

KNOWLEDGE ON USE OF ELECTROTHERAPY AