Surgical model pig *ex vivo* for venous dissection teaching in medical schools[1]

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Abstract

Purpose: To investigate a method for development of surgical skills in medical students simulating venous dissection in surgical ex vivo pig model.
Methods: Prospective, analytical, experimental, controlled study with four stages: selection, theoretical teaching, training and assessment. Sample of 312 students was divided into two groups: Group A - 2nd semester students; Group B - students of 8th semester. The groups were divided into five groups of 12 students, trained two hours per week in the semester. They set up four models to three students in each skill station assisted by a monitor. Teaching protocol emergency procedures training were applied to venous dissection, test goal-discursive and OSATS scale.
Results: The pre-test confirmed that the methodology has not been previously applied to the students. The averages obtained in the theoretical evaluation reached satisfactory parameters in both groups. The results of applying OSATS scale showed the best performance in group A compared to group B, however, both groups had satisfactory medium.
Conclusion: The method was enough to raise a satisfactory level of skill both groups in venous dissection running on surgical swine ex vivo models.
Key words: Models, Animal. Education Medical, Undergraduate. Venous Cutdown.

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■ Introduction

The National Curricular Guidelines (DCN) of medical school revised in 2014, called for the need of the relationship between knowledge, skills and attitudes required by the doctor to his graduation, fundamental for their professional future practice. The use of simulators is shown as a good strategy in order to achieve established by them.

Experiences in national universities that introduced the use of porcine models for teaching surgical skills in medical schools, demonstrated positive results[1,2].

In this context the Federal University of Pernambuco from 2014, have joined to that transformation process in medical education by implementing innovative initiatives using this type of simulators[3,4].

This study sets out the method used to raise the surgical skills at a satisfactory level in the venous dissection execution by students of second and eighth semesters of medical school UFPE, using as a key resource training in a live surgical pig model ex easy assembly and low cost.

■ Methods

The research was part of a principal project Postgraduate Surgery Program, approved by the Research Ethics Committee in Human Beings of Health of the Federal University of Pernambuco Science Center getting Presentation Certificate for Ethics Assessment (CAAE) N°: 40608215.0.0000.5208.

Study design

Prospective, analytical, experimental, controlled study with four stages: selection, theoretical teaching, training and assessment.

Study population

2nd half of medical students (Medical Practice Fundamentals of discipline - FPM), and 8 semesters (Fundamentals of discipline of the High Complexity Attention to Health II).

Sample selection

a) **Inclusion criteria**

1) Medical students without experience in the practice of venous dissection with the use of surgical ex vivo pig models;

2) Without exposure medical students' constructivist methodology applied to the venous dissection education;

3) Term of Consent accepted and signed - IC.

b) **Exclusion criteria**

1) Students with a history of venous dissection practices;

2) History of allergy, intolerance or hypersensitivity to biological tissues, materials or inputs used;

3) Refusal to participate in the study or to sign consent form - ICF.

The population consisted of 145 students of 2nd semester and 187 from the 8th semester. We excluded 20 students, four by allergy to latex and talc gloves; one had a phobia of blood and animal tissues; five were monitors in surgical disciplines and 10 were volunteers in emergency services and already had experienced venous dissection patient[3].

The final sample was made up of 312 students (n = 312) distributed into two groups: 2nd semester students formed the group "A"; 8th semester students of the "B" group.

Didactics of theoretical

Two lectures were presented: shock and venous dissection, for both groups, referenced in the written description in the manual ATLS[5,6].

It used the method of learning based on problems (ABP) and the level of deepening

of differentiated classes for the "A" group, descriptive and informative method was applied, encouraging natural curiosity own beginner student. In group "B" method of case discussion it was the chosen strategy, describing problem situations based on clinical cases.

Ex vivo pig model description for venous dissection

For its production the following materials were used: a complete swine costal grid, easy to acquire as needed in any supermarket or authorized meat trade, which guarantees its innocuity; a plastic tub of 8Lts and another of 4Lts, a party balloon N° 10, a plastic kitchen foil and a small wooden backboard of 5cm x 30cm, accessible in any local commerce; a 20 mL syringe, procedure gloves, a 500 mL physiological saline solution, a serum kit, a Venocath No. 18 catheter, a 5mm x 30cm long latex tube, 2-0 cotton yarns And nylon 3/0 with T/C needle, a roll of adhesive tape, a fenestrated field, a basic surgical dissection kit. All this hospital material does not need special authorization and are easy to acquire in authorized stores and hospital materials and supplies (Figure 1).

