



Cadaveric Workshop and Implications in Regional Anaesthesia

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Introduction

The human cadavers have always been an immense source of knowledge from time immemorial and has been aptly termed as “Silent teachers” [1]. Cadaver dissection has been the basis of teaching anatomy to the aspiring anaesthesiologist to develop their skills in regional anaesthesia. The practice of regional anaesthesia has evolved from the landmark based technique eliciting paraesthesia to peripheral nerve stimulation (PNS) guided technique and in the recent times to use of ultrasound guided (USG) technique alone or a combination of PNS and USG - Dual Modality. Successful regional nerve block technique can be a combination of any of these techniques with the most reliable modality depending on the expertise of the performer. In order to excel we need to be appropriately trained akin to a real life scenario. The cadaver workshop has not only facilitated understanding anatomy but also helped in acquiring practical clinical skills.

History

“Sushruta Samhitha” an ancient text book in ayurvedic medicine said to be written in 6 BC comprises of a systematic description of cadaveric dissection [1]. In western literature the study on cadaver dissection and learning has been dated to 3 BC. Many unethical practices, grave robbery and murder were in vogue to procure a cadaver for the cause. Usually the cadavers were either of destitutes, murdered or prisoners. Amidst many restrictions and unethical practices, in procuring and dissecting the cadavers for educational purposes, enthusiasts interested in human structure continued to study the human body. Henri de Mondeville (1260-1320AD), the French anatomist performed the first unauthorized human dissection in the University of Montpellier in 1315 AD. By the beginning of the 14th century cadaver study was conducted once or twice a year. By end of 15th century cadaver dissection became quite popular increasing the requirement of cadavers [2, 3]. The Anatomy Act in 1832 allowed legal use of unclaimed cadavers for dissection and curtailed the illegal acts to a certain extent [2, 4]. Cadaver workshops have become an integral part of teaching anatomy and regional anaesthesia skills with integration of ultrasound guided techniques [5, 6].

The Role of Cadaveric Workshop in Regional Anaesthesia

Regional anaesthesia cadaver workshops traditionally involved dissection of cadavers or demonstration of prosected specimens. The use of landmark based techniques with needling help in understanding of three dimensional anatomy. Few such workshops are being conducted in association with the anatomist [7]. With the advent of modern cadaveric labs equipped with state of the art equipment and better cadaveric preservation techniques, anaesthesiologists and pain physicians are able to learn and refine their skills using ultrasonography, fluoroscopy and computed tomography as tools to perform procedures on cadavers. Cadavers have the advantage of providing high fidelity akin to real life scenarios and is a great tool to learn the fascial tactile feedback and the ergonomics [8, 9].

Dye and contrast studies in cadavers have been used to validate many of the traditional regional anaesthesia techniques. Realtime injection helps to assess the extent of drug spread with respect to the site of injection and the volume of the injectate [10, 11]. These results can be extrapolated to the patients. Cadaveric studies of the fascial

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planes and its relationship with the nerves and plexuses has led to the development of multitude of newer blocks. Injection of dyes followed by dissection has been used to validate some of these blocks and has become the foundation of other newer blocks [11, 12].

Cadaver Preservation Techniques and Ultrasound Imaging

The conduct of a successful workshop requires appropriate cadaver with organoleptic properties for regional anaesthesia techniques [13]. The characteristics of a cadaver which rates the suitability for a regional anaesthesia workshop differs in the way they are preserved [7, 14]. Different methods of preservation of the cadavers and their characteristic features are as enumerated in the table below [7].

Cadaver Validity

Cadavers are validated for any procedure by comparing the flexibility, structural and visibility or imaging characteristics [7, 13]. No cadaver is perfect for any educational use. Cadaver validity is essential to compare the cadavers and live patients with respect to their characters. This can be with respect to colour, build, skin turgor—with regards to resilience to skin puncture, flexibility of the joints etc.

Validation of the cadavers for surgical training has been based on few characteristics like **Task fidelity**- How much the trained products resemble the real thing?, **Construct Validity**- Whether the model can discriminate between different levels of surgical experience? Similar validation can be applied for regional anaesthesia [13].

