https://doi.org/10.23934/2223-9022-2020-9-4-606-611

Cadaver Course in the Training System of an Urgent Surgeon

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INTRODUCTION In our country, severe concomitant injury is one of the main causes of death among people of working age. This poses an urgent task for the national health care and education system in the form of training qualified emergency surgeons.

PURPOSE OF THE STUDY To improve the quality of practical training of specialists in the delivery of urgent surgical care for concomitant injury.

MATERIAL AND METHODS The "Cadaver course of operative surgery for severe concomitant injury" was developed. The participants of the cadaver course were senior students of the Ryazan State Medical University. At the stages of the course, theoretical training was carried out, work in a cadaver operating room with mentors and independently was performed, as well as a comparative assessment of learning outcomes with the results of similar tests of clinical residents of the 2nd year of study.

RESULTS Statistically significant differences were obtained in terms of indicators reflecting the level of practical training of students who completed the developed course. The level of theoretical training in the compared groups did not differ significantly.

CONCLUSION New opportunities have been opened for the widespread introduction of the developed training course into the educational process. It is necessary to further improve the proposed methodology and study the results of its use.

Keywords: cadaver course, training of surgeons, urgent surgery

For citation Khubezov DA, Khubezov LD, Trushin SN, Ogoreltsev AYu, Puchkov DK, Ignatov IS, et al. Cadaver Course in the Training System of an Urgent Surgeon. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2020;9(4):606–611. https://doi.org/10.23934/2223-9022-2020-9-4-606-611 (in Russ.)

Conflict of interest Authors declare lack of conflicts of interest.

Acknowledgments, sponsorship The study had no sponsorship

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INTRODUCTION

In the structure of mortality among the population in the world, traumatism ranks third and fourth after cardiovascular diseases, malignant neoplasms, respiratory diseases and infectious diseases [1]. The number of people injured in road accidents in the Russian Federation annually totals more than 200,000 people, and more than 16,000-18,000 become victims of road traffic accidents [1].

Concomitant injury today is the leading cause of death (52%) among the population in the age group under 40, leaving behind cardiovascular diseases and oncology [2]. According to the Russian Ministry of Health, the annual economic losses from injuries reach 2.6% of the gross domestic product (GDP) [1]. The immediate causes of high mortality in concomitant trauma are, mainly, acute blood loss and traumatic shock due to damage of the liver, spleen, large vessels, kidneys, and fractures of the pelvic bones [1].

In recent years, the system of regional trauma centers has been introduced in Russia, which has significantly improved the quality of medical care for patients with concomitant injury [3]. In 2015, there were more than 1,500 trauma centers in Russia, equipped with all the necessary equipment [4]. However, in addition to equipment, each trauma center must be provided with a multidisciplinary team of highly qualified specialists with extensive experience in urgent surgery for severe concomitant trauma, which requires special training. The process of teaching and practicing skills in emergency surgery is hampered by a number of factors: the grave condition of those who have suffered, lack of time to make a decision, and a stressful environment. It is difficult to fully simulate such situations in an office environment and on simulators [3]. Thus, the process of training qualified specialists in emergency surgery remains an important problem requiring the improvement of the modern health care system and education.

Purpose: to improve the quality of practical training of specialists in the provision of urgent surgical care for concomitant injury.

Tasks:

- to develop a training program for senior students, resident surgeons, cadets of postgraduate education of medical universities "Cadaver course of operative surgery for severe concomitant injury";
- to evaluate the effectiveness of the developed program in comparison with the traditional form of education.

MATERIAL AND METHODS

The program "Cadaver course of operative surgery for severe concomitant injury" was developed and launched in September 2017. The participants of this program were 5–6-year students of the medical faculty of Federal State Budgetary General Education Institution of Higher Education (FSBGE HE) of "Ryazan State Medical University named after academician I.P. Pavlova ", participants and prize-winners of the All-Russian Olympiads in surgery.