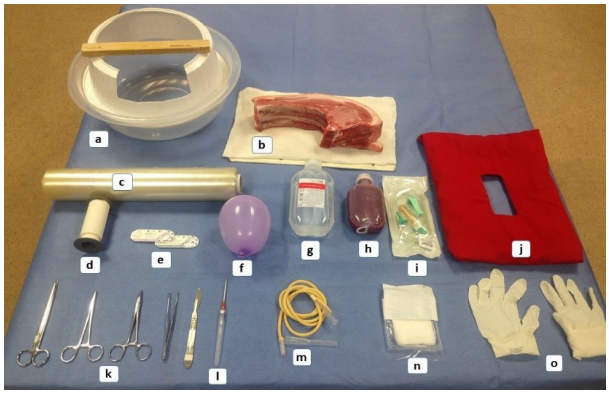

Figure 1 - Model Surgical Swine Ex Vivo. Materials: **a**) Plastic bowls and wooden support, **b**) Grating Costal pig, **c**) Cooking plastic film, **d**) Plasters, **e**) Cotton Yarn simple 2/0 and nylon 3/0 with needle t/c, **f**) Balloon, **g**) 0.9% saline solution 500 ml, **h**) Serum bottle with red paint (simulation of blood), **i**) Serum Equip, **j**) Fenestrated field, **k**) Basic Kit dissection, **l**) Endovenous Catheter Nº 16, **m**) Latex tube, **n**) Gases, **o**) Procedure gloves.

Model manufacturing

To build the model we follow the following, step by step:

1. The lower basin had the bottom removed and a side opening was made for the landing of the vertebral end of the pig cage, being capsized and fits within the larger and fixed with adhesive tape to the side structure of stability and support.

2. The timber support is disposed intermediate the lower opening of the basin, perpendicular to its lateral cut and fixed with adhesive tape on the sides, allowing the support of the sternal end of the rib cage on both the vertebral end landed on the side of the opening bowl (Figure 2a).

3. With the help of a Kelly clamp curve was introduced latex tube longitudinally through the thickness of the costal arch to 5 cm below the pigskin, leaving a remainder of 5 cm on each side exceeding the ribcage (Figure 2b).

4. It was connected to a party balloon No. 10 to one end of the tube by a capful of venocath cut in half and tied, closing the other end of the tube with surgeon knot with cotton thread 2-0. The balloon was filled syringe seeping with 60 ml of red ink for free and closed end, which kept the completed and constant positive pressure tube to simulate the venous return at the time of puncture with the catheter (Figure 2c).

Finally, the model was covered with fenestrated field leaving outside only the end of the tube attached to the balloon to observe their fill during the procedure (Figure 2d).

Training logistics

Each group was divided into five subgroups of 12 students being trained two subgroups "A" the first day of the week and two subgroups "B" the next day. Training sessions had lasted two hours a week throughout the semester.

Figure 2 - **a**) Positioning the costal pig cage on the side opening of the lower capsized basin, **b**) Introducing the line of latex tube longitudinally through the thickness of the costal arch to 5 cm below the pigskin, **c**) Balloon connection one end of the latex tube, filled with red ink and constant positive pressure to simulate the venous blood return, **d**) Pig surgical model field fenestrated covered with ready for use.

The anatomical references of the main veins to venodissecção the patient were taught pointing the approach of sites in the body of a man student who voluntarily gave up at the beginning of practice.

They set up four skill stations in each training session where three students assisted by a trained monitor reproduced the venous bed in the surgical ex vivo pig model.

The monitors performed the first procedure, demonstrating to the students' step by step as described in the manual ATLS[5,6] standardizing the times and movements to let students repeat the maneuvers: diereses tissues, identification and isolation of the bed vein, placement catheter number 18 to connection into the 0.9% saline solution.
Finally fixing the catheter to the vein and plans for tissue synthesis (Figure 3a-d).

