

Formalin Embalmed Cadavers are Effective Training Tools for Hands-on Skills Training of Combat Advanced Trauma Life Support Course (C-ATLS)

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Abstract

Introduction: Use of cadavers as replacement of mannequins has been practiced since many years now and they are more suitable in resource scarce societies where cadavers are available. Cadavers that are used for the purpose of anatomy teaching at undergraduate level can be used for hands on training of various clinical and procedural skills. We describe the finding of a hands on workshop on procedural skills conducted at our institute.

Methodology: During hands on session of combat advanced trauma life support course (C-ATLS), procedural skills Tracheostomy, Colostomy, Diagnostic Peritoneal Lavage, Suprapubic Catheter Insertion, Tube Thoracostomy, Pericardiocentesis, Venesection and Application of External Fixator were taught using traditionally embalmed human cadavers. Structured and non-structured feedbacks from both facilitators of the course and participants were obtained to assess the suitability of cadavers for skills training.

Results: Most facilitators and participants responded that use of cadavers in the skills training was suitable as per the learning objectives and needs. Some drawbacks of using these cadavers were also noted.

Conclusion: Traditionally fixed human cadavers can be effectively used for hands on training program of procedural skills of C-ATLS.

Key words: Objective Structured Long-case Examination Record, postgraduate students, clinical skills, Obstetrics & Gynaecology.

Introduction

Use of cadavers for skills training in medicine, surgery and allied specialties is well established now. (Anastakis *et al.*, 1999; Atesok *et al.*, 2012; Gilbody *et al.*, 2011; Levine *et al.*, 2006; Reed *et al.*, 2009; Sharma *et al.*, 2013; Yang *et al.*, 2010).

The cadavers used in such trainings also varied from simple traditionally embalmed and preserved cadavers to cadavers treated in multiple ways including fresh frozen cadavers, Thiel embalmed cadavers, lightly embalmed cadavers etc. Some researchers have reported comparisons in effectiveness of fresh frozen cadavers in such trainings with mannequins, bench models or other training tools (Eisma *et al.*, 2011; Benkhadra *et al.*, 2009; Wolff *et al.*, 2008; Sharma & Horgan, 2012).

Our hospital is a tertiary level referral hospital of our national army medical services. It also has an affiliated teaching institute for medicine, nursing and paramedic students with a well-equipped Human Anatomy Department and

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dissection theatre. We also have good access to human cadavers from unclaimed bodies.

As part of continuing professional development (CPD) activities, training cell of our hospital regularly conducts many CPD activities including Combat Advanced Life Support Course (C-ATLS). The objective of this course is to train the medical human resources of our army medical services so that they can competently perform lifesaving procedures in both combat and peace scenarios. The curriculum of the training is designed and developed jointly by training cell and department of orthopedics of our hospital. C-ATLS consists of various hands-on training sessions, which are conducted using bench models, mannequins, simulators and improvised models. Medical doctors, nurses and paramedics participate in this course and experts from various specialties act as facilitators of the course.

Mannequin simulators are undoubtedly excellent tools to impart clinical skills. (Aggarwal *et al.*, 2010) High cost of high fidelity simulators and resource constraints associated with its regular maintenance however limit their use in resource scarce developing countries. There is this unique opportunity for centers affiliated with medical colleges to utilize cadavers as substitute of mannequins.

Based on the feedbacks from facilitators and trainees of earlier batches of C-ATLS, literature review of the subject and with consultation of Human Anatomy and Medical Education

departments, we planned this study to evaluate the suitability, feasibility and effectiveness of use of cadavers in hands-on training of selected skill sets of C-ATLS.

Methods

Cadavers used in the training were fixed traditionally using fluid containing Formalin, Glycerin and water mixture in the ratio of 3:2:1 and preserved in the tank fluid of same composition. Washing surf was used as fungicide in tank fluid.

The facilitators of the training for these skill sets were from departments of Otorhinolaryngology, General Surgery, Orthopedic Surgery and Cardiothoracic and Vascular surgery. Total number of facilitators involved in training of was six. A brainstorming session was held among faculties of the course to discuss the skill sets that could be trained using cadavers. The skill sets included in this study were Tracheostomy, Colostomy, Diagnostic Peritoneal Lavage, Suprapubic Catheter Insertion, Tube Thoracostomy, Pericardiocentesis, Venesection and Application of External Fixator.

The participants of the course were as depicted in table 1. All participants were divided into four groups with one cadaver assigned to each group. Facilitators took rotations among groups until all skills were demonstrated in all groups. Demonstration of the procedure was followed by hands-on practice by all members of the group.

Table 1: Composition of participants

SN	Participants	Number
1	Medical Doctors	18
2	Nurses	3
3	Paramedics	15
	Total	36

Suitability of cadavers to train the skill sets was evaluated as feedbacks from expert facilitators of the course in the form of structured questionnaire. To evaluate the effectiveness, feedbacks were obtained from participants and facilitators of the course regarding their opinion and experience on performing the skills in cadavers using structured questionnaires. Feasibility was measured by teaching faculties of human anatomy department in terms of

whether the cadavers used in hands-on training were deemed still useful or useless for anatomical dissection by medical undergraduates.

Informed written consent was obtained from all participants and facilitators. Cadavers used in the study were obtained for the purpose of Anatomical dissection fulfilling all ethical and legal guidelines and no separate consent was

obtained for this study; written permission was obtained from Human Anatomy Department. Nepal Medical Council provided accreditation to the course with CPD units of 14.5 for medical doctors only.

