistern. Practicing irrigation and clearing of liquid inside the ventricles was achieved, as were observing the pul-

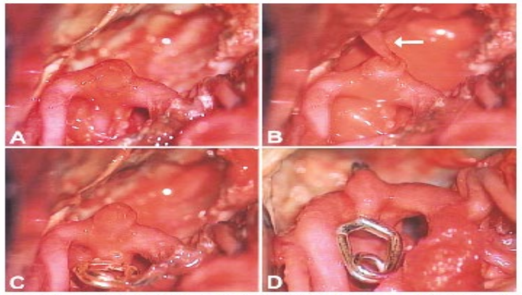


FIG. 7. Management of aneurysm bleeding. A: Artificial aneurysm located on the MCA bifurcation. B: Bleeding jet from the punctured aneurysm *(arrow)*. C: Temporary clipping of the MCA. D: Clipping of the aneurysm neck.

J Neurosurg 97:1367–1372, 2002

New laboratory model for neurosurgical training that simulates live surgery

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Object. Laboratory training models are essential for developing and refining surgical skills, especially for microsurgery. The closer to live surgery the model is, the greater the benefit. In this paper the authors introduce a cadaver model with unique characteristics: dynamic filling of the cerebral vasculature with colored liquid and clear fluid filling of the arachnoid cisterns. This model is distinctive and has great practical value for training in a wide range of surgical procedures.

Methods. Cadaveric heads were prepared for surgical procedures in the following manner: the carotid arteries (CAs) and vertebral arteries (VAs) in the neck were cannulated, as were the internal jugular veins (JVs) on both sides. Two tubes were introduced into the spinal canal and each one was advanced into one of the cerebellopontine angle cisterns.

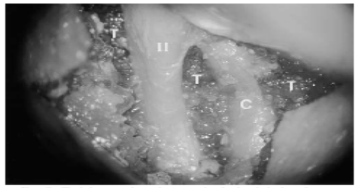

FIG. 8. Training session photograph obtained during the resection of an artificial parasellar tumor (T). C = carotid artery; II = optic nerve.

sation of the BA and identifying the liquid flow through the fenestra.

Utilization of Both Hemispheres

All the aforementioned procedures were then performed on the other side of the cadaveric head after the MCA on the first side had been closed and all ruptured vessels had been coagulated or clipped. The CA and the JV on the second side were connected to the colored fluid reservoirs. (Changing connections from side to side between the VA and the JV and the fluid reservoirs had no impact.) The same procedures were then performed on the second side in addition to interhemispheric approaches.

Posterior Circulation

When all possible training procedures on the anterior circulation had been completed, the CA was disconnected and the posterior communicating arteries were clipped on both sides proximal to the posterior cerebral arteries. The VA from one or both sides was connected to the reservoir filled with light red fluid and one of the JVs was connected to the source of the dark red fluid. Dissection of the posterior fossa and posterior circulation, in addition to previously mentioned procedures, were then performed through the occipital and suboccipital approaches.

Whole-Brain Application

We also applied this method in a whole-brain specimen obtained at autopsy. In this case both CAs were cannulated, allowing a variety of vascular exercises on the major branches (Fig. 9).

Discussion

As a surgical specialty, neurosurgery requires the development of dexterity and skills for basic and challenging procedures and techniques. In delicate organs such as the central nervous system, the surgeon's individual skills play a crucial role in determining patient outcome. Hence, the emphasis has been placed on laboratory training, preparing surgical trainees for the operating room experience.[10] The

FIG. 9. Photograph demonstrating cannulation of the CA in a brain obtained at autopsy.

fine manipulation and dissection of cerebral vessels with anastomosis usually have been practiced on animals.[11] Unfortunately, these procedures are limited to a simple technique and have no relation to the actual anatomy or to surgical crises that are encountered by the trainee during live surgery. A critical part of this training is mastering the anatomy. Hence, fine publications, methods, and courses are richly introduced and widely available.