In 2007, Tsui.B in his study compared a formalin preserved cadaver (solution containing a combination of 4% formaldehyde, 95% ethanol, glycerol, phenol and water) and a volunteer with similar BMI and suggested that cadavers are very good training tool for the ultrasonography guided procedures. He explained importance of “*use of a stress-free preclinical setting to practice the intricacies of both needle-probe alignment and dynamic needle tracking within the target tissue could be of great value*” illustrating this with an infraclavicular brachial plexus block with close proximity of the needle with the pleura and great vessels. Cadaver studies on brachial plexus blocks demonstrate the appropriate deposition and minimal volume required and correlation of the same in minimizing the potential complications of the same [8].

During the same year Tsui.B, explained about the use of cadavers in studying lower limb blocks. The femoral nerve appeared more circular in them and oblong in the volunteer. Though the fascia lata was more hyperechoic

and distinct than the fascia iliaca. Tsui.B opines that the ultrasound images from fresh cadaver images are better than the formalin preserved cadavers as they have higher water content in them [15]. Subsequent article by Tsui.B explains complexity of interpreting and performing the spine, paraspinal and intercostal sonography, because formalin preserved cadavers were very rigid with taut paraspinal muscles for exact simulation of a patient. The concerns of the muscles being very rigid and hardly flexible in the cadavers preserved by the older methods has been addressed. Lower concentration of formaldehyde has been shown to decrease the stiffness of the cadavers [16]. Cadavers preserved by Thiel embalming technique and embalming technique employed by M.S. Ramaiah Advanced Learning Center (MSRALC) solution has been found to have near natural features.

Flexibility, skin turgor and echogenicity of the tissues are known to be the best with Thiel embalmed cadavers. The fresh frozen cadavers are known for its clarity of soft tissue and vascular structures on ultrasonography. MSRALC cadavers shares the features of both.

The major drawback of cadaver based workshop is the lack of excitability of the tissues, thus posing a limitation on learning PNS guided techniques. The absence of blood flow and many a times the collapse of the blood vessels results in absence of vascular landmarks which are necessary for many of the regional blocks. In our experience with cadaver workshop at MSRALC we were able to demonstrate larger blood vessels due to the better water content of the cadavers. However their visibility deteriorated within 4-5 hr due to draining and evaporation of fluids from the cadaver. Multiple needle passes and injection of fluids can also result in the deterioration of ultrasound images.

Barrington et al estimated that that novices would require approximately 28 supervised trials with feedback before competency in ultrasound needle visualization is achieved in a simulation of sciatic nerve block [17]. Cadaver training of regional anaesthesia is to be tailored to have a curriculum which is time, technique and competency targeted.

Extent of Spread

Fascial plane blocks have revolutionized the regional analgesia technique by moving away from neuraxial techniques. Various combinations of the blocks have been studied with injection of dye for transverse abdominis plane [12] (TAP), subcostal TAP, transversalis fascia plane block [18], serratus anterior plane block [19], quadratus lumborum block (QLB) [20], erector spinae block (ESP) [21]. These discoveries and research aid us in selection of

Common body preservation methods and their key characteristics						
Preservation Method	Agents	Storage	Period of Use	Advantages	Disadvantages	Typical Use
Formalin	Formaldehyde, with possible additions Such as phenol and Glycerine	Room Temperature	Years	Longevity, minimal infection risk, solid organs may be easier to handle	Stiff, discoloured, unnatural texture, poor tissue plane preservation, odour, low grade carcinogen, not suitable for insufflation or ventilation	Dissection based anatomy instruction and research
Thiel	Glycol, various salts, Boric-acid, chlorocresol, formaldehyde (low levels), alcohol	Room temperature after several months of immersion	Years	Flexible joints and tissues, realistic ,minor tissue change, long lasting, ability to ventilate, preservation of colour	Infrastructure required, time needed for embalming process, not all tissues lifelike	Both short and long lasting applications in teaching and research
Other soft Embalming	Various (e.g., Glycerine, alcohol, formaldehyde, etc.)	Fridge	Months	Somewhat flexible, Some colour Preservation	Shorter lifespan, storage in fridge	
Fresh frozen	Nothing	Freezer	Days	Flexible, realistic, minimal tissue Change	Infection risk, need for full personal protective equipment, time needed for thawing, deterioration through usage period, mounting of body parts when not using full cadaver	Short surgical training Courses, short-term Research