Results

After the brainstorming session, consensus was reached to include Tracheostomy,

Colostomy, Diagnostic Peritoneal Lavage, Suprapubic Catheter Insertion, Tube Thoracostomy, Pericardiocentesis, Venesection and Application of External Fixator in the study (photographs 1 to 4). Training of remaining skills was carried out using mannequins, bench models and other training tools.

Table 2: Response of Facilitators

SN	Question	Response				
		1	2	3	4	5
1	On a scale of 1 to 5, how effective was use of cadaver for training purpose of skill?	1	2	3	4	5
		-	-	1	4	1
2	What was the fidelity (sense of being as real as real human being) level of performing skill on cadaver?	1	2	3	4	5
		-	1	1	3	1
3	Given an option, would you participate in future skill training that use cadavers?	Yes			No	
		5			1	
4	What problems were faced due to use of cadaver?	Formalin smell, stiffness of cadaver, lack of 'human' feel				
5	Any suggestion or recommendations for future use of cadavers in skills / procedures training?	Use of fresh frozen cadaver, soft embalming of cadavers, practice session for us before the real workshop to get adjusted to cadavers' consistency.				

(Total respondents =6)

Table 3: Response of Participants

SN	Question	Response				
		1	2	3	4	5
1	On a scale of 1 to 5, how effective was use of cadaver for training purpose of skill?	1	2	3	4	5
		2	5	10	15	4
2	What was the fidelity (sense of being as real as real human being) level of performing skill on cadaver?	1	2	3	4	5
		7	6	5	10	8
3	If given an option, what would you participate in the future in skill trainings that use cadavers?	Yes			No	
		31			5	
4	What problems were faced due to use of cadaver?	Practice of skills by all participants not possible, elasticity not sufficient for some procedures like tracheostomy,				
5	Any suggestion or recommendations for future use of cadavers in skills / procedures training?	Remove the formalin's smell, use soft embalmed cadavers, make smaller group of trainees,				

(Total respondents = 36)

All facilitators and 38 participants of the course responded to the feedback questionnaire. Facilitators' and participants' response to questionnaires to evaluate the suitability and effectiveness of training skill sets using cadavers are depicted in tables 2 and table 3 respectively.

All cadavers that were used in hands-on training were subsequently used for Anatomical dissection by medical undergraduates without any problem.

Discussion

Continuing professional development (CPD) is the process by which health professionals keep updated to meet the needs of patients, the health service, and their own professional development. (Peck et al., 2000) It has become progressively more important for individuals, employers and professional organizations with the increasing demand for accountability, competitiveness, flexibility and a skilled and competent workforce (O'sullivan, 2003). Ar par with the global trend, Nepal Medical Council has introduced a compulsory CPD structure for all doctors under its jurisdiction in 2019. It can be expected that the demand for trainings and workshops for healthcare professional is going to rise. In resource scarce regions like ours, CPD providers are going to face multitude of challenges to fulfill this demand.

Soft skills and non-invasive procedures can be conveniently acquired by many tools like peer learning, simulated patients or even real patients. These tools are however cannot be used for acquiring skills for invasive procedures.

Mannequins are working models that provide excellent fidelity for training of medical and surgical skills, are skills-specific and hence are ideal tools for such CPD activities. However, such tools are neither easily available nor affordable for all centers of our region. On the other hand, most tertiary care centers in our region have fair access to cadavers.

Our study shows that cadavers can be successfully used for training of invasive

procedures. Results of feedbacks from facilitators and participants show that the suitability and effectiveness after using cadavers was satisfactory. In addition, cadavers being real human bodies unlike models or mannequins, they provide ideal replication of human body. Some limitations that were identified with cadaver-model were non-specific model that may not be suitable for all procedures, pungent smell of formalin, possible teratogenicity of formaldehyde, inability to repeatedly practice same procedure in same cadaver, lack of elasticity and flexibility and inability to practice all procedures in cadavers.

Some cadaver treatment methods like Thiel embalming are best suited for procedural trainings (Benkhadra et al., 2009; Eisma et al., 2011; Wolff et al., 2008; Levine et al., 2006) but unfortunately they too are resource intense and we still lack the technical knowhow of the method. (Benkhadra et al., 2011) Other methods like use of Phenoxetol are more practical substitute of Thiel embalming and can be used in our region. (Tandon et al., 2014) Phenoxetol is a formalin-removing agent that reduces the pungent smell of Formalin as well as its teratogenicity. Cadavers can also suitably modified and prepared for performing specific procedures e.g. prefilling cavities like urinary bladder, pericardial cavity, peritoneal cavity, pleural cavity, joint cavities for drainage procedures. Only certain parts of cadavers can be used in certain skills like arthroscopic repair, petrous bone dissection or neurosurgeries. Sustainability of cadavers as resources should be considered and each cadaver should be used to its fullest. Skills training should be planned either before or after the anatomical dissection of cadavers by medical students with minimal disturbance to both purposes.

Conclusion

This study shows that cadavers can be effectively used for training of selected medical and surgical skills included in C-ATLS developed by training cell of SBH.

In next stage, we plan to study the feasibility of other skill sets that are included in C-ATLS and

can be trained using cadavers. Use of fresh frozen cadavers, though available, is not sustainable for the reason that they cannot be subsequently embalmed and preserved for anatomical dissection after the workshop. Use of a formalin removing method as described by Tandon A. et al (Tandon *et al.*, 2014) is being considered for our upcoming C-ATLS course.

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