To improve the illustrative value of cadaver dissection, colored materials are injected into the vessels of cadavers to identify arteries and veins for anatomical studies. Fluorescein and radiopaque substances, silicone, gelatin, latex, acrylic, or tinted polyester resin[3,7–9] have been used for this purpose. Mechanical pressure pumps have been used to introduce and perfuse embalming fluids via the common CAs or femoral arteries.[1,6] Nevertheless, there have been no reports of using such machines to induce pulsation and vascular filling in cadavers for training purposes. In studying the role of neurovascular compression in trigeminal neuralgia, Hamlyn[4] described injection filling of cadaveric vessels to determine neurovascular relationships within the posterior fossa.

To our knowledge, a model such as ours has not previously been developed. This model can increase the capacity of neurosurgical laboratories to train for a variety of surgical approaches, including skull base, neurovascular, endoscopic, and even endovascular procedures. The presence of clear fluid in the subarachnoid spaces, the pulsation, and the vascular filling give greater realism to these training procedures. This model provides the trainee with a unique

"Live cadavers" for training in the management of intraoperative aneurysmal rupture

Emad Aboud, MD,[1] Ghaith Aboud,[2] Ossama Al-Mefty, MD,[3] Talal Aboud,[2] Stylianos Rammos, MD,[1] Mohommad Abolfotoh, MD, PhD,[3,4] Sanford P. C. Hsu, MD,[5] Sebastian Koga, MD,[6] Adam Arthur, MD, MPH,[7] and Ali Krisht, MD[1]

[1]Arkansas Neuroscience Institute, St. Vincent Health System, Little Rock, Arkansas; [2]Atlantic University, School of Medicine, Island Park, New York; [3]Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts; [4]Department of Neurosurgery, Ain Sham University, Cairo, Egypt; [5]Taipei Veterans General Hospital, National Yang-Ming University, Taipei, Taiwan; [6]International Neuroscience Institute, Hannover, Germany; and [7]Semmes-Murphey Neurologic and Spine Institute, and Department of Neurosurgery, University of Tennessee, Memphis, Tennessee

OBJECT Intraoperative rupture occurs in approximately 9.2% of all cranial aneurysm surgeries. This event is not merely a surgical complication, it is also a real surgical crisis that requires swift and decisive action. Neurosurgical residents may have little exposure to this event, but they may face it in their practice. Laboratory training would be invaluable for developing competency in addressing this crisis. In this study, the authors present the "live cadaver" model, which allows repetitive training under lifelike conditions for residents and other trainees to practice managing this crisis.

METHODS The authors have used the live cadaver model in 13 training courses from 2009 to 2014 to train residents and neurosurgeons in the management of intraoperative aneurysmal rupture. Twenty-three cadaveric head specimens harboring 57 artificial and 2 real aneurysms were used in these courses. Specimens were specially prepared for this technique and connected to a pump that sent artificial blood into the vessels. This setting created a lifelike situation in the cadaver that simulates live surgery in terms of bleeding, pulsation, and softness of tissue.

RESULTS A total of 203 neurosurgical residents and 89 neurosurgeons and faculty members have practiced and experienced the live cadaver model. Clipping of the aneurysm and management of an intraoperative rupture was first demonstrated by an instructor. Then, trainees worked for 20- to 30-minute sessions each, during which they practiced clipping and reconstruction techniques and managed intraoperative ruptures. Ninety-one of the participants (27 faculty members and 64 participants) completed a questionnaire to rate their personal experience with the model. Most either agreed or strongly agreed that the model was a valid simulation of the conditions of live surgery on cerebral aneurysms and represents a realistic simulation of aneurysmal clipping and intraoperative rupture. Actual performance improvement with this model will require detailed measurement for validating its effectiveness. The model lends itself to evaluation using precise performance measurements.

CONCLUSIONS The live cadaver model presents a useful simulation of the conditions of live surgery for clipping cerebral aneurysms and managing intraoperative rupture. This model provides a means of practice and promotes team management of intraoperative cerebrovascular critical events. Precise metric measurement for evaluation of training performance improvement can be applied.

http://thejns.org/doi/abs/10.3171/2014.12.JNS141551

KEY WORDS live cadaver; perfused cadaver; surgical training; cerebral aneurysm; pulsatile model; neurovascular

The intraoperative rupture of an intracranial aneurysm can be a critical event that can jeopardize a patient's outcome. The rate of this event ranges from 6% to 20% of all surgical cases.[5,9,11,14,16] In some reports, the aneurysmal rupture rate is as high as 41.6%.[21] In a recent study that reviewed the literature, involving a total of 9488 aneurysm surgeries, Madhugiri and colleagues[17] found that the rate of intraoperative rupture in the entire group was 9.2%.