Illustration of ultrasound images of structures in volunteers and cadavers preserved by different techniques

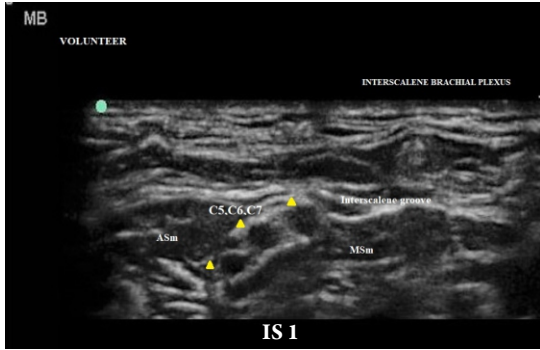
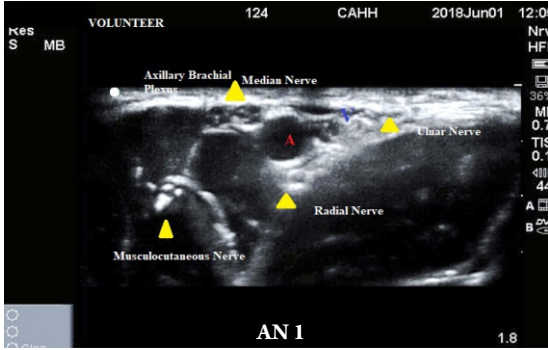
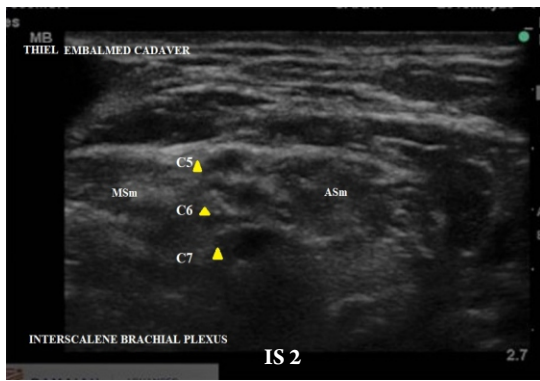
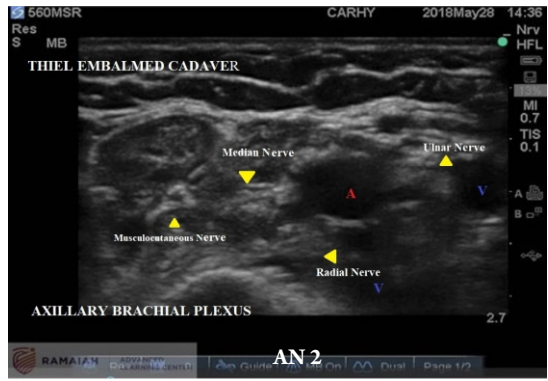