We conducted the test for patent intravenously down the serum below the level of venous dissection, watching the red ink return on equip serum from the balloon returned to the balloon when elevated serum above the model level, indicating the success of the procedure.

Figure 3 - Procedure venous dissection. **a**) Diereses tissue, vein identification and release of his bed, **b**) Vein isolation with cotton thread and placement of the intravenous catheter Nº 18, **c**) Catheter connection to the saline 0.9%, **d**) Fixing the catheter and plans for tissue synthesis.

Evaluation

Teachers in selected disciplines were responsible for the application of the evaluation instruments.

Data were collected by applying the Teaching Training Emergency Procedures Protocol - "PETPE[3] modified to Venous Dissection, which evaluated the quality of the model, its anatomical correlation with human perception of the student on their use for venous dissection training. This instrument was applied before the start of theoretical activities (pre-test) and after completed classes (post-test).
The Rating Scale Objective Structured Technical Skills - OSATS[7-9] was applied after the training of the subgroups for research sufficiency and proficiency training method.
The retentive and theoretical use of groups were evaluated by applying a goal-discursive evidence under the standard criteria of medical school UFPE: from 0 to 10, with seven minimum approval value. This criterion established SATISFACTION parameter to our research.
Surgical skills estimated by the scale of objective structured assessment of technical skills (OSATS)[7-9] in students, had six variables evaluated with values from one to five, setting 2.6 as a parameter of "satisfaction" for each variable, adding a total of 30 points, regarded as

"satisfactory" all score above 16 points (Table 1).

Statistical analysis

Data were tabulated and consolidated in an Excel spreadsheet, after it applied the SPSS software version 17, which made the analysis of the variables. The chi-square test was used the

Table 1 - Objective Structured Assessment of Technical Skills (OSATS) Global Assessment Scale Operating Performance

Student's Name:	**Group:**	**Code:**	**Procedure:**

Please, circle the number corresponding to the candidate's performance in each category, regardless of the training level

1. Respect to tissues:	1	2	3	4	5
	It often uses unnecessary force in handling the tissue or causes damage by inappropriate use of instruments		Carefully manipulates the tissues, but occasionally cause inadvertent damage		Consistently and properly handles the tissues causing minimal damage
2. Movement time:	1	2	3	4	5
	Many unnecessary movements		Efficient time / movement, but sometimes uses unnecessary movements		Clean and economic movements, with maximum efficiency
3. Knowledge and handling of the instrument:	1	2	3	4	5
	It shows a lack of knowledge in the use of instruments		Competently use the instruments but appears occasionally some degree of rigidity or inability		Shows obvious familiarity with the use and handling of instruments
4. Operating flow:	1	2	3	4	5
	Conducts frequent stops in the procedures and seems unsure of next move		Demonstrates some degree of forward planning with reasonable progress in the procedure		Shows obvious planning in the course of dealing with natural flow of movement for the next sequence of steps
5. Assistant Direction:	1	2	3	4	5
	The assistant is consistently misplaced and / or not properly guide the attendants		Guide properly assistants but exceeds the time		Guide and use strategically to the assistants to the best advantage at all times of the procedure
6. Specific knowledge of the procedure:	1	2	3	4	5
	Demonstrates knowledge deficit. It took many instructions at most steps		It knew all the important stages of the procedure		Demonstrated familiarity with all aspects of the procedure

Comments: **Tester Name:** **Date:**

prevalence found by comparing the ratios for comparative homogeneity of the pre and post-test theoretical.

The Fisher exact test was applied in cases where the assumptions of the chi-square test were not met. The descriptive analysis of knowledge scores was made by the statistics: mean and standard deviation. Normality score was evaluated by the Kolmogorov-Smirnov test and where the test did not indicate normality, we applied the Kruskal-Wallis test. The level of significance was set at p = 0.05 for all variables.

■ Results

The pre-test confirmed that the methodology has not been previously applied to the students. All values obtained in the theoretical analysis above seven reached in both groups, considering the results "satisfactory".