Factors such as the reduced number of working hours

ABBREVIATION MCA = middle cerebral artery.

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DISCLOSURE The technique described in this article is based on US Patent no. 6,790,043 (2004): Method and apparatus for surgical training. This work was sponsored in part by the institutions mentioned in the body of the article: Arkansas Neurosciences Institute, Little Rock, Arkansas; Practical Anatomy Workshop, St. Louis, Missouri; Medical Education and Research Institute, Memphis, Tennessee; and National Yang-Ming University, Taipei, Taiwan.

"Live Cadavers" for Practicing Airway Management

Emad T. Aboud, MD; Ghaith Aboud; Talal Aboud

ABSTRACT Human cadavers have been used successfully as training models to practice airway management, but the lack of lifelike conditions reduces the utility of this model when softness of tissue and the ability to bleed are required for training scenarios. This report describes our "live cadaver" model, which combines lifelike conditions with real human anatomy. Five human cadavers were prepared as "live cadavers". This entailed cannulating the carotid and femoral arteries and the jugular and femoral veins, and then connected them to artificial blood reservoirs. An intra-aortic balloon pump was used to provide pulsating flow through the heart and major arteries. Finally, central and peripheral lines were inserted. Multiple techniques related to airway management were practiced in setting simulating the treatment of casualties with multiple trauma to include emergency cricothyroidotomy. With this model, participants were confronted with medical situations similar to those found in traumatized live patients (e.g., blood and other body fluids filling the mouth and nose, edema of the tongue and face). With the combination of lifelike conditions and real human anatomy, our experience demonstrated that the "live cadaver" increased the training value of traditionally prepared cadaver models.

INTRODUCTION

Laryngoscopy, intubation, and other airway management techniques are commonly taught in elective anesthesia settings on live patients.[1] Although this situation provides the ideal setting, it creates problems that severely limit physician training.[2] Patient safety is the priority, and procedures cannot be repeated just for practice. As an alternative, cadavers offer a unique opportunity for airway management training because the physician can interact with, and visualize, human tissue without the clinical risks associated with practicing on live patients. In addition to cadavers, live animals, animal heads, mannequins, and virtual reality have all been used for this purpose.[3–7]

Most of these models are extremely important in teaching the individual skills required for airway management. However, an important feature missing in these models is the combination of the lifelike conditions of the living body with real human anatomy. Such a combination is essential for advanced training. Some reports suggest that adjunctive teaching sessions that use cadavers do not improve the physician's initial success in clinical intubation over the use of the mannequin alone, especially for repetitive training.[8,9] We believe that adding the lifelike conditions to cadaver models ("live cadaver") will overcome some of the shortcomings encountered with available training models.[10–15] In addition, the "live cadaver" model enhances skills acquisition for airway management, and promotes teamwork.

This model was not initially developed for training on airway management techniques, but the success and positive feedback we achieved in using this model for neurosurgical, vascular, and trauma surgery[16–18] encouraged us to use it for other surgical and procedural techniques as an advanced level of physician training. This model was also used to test medical devices with clinical applications[19] and in conjunction with other training techniques.[20,21] In this report, we describe the use of a technique that combines the lifelike conditions of the living body with real human anatomy for training on airway management procedures.

METHODS

All cadavers were ethically donated according to the individual's legally executed, advance directive bequest on file at the host site. Sponsoring institutions included the University of Arkansas for Medical Sciences, Little Rock, Arkansas; Upstate Medical University, Syracuse, New York; Saint Louis University, Saint Louis, Missouri; and the Anatomy Gift Registry, Glen Burnie, Maryland. The "live cadaver" model, which was developed initially for neurosurgery training, is in practical use in some of these centers and in other academic and nonacademic training centers for surgical training in different surgical disciplines.