The stage of theoretical training lasting 2 weeks included 6 lessons of 2 hours each. Each lesson consisted of a lecture part and students' independent work. The lecture material was devoted to the main aspects of the topographic anatomy of various regions (head, neck, chest and abdomen); the main operational access to the organs and vessels of these areas, the key stages of operations on organs. The lectures were held in the form of presentations with demonstration of illustrations, diagrams and video recordings of operations. Further, the independent work of students included working with anatomical atlases, sketches of anatomical diagrams and drawing up notes.

The next was the stage of work with a mentor in the department of pathological anatomy State Budgetary Institution (SBI) of the 'Ryazan Region - Regional Clinical Hospital'.

The mentors were leading specialists of the departments of neurosurgery, thoracic surgery, urology, general and vascular surgery and traumatology SBI of the Ryazan Regional Clinical Hospital, who have extensive experience in urgent surgery for severe concomitant injuries. Each mentor was responsible for his area of expertise in accordance with his specialty. In the course of the work, the mentor demonstrated certain surgical techniques, while the students observed the actions and assisted him. In total, 5 sessions were held on unfixed corpses, the topic was the study of various anatomical areas. The structure of the classes of the second stage is presented in table 1.

Table 1

Lesson structure of the second stage

Lesson	Anatomical region	Instructor	Practiced operational techniques
1	Head and neck	Neurosurgeon Vascular surgeon	Craniotomy Mobilization of the great vessels of the head and neck, suturing of their defects Tracheostomy Vascular anastomosis Temporary artery prosthetics
2	Thoracic cage	Thoracic surgeon	Thoracotomy Sternotomy Mobilization of pulmonary vessels Suturing a lung wound Lung mobilization with torsion Suturing heart wound Pulmonectomy Thoracocentesis, thoracostomy
3	Abdominal cavity and retroperitoneal space	General surgeon	Laparotomy Splenectomy Mobilization of the liver and suturing of its ruptures Hemighepatectomy Closure of diaphragm tears
4	Abdominal cavity and retroperitoneal space	General surgeon Coloproctologist	Pancreas mobilization Pancreatic tail resection Mobilization of the duodenum according to Kocher Suturing of perforations of various parts of the intestine Intestinal anastomoses Removal of intestinal stomas
5	Pelvis, retroperitoneal space	Urologist Vascular surgeon	Nephrectomy Suturing the bladder Epicystostomy Mobilization of the inferior vena cava and aorta, iliac vessels, suturing of their defects, imposition of vascular anastomoses, endoprosthetics

It should be noted that the conditions of the classes were as close as possible to the conditions of a real operating room: each operation began with the handling of the operating field in compliance with the rules of aseptics and antiseptics and ended with layer-by-layer suturing of the operating incision. During the interventions, a wide range of surgical instruments and modern electrosurgical equipment were used.

The third stage was students' independent work. The surgical team during the lessons consisted entirely of students, the mentor only commented on the actions of the students and corrected them if necessary. The frequency, duration and structure of the sessions were the same as in the second stage, however, the number of practical sessions was doubled to 10 (2 sessions for each anatomical area). By the end of the third stage, each student had the experience of several assistances and at least once performed any of the operations listed in table 1.

The assessment of the knowledge level and skills of the cadets and a comparative assessment of the same indicators in the group of second-year clinical residents has become the task of the final stage. Thus, the clinical residents made up the comparison group, and the students who completed the developed cadaver course - the main study group. The final test was complex:

- the test task included 100 questions to test knowledge of topographic anatomy and operative surgery;
- situational task (case) - testing knowledge for tactics in the context of providing assistance in emergency surgical pathology;
- in the practical part, it was envisaged to perform one of five operations (suturing a wound of the heart, pulmonectomy, defect suturing in the inferior vena cava with its mobilization, nephrectomy, splenectomy).