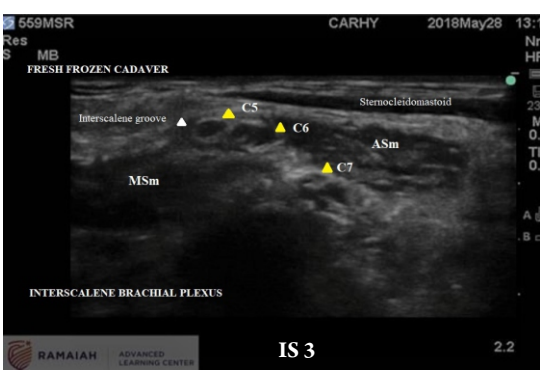
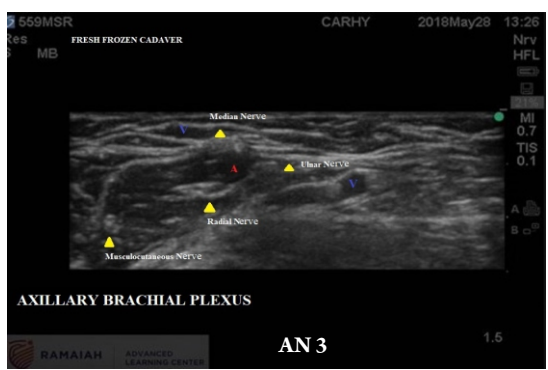
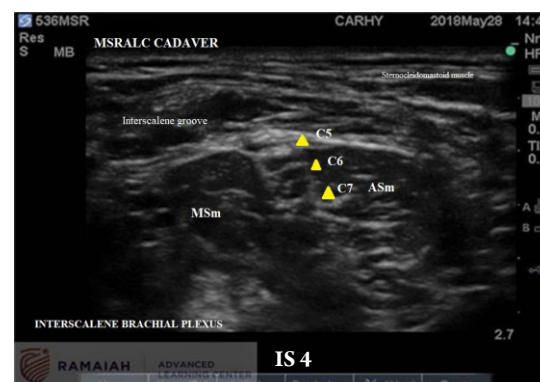
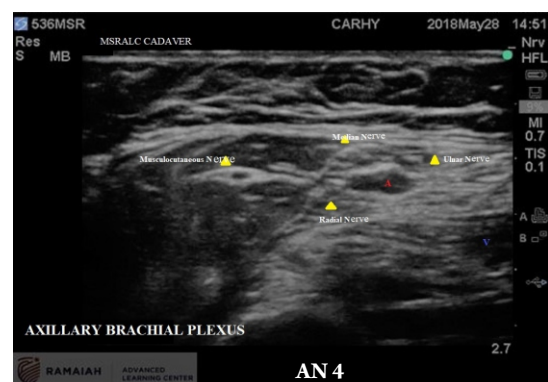
Region	Interscalene	Axillary
Live Volunteer		
Theil Embalmed Cadaver		
Fresh Frozen Cadaver		
Cadaver With MSRALC Solution		