Preparation

Five fresh, whole human cadavers were cannulated and prepared according to the preparation protocol for the "live cadaver" model. Each of the five cadavers was placed supine on an embalming gurney and washed with an antibacterial soap. The Duotronic embalming machine (California Professional Manufacturing, Modesto, California) was filled with saline to prepare for the infusion. A small incision was made along the lower anterior borders of the sternocleidomastoid muscle, and the right internal jugular vein and common carotid artery were exposed. Ligatures were looped around the jugular and the carotid artery, and a small incision was then made on the jugular vein. Long forceps were inserted

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This work describes a method patented by the first author: U.S. Patent number 6790043.

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Novel Simulation for Training Trauma Surgeons

Emad T. Aboud, MD, Ali F. Krisht, MD, Terence O'Keeffe, MD, Remi Nader, MD, Moustafa Hassan, MD, C. Melinda Stevens, MD, Fahd Ali, MD, and Fred A. Luchette, MD, MSc

Background: Clinical training in operative technique is important to boost self-confidence in residents in all surgical fields but particularly in trauma surgery. The fully trained trauma surgeon must be able to provide operative intervention for any injury encountered in practice. In this report, we describe a novel training model using a human cadaver in which circulation in the major vessels can be simulated to mimic traumatic injuries seen in clinical practice.

Methods: Fourteen human cadavers were used for simulating various life-threatening traumatic injuries. The carotid and femoral arteries and the jugular and femoral vein were cannulated and connected to perfusate reservoirs. The arterial reservoir was connected to an intra-aortic balloon pump, which adds pulsatile flow through the heart and major arteries.

Fully trained trauma surgeons evaluated the utility of this model for repairing various injuries in the thoracic and abdominal cavity involving the heart, lungs, liver, and major vessels while maintaining emergent airway control.

Results: Surgeons reported that this perfused cadaver model allowed simulation of the critical challenges faced during operative trauma while familiarizing the student with the operative techniques and skills necessary to gain access and control of hemorrhage associated with major vascular injuries.

Conclusion: In this report, we describe a novel training model that simulates the life-threatening injuries that confront trauma surgeons. An alternative to living laboratory animals, this inexpensive and readily available model offers good educational value for the acquisition and refinement of surgical skills that are specific to trauma surgery.

Key Words: Surgical training, Trauma training, Vascular, Training model, Simulation, Alternative model, Surgical skills, Live surgery, Live cadaver, Perfused cadaver, Stab wounds, Military surgical training, Combat injury, Circulation, Bleeding, Cadaver, Anatomy, Veterinary surgical training, Education.

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In light of the reduction in residents' working hours and the trend toward minimally invasive or even nonoperative management of many surgical pathologies and traumatic injuries, residents and other surgical trainees have consequently had less training and experience with traditional open operations.[1–4] This issue is even more problematic given the tremendous advances in surgical techniques and in treatment modalities. Clinical experience is becoming exceedingly rare for scenarios involving highly complex injury patterns or wounds that are not routinely seen in most centers, such as complicated blunt injuries or those occurring with penetrating trauma. To facilitate this change in surgical training, appropriate educational models that offer a more readily available source of tactile and visual experience for training are needed.[5–11] One such simulation model that holds promise is laboratory surgical training.

Numerous training models are now available for this purpose, involving various models to simulate clinical practice. They include mannequins, human patient simulators, computer models,[12–14] use of animal parts and animal cadavers,[15,16] live animals,[17,18] and human cadavers.[19] However, none of these models reflect both the human anatomy and the characteristics of actual surgery in terms of pulsatile vessels and natural tissue textures. Despite advances in surgical education, a model has not yet been developed for training in the open surgical procedures necessary for managing traumatic injuries. The ideal model would include relevant human anatomy and physiology with the ability to recreate life-threatening traumatic wounds. It should also allow for trainees to gain experience in the various complex surgical maneuvers necessary to repair the specific wounds.

Such a model has been previously described for neurosurgical training. In 2002, Aboud et al.[20] described a perfused cadaver model using human head and neck sections. The carotid and jugular vessels were perfused with fluid to simulate cerebral circulation. Various neurologic pathologies were constructed, such as cerebral aneurysms. This novel laboratory model that allowed simulation of live surgery was then used to train residents in the techniques and maneuvers required to competently manage neurosurgical diseases.

In this report, we present a new and unique training model using the human cadaver in a functional simulation, providing a life-like environment for more realistic and practical laboratory surgical training for traumatic injuries. Academic trauma surgeons from throughout the United States have evaluated the utility of this preparation for training in trauma surgery.