The results of measurements obtained from the application of OSATS[7-9] Scale for estimation of developed surgical skills are shown in Table 2.

Table 2. Comparative averages of the assessments: Theoretical Evidence and skills test (OSATS Scale) by groups

Type Evaluation	Results		
	medium		Differences
Objective test – discursive proof	Group A	Group B	p-value[1]
	8,4±1,5	8,6±1,5	0,003
Skills test - Application Scale OSATS			
Variables Evaluated	Group A	Group B	p-value[1]
1. About tissues	4,1±0,8	3,7±0,9	<0,001
2. Time and motion	3,7±0,8	3,2±0,9	<0,001
3. Knowledge and instrument handling	3,8±0,8	4,2±0,8	<0,001
4. Operating flow	3,3±0,7	3,3±0,8	<0,001
5. Direction assistants	2,9±0,7	2,2±0,9	<0,001
6. Specify knowledge of procedure	4,6±0,5	4,1±0,8	<0,001
General Average	22,3±1,6	20,7±2,1	<0,001

There were no previous results than the minimum standards established in the research, both theoretical advantage as to the practical in either group (Table 3).

Table 3 - Average overall result of the theoretical evaluation and practice of students in both groups.

	theoretical assessment	Average
Overall average	Objective test – discursive proof	8,6±1,5
	Rating Scale OSATS	
N°	Variable	Mean
1	About tissues	3,9±0,9
2	Time and motion	3,4±0,8
3	Knowledge and instrument handling	4,1±0,8
4	Operating flow	3,4±0,8
5	Direction assistants	2,6±0,9
6	Specify knowledge of procedure	4,3±0,8
General Average		21,7±2,4

■ Discussion

The survey assessed the surgical ex vivo pig model used in venous dissection training for medical students in the second and eighth semesters, these had not previously been exposed to practice this procedure. The training method resulted in the acquisition of satisfactory surgical skills according to the results shown in Tables 1 and 2, demonstrates the participants' ability to perform the procedure in the future, presumably a few years later in an emergency environment.

The Simultaneous knowledge development of surgical skills was determined using objective methods (objective-discursive test and OSATS Scale), in an evidence search that demonstrate that the proposed method can be considered an effective and innovative instrument in the early surgical training of medical students.

Experimental studies performed by Spencer et al in the porcine model for training in venous dissection applied to medical students and physicians, analyzed their quality (mean = 9.16), while the anatomical correlation between this and the human anatomy reached an average of 8.07; However, the model was approved and considered useful in the teaching of venous dissection subjectively without establishing an average of approval[10].

Our research has reached a heterogeneous sample and higher volume compared to the study of Spencer-Netto *et al.*[10], however, in contrast to the population of these, we selected students from the 2nd semester of medicine for presenting in their curriculum the first surgical discipline of the medical course with a focus on the topics of the research (Fundamentals of Medical Practice). This group had not undergone any surgical training, which would facilitate the testing and objective estimation of the constructivist methodology proposed in our project.

The 8th semester students were selected because they had undergone previous surgical training in previous semesters, which would show surgical skills already developed and that would facilitate the comparison of the results with those obtained in the second semester students.

Contrary to the Spencer study population, we believe that the results obtained in our research could prove the effectiveness of the constructivist methodology and the use

of the ex vivo swine surgical model proposed as a fundamental tool, by the fact that they are tested in an extremely heterogeneous sample (Students at the beginning and end of the medical school).

The study also evaluated the quality of the model, anatomical correlation and palpatory perception of the student during the venous dissection training, but the difference of other reports[10], the averages estimated in our research were relatively lower in reference to the quality of the model (mean = 8.4 ± 1.4); The anatomical correlation was also lower (mean = 7.6 ± 1.5), but the estimated perception in the students had an approval of 99.1% of the participants.

We believe that these differences can be attributed to the fact the heterogeneity of our sample (students 2nd and 8th semesters) differentiates sample of that research was made up of students from last semester and medical graduados10, which would justify the lower averages in our study. Still, as shown in the results, the average reached parameters of "satisfaction" for all variables.