Illustration of ultrasound images of structures in volunteers and cadavers preserved by different techniques

Region	Popliteal Sciatic	Transverse Abdominus Plane
Live Volunteer	<p>PS 1</p>	<p>TAP 1</p>
Thiel Embalmed Cadaver	<p>PS 2</p>	<p>TAP 2</p>
Fresh Frozen Cadaver	<p>PS 3</p>	

an appropriate block, volume of local anaesthetic required and the extent of the block. However the extent of spread realistically may defer between the cadaver and the live.

Hazards of Cadaver Workshop

Cadavers are procured either from voluntary donations or cadavers which are unclaimed. At MSRALC they are routinely screened for the common contagious viruses like HIV, hepatitis causing HIV and Hepatitis C viruses. Yet a risk of transmission of infections from the cadavers cannot be ruled out. So it is always advised to handle these cadavers with due precautions. The protocols of optimization makes procuring fresh cadavers difficult.

Indian Scenario

Presently there are few advanced skill cadaver laboratories with the availability of facility for dissection and research. Imaging modalities like fluoroscopy, CT scanning, MR imaging should be part of the infrastructure.

Conflict of Interest: Nil

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References

1. Loukas M, Lanteri A, Ferraiuola J, Tubbs RS, Maharaja G, Shoja MM, et al. Anatomy in ancient India: A focus on the Susruta Samhita. *J Anat.* 2010;217(6):646–50.
2. Ghosh SK. Human cadaveric dissection: A historical account from ancient Greece to the modern era. *Anat Cell Biol.* 2015;48(3):153–69.
3. Bohl M, Bosch P, Hildebrandt S. Medical students' perceptions of the body donor as a "First Patient" or "Teacher": A pilot study. *Anat Sci Educ.* 2011;4(4):208–13.
4. Bharambe V, Puranam V, Manvikar PR, Bajpayee P. Anatomy acts in India: a review. *Eur J Anat.* 2019;23(6):469–77.
5. Kirchmair L, Entner T, Wissel J, Moriggl B, Kapral S, Mitterschiffthaler G. A study of the paravertebral anatomy for ultrasound-guided posterior lumbar plexus block. *Anesth Analg.* 2001;93(2):477–81.
6. Wedel DJ. Don't try this at home! Vol. 91, *Anesthesia and analgesia.* United States; 2000. p. 771–2.
7. Eisma R, Wilkinson T. From "Silent Teachers" to Models. *PLoS Biol.* 2014;12(10):1–5.
8. Tsui BCH, Dillane D, Walji AH. Cadaveric ultrasound imaging for training in ultrasound-guided peripheral nerve blocks: Upper extremity. *Can J Anesth.* 2007;
9. Chuan A, Lim YC, Aneja H, Duce NA, Appleyard R, Forrest K, et al. A randomised controlled trial comparing meat-based with human cadaveric models for teaching ultrasound-guided regional anaesthesia. *Anaesthesia.* 2016;71(8):921–9.
10. Diwan S, Feigl GESRA19-0487 Cadaveric studies and its impact on regional anaesthesia *Regional Anesthesia & Pain Medicine* 2019;44:A60-A62.
11. McDonnell JG, O'Donnell BD, Farrell T, Gough N, Tuite D, Power C, et al. Transversus Abdominis Plane Block: A Cadaveric and Radiological Evaluation. *Reg Anesth Pain Med.* 2007;32(5):399–404.
12. Tran TMN, Ivanusic JJ, Hebbard P, Barrington MJ. Determination of spread of injectate after ultrasound-guided transversus abdominis plane block: A cadaveric study. *Br J Anaesth.* 2009;102(1):123–7.
13. Sharma M, Macafee D, Pranesh N, Horgan AF. Construct validity of fresh frozen human cadaver as a training model in minimal access surgery. *J Soc Laparoendosc Surg.* 2012;16(3):345–52.
14. Munirama S, Eisma R, Columb M, Corner GA, McLeod GA. Physical properties and functional alignment of soft-embalmed Thiel human cadaver when used as a simulator for ultrasound-guided regional anaesthesia. *Br J Anaesth.* 2016;116(5):699–707.
15. Tsui BCH, Dillane D, Pillay J, Walji A. Ultrasound imaging in cadavers: Training in imaging for regional blockade at the trunk. *Can J Anesth.* 2008;55(2):105–11.
16. Tube AC, Use FOR, Sacs C. 336 sciencf! 1922;LX(1554).
17. Barrington MJ, Wong DM, Slater B, Ivanusic JJ, Ovens M. Ultrasound-guided regional anesthesia: How much practice do novices require before achieving competency in ultrasound needle visualization using a cadaver model. *Reg Anesth Pain Med.* 2012;37(3):334–9.

18. Barrington MJ, Ivanusic JJ, Rozen WM, Hebbard P. Spread of injectate after ultrasound-guided subcostal transversus abdominis plane block: A cadaveric study. *Anaesthesia*. 2009;64(7):745–50.
19. Biswas A, Castanov V, Li Z, Perlas A, Kruisselbrink R, Agur A, et al. Serratus Plane Block: A Cadaveric Study to Evaluate Optimal Injectate Spread. *Reg Anesth Pain Med*. 2018;43(8):854–8.
20. Carline L, McLeod GA, Lamb C. A cadaver study comparing spread of dye and nerve involvement after three different quadratus lumborum blocks. *Br J Anaesth*. 2016;117(3):387–94.
21. Vidal E, Giménez H, Forero M, Fajardo M. Erector spinae plane block: A cadaver study to determine its mechanism of action. *Rev Española Anestesiología y Reanim (English Ed [Internet])*. 2018;65(9):S14–9. Available from: <http://dx.doi.org/10.1016/j.redare.2018.09.002>
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