Due to the absence in the curriculum of students of the conventional delivery of trainings on the performance of surgical interventions, the choice of the comparison group was carried out in favor of clinical residents who were able to complete the practical task. Thus, we counted the group of students who completed the cadaver course, comparable only to the group of second-year residents with experience in performing operations independently.

Also, each study participant was asked to assess confidence in their manual skills before conducting the final test. For this we used the Likert scale (absolutely not sure - 1 point, not sure - 2, find it difficult to answer - 3, sure - 4, absolutely sure - 5).

In a comparative assessment of the results in the groups, the following average indicators were taken into account: the number of correct answers in the test, point for solving a situational task (maximum - 5), time in minutes spent on performing the operation, assessment of the quality of the intervention performed (assessed by an expert on a five-point scale), point on the Likert scale. For the statistical analysis, Microsoft Excel 2010 and IBM SPSS Statistics 20.0 software were used. When comparing the mean values, an independent T-test was used for paired samples. The differences were considered statistically significant at $p < 0.05$.

RESULTS

The following results were obtained (Table 2).

Table 2

Comparison of theoretical and practical training levels between groups

criterion	Main group, n = 11	Group comparison, n = 10	p
The number of correct answers to the test task, M ± SD, n	92,0±2,1	93,3±2,8	0,15
Assessment for solving a case, M ± SD, points	4,2±0,6	4,0±0,5	0,13
Average time spent on a practical task, M ± SD, min	35,2±9,1	44,3±7,9	0,02
Expert assessment of the quality of operations performed, M ± SD, points	4,4±0,6	3,6±0,5	0,03
Average Likert score, M ± SD, points	4,1±0,9	3,9±1,4	0,47

The results obtained demonstrate that the level of theoretical training did not differ statistically significantly between the main and the comparison group. Thus, the average number of correct answers in the test was 92.0 ± 2.1 in the main group, and in the comparison group - 93.3 ± 2.8 ($p = 0.15$). Also, no statistically significant differences were obtained between the main and control groups in terms of the average score for the situational task - 4.2 ± 0.6 versus 4.0 ± 0.5, respectively ($p = 0.13$). However, statistically significant differences were obtained in terms of indicators indicating the level of practical training. The average duration of the intervention and the quality assessment of the performed operation in the main group was 35.2 ± 9.1 minutes and 4.4 ± 0.6 points, and in the comparison group - 44.3 ± 7.9 minutes and 3.6 ± 0, 5 points, respectively ($p = 0.02$ and $p = 0.03$). The subjective assessment of one's own level of practical skills, assessed by the Likert scale, did not differ statistically significantly between the compared groups - 4.1 ± 0.9 in the main group and 3.9 ± 1.4 in the comparison group ($p = 0.47$).

DISCUSSION

In the 19th century, the great Russian surgeon, anatomist and teacher Nikolai Ivanovich Pirogov, after graduating from the medical faculty of Moscow University, wrote: “So I graduated from the course without doing a single operation , without excluding bloodletting and pulling teeth. I have not performed a single operation, not only on a living person, but also on a corpse. The whole demonstration consisted of drawing on a board ”[5]. Many of yesterday's medical graduates can repeat these words. But it is already obvious that today it is impossible to train a specialist surgeon, based only on theoretical training. Recently, the problem of practical training of highly qualified specialists in surgery attracts considerable attention and resources. For example, within the framework of the "Concept for the development of the health care system in the Russian Federation until 2020" many training bases have been equipped with simulation equipment, the training operating rooms being organized for working with laboratory animals in some centers. However, with a careful study of the world literature, one cannot fail to note a significant predominance of programs for training the skills of planned surgical interventions, in particular laparoscopic surgery. A large number of publications have been published which

highlight various techniques in teaching minimally invasive surgery: working with laparoscopic boxes, the use of the virtual simulators, and surgical interventions on animals [6–8].