US006790043B2

(12) **United States Patent**
Aboud

(10) **Patent No.: US 6,790,043 B2**
(45) **Date of Patent: Sep. 14, 2004**

(54) **METHOD AND APPARATUS FOR SURGICAL TRAINING**

(75) Inventor: **Emad T. Aboud**, Swaida (SY)

(73) Assignee: **Board of Trustees of the University of Arkansas**, Little Rock, AR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 57 days.

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(List continued on next page.)

Primary Examiner—Derris H. Banks
Assistant Examiner—Dmitry Suhol

The model is recognized and sited in the Medical Modeling and Simulation data base of the American College of Surgeon

Medical Modeling and Simulation Database

AMERICAN COLLEGE OF SURGEONS

#	Edit	Rank	Title	Date of Publication	Full Author	Publication Type
1.		77	New laboratory model for neurosurgical training that simulates live surgery.	2002 Dec	Aboud, Emad; Al-Mefty, Ossama; Yasargil, M Gazi	Journal Article
2.		62	Robotic radical prostatectomy: a technique to reduce pT2 positive margins.	2004 Dec	Ahlering, Thomas E; Eichel, Louis; Edwards, Robert A; Lee, David I; Skarecky, Douglas W	Journal Article

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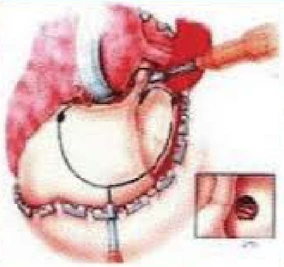

Al-Mefty Residents Course, Microsurgery of the Skull Base

Hands-on Cadaver Workshop with Live Surgery & Life-Like Simulation

Sep 20-22, 2025

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Course Director
Ali Krisht, MD
Director, Arkansas Neuroscience Institute

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Kenan Arnautovic, MD
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Federal University of Parana, Curitiba, Brazil

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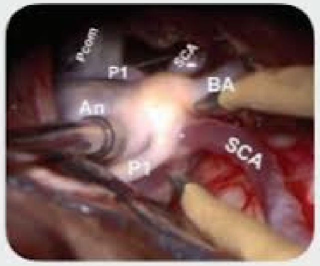
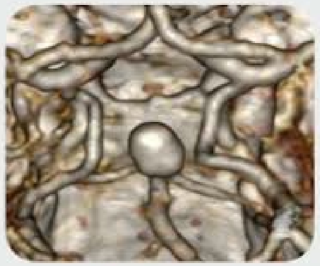
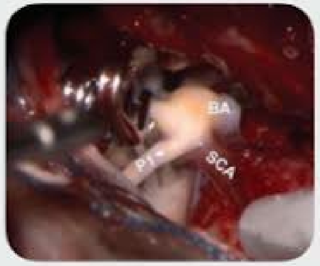
Hands-On Cadaver Workshop with Live Surgery & Life-Like Simulation







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Al-Mefty Residents Course, Microsu

Hands-on Cadaver Workshop with Live Surge

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Arkansas Neuroscience Institute

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M.G. Yasargil Advanced Course in Cerebral Aneurysms

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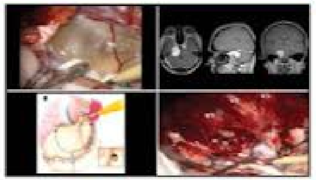
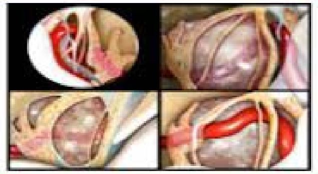


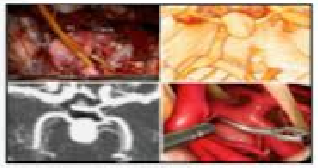
Evandro de Oliveira Cavernous Sinus Course

June 21 - 24, 2025



Al-Mefty's Course, Microneurosurgery of the Skull Base

Sept 20 - 22, 2025



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Finaly

The Live Cadaver Model
is the only
Existed model that combines
the real human anatomy
with the life-like conditions
of the living body

aboudemad@gmail.com

Thank you