The surgical swine ex vivo model used in this work was built with readily available and inexpensive materials. The pork pieces acquired in approved slaughterhouses and sanitary certification, ensuring their safety without biohazard since met strictly the principles of biosafety of Experimental Surgery Center of UFPE regarding the use of biological material.

An important factor and that is the main advantage of this simulator is definitely the cost. The investment in the production of the models was low, even considering that some of the items resulted relatively expensive to acquire, in the case of plastic bowls. However, these are only purchasing items and reusable many times to the natural aging of the material. The cost of hospital supplies was also low.

Another survey using a low-cost simulator, developed for teaching venipuncture skills showed that the cognitive, procedural and attitudinal performance of students who used was equivalent to those trained in a simulator comercial[11]. This shows that can be achieved similar results with much smaller budgets, strengthening our preference for simulator developed for our research.

The model ready for surgical training, had an investment of between R $ 80 and 100 (equivalent to 30 US dollars), but can be used by the student with recurrent possibility of surgery numerous times to ask swine get totally damaged.

Compared with expensive synthetic models, virtual simulators and high materials custo[11], our model reproduces the basic elements that intervene in a deep vein dissection, allowing the student a palpatory experience similar approach in humans.

Certainly, persevering practice and repetition of a skill are essential for the development of psychomotor skills. The innovative design of the proposed model facilitated the student to repeat the procedure until these skills.

Early in the project showed clear differences between both groups. Group A showed lower theoretical knowledge on the subject because it is the 2nd half of students who had not received the contents presented in class.

However, these differences were much less evident in practice as the students in group A were able quickly to balance these deficiencies and homogenize the level of knowledge in parallel with the development of skills in venous dissection of execution compared to those observed in group B.

The mean values affected in theoretical evaluation of both groups indicate that there was a significant difference, thus demonstrating the retentive capacity and theoretical uptake of students the group shown by the students similar to the group B.

The application of OSATS[7-9] Scale showed significant differences between the mean values obtained in the evaluation of skills by groups, it is interesting to note that the group A averaged markedly higher than in Group B on four of the six variables and the overall average favored the group A. Even so, each individual variable analyzed in both groups reached averages> 2.6 considering the results "satisfactory".

The difference found in favor of the group A can be attributed to the constructivist methodology that allowed the development of training in a playful environment of complete relaxation, stimulating students to improve the acquired surgical skills.

It is interesting to note that the resolving level reached by the Group was superior to Group B, which did not match with the expected profile for each group by the academic differences between semesters; this shows that early surgical training establishes a proportional correlation between theory and practice and determines the ease of acquisition of surgical skills and encourages the implementation of this method for its development.

There is little discussion in the literature about what medical procedure the medical student should be able to perform at the undergraduate course end and at what time of the curriculum they should be inseridos[12]. However, the results of our research suggest that this may be one of the procedures which may be implemented early in medical education.

The best performance of younger students deserve more research suggests that by as early introduction of skills training in medical school may result extremely positive for their training.

Study limitations

There were applied theoretical pre-test nor practical, so it has no baseline data to establish the affected comparative averages.
In reference to the surgical ex vivo pig model for venous dissection, the thick skin made it difficult to tissue synthesis, the needles could not have transfixed her, prolonging the procedure.

An important limitation was the sensation during palpation punch latex tube, this resistance was the hardness of the material which means that the model still needs to be improved experiencing other materials allowing greater realism in the procedure. However, the importance of the work was based on the early stage of training where the emphasis was placed on the systematization of steps and handling of tissues, since the model is simple.

In the literature review found no papers applying a similar methodology in the medical graduate to establish parameters for comparison to assess this pedagogical proposal. This study will be repeated including the considerations and constraints encountered.

The applicability of the concepts and skills acquired by the second semester students will require a solid command of the operative technique and the scientific basis that they expect to be continued and improved in subjects of surgical content in later periods. The introduction of the constructivist methodology tested in this project, in the grades of future surgical disciplines in the medical course, will guarantee the achievement of this objective

However, the improved performance of younger students deserves more research as it suggests that the early introduction of skills training in the medical course can be extremely positive for their training.

■ Conclusion

The method used was enough to raise a satisfactory level of skill both groups in the implementation of venous dissection procedure.

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