There are very few works devoted to the development of the skills of urgent surgery, where the methods of open (traditional) interventions become paramount. This dictates the need to develop and implement new algorithms for training specialists in this area.

Of course, the news about the introduction of simulators for training certain general surgical techniques is encouraging. For example, an electronic 3D simulator "Virtual Surgeon" was designed at the Samara State Medical University. It is designed for virtual simulation of open operations, mainly laparotomy and systemic training in surgical techniques [9]. Obviously, a much wider range of capabilities is required to train a highly skilled emergency surgeon.

In our opinion, the most promising, low-cost and effective direction in developing the skills of open surgery is the introduction of cadaver courses into the educational process. At the same time, it is important that a practicing surgeon should be the mentor, which is possible only in clinical departments with the involvement of leading specialists with pedagogical experience. N.I. Pirogov, continuing his studies in Berlin, wrote: “Let the anatomist examine the human corpse to the smallest details. And yet, he will never be able to draw the attention of students to those points of anatomy that are extremely important for the surgeon, but for him they may not have absolutely no significance ”[5]. Unfortunately, in our country this direction is not well developed. We associate this with both gaps in the legal regulation of aspects of the students work with cadaveric material, and with the lack of developed algorithms and experience in carrying out such work. However, in a number of countries, cadaver courses have become common use. In the UK, USA and Japan, there are a number of cadaver training courses on combined trauma: Definitive Surgical Trauma Care (DSTC), Advanced Surgical Skills for Exposure in Trauma (ASSET), etc. [10-12]. An analysis of the learning outcomes of such courses indicates their high efficiency in comparison with other methods. Thus, in the study by D.J. Anastakis et al. three groups of resident surgeons were trained in six general surgical operations according to one of three programs: 1st group - cadaver course, 2nd - simulator course , 3rd - theoretical course using guidelines. Surgeons trained in the cadaver course showed the best results in the study [13]. A Canadian study by F. LeBlanc et al., which compared cadaver training with training on a virtual ProMIS simulator, showed an absolute advantage of the cadaver course over the simulation one [14]. In our country, the MMAWI (russian-CMAPT) program (Modern methods and algorithms for the treatment of wounds and injuries) has been successfully introduced. It was developed by the specialists of S.M. Kirov Military Medical Academy and includes work with laboratory animals, cadaver material and simulators as part of the Damage Control tactics.

It should be noted that mainly cadaver courses are developed for practicing doctors and surgeons with experience. As a rule, they are not available for beginner specialists and, especially, students. C.E. Lewis et al. in 2012, having conducted a meta-analysis, found that students were involved to work with cadaver material in only 1 of 15 studies, while the rest involved only doctors and residents [15].

In our opinion, conducting a cadaver course at the stages of professional training of students made it possible to achieve both a high level of practical skills in comparison with clinical residents, and a sufficient degree of confidence in their own skills. These results, in our opinion, were obtained largely due to the stages of training: from observation of the mentor to assistance, and then to the independent implementation of individual surgical techniques and, finally, the entire intervention. Thus, the future specialist "from the student's days" develops the skills to "feel" the tissues, quickly achieve an adequate exposure of the operating field and follow the principle of "sheathing" during dissection. This undoubtedly helps to reduce the influence of the stress factor in the conditions of urgent surgery. A young specialist, having completed such a course and coming to residency, will be able to build up practical skills in a more orderly and systematic manner and more easily perceive the high level of a surgeon responsibility.

CONCLUSION

Students who completed the training course under the original program "Cadaver Course of Operative Surgery for Severe Combined Trauma" showed a higher level of practical skills than clinical residents trained according to the traditional system. However, the small sample did not allow us to formulate specific conclusions. Our work only provides an opportunity for a wider introduction of the cadaver course in the educational process, further study of the results of using this methodology and sets the task of improving the regulatory framework in this area.

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Received on 21.02.2020

Review completed on 20.04.2020
Accepted on 29.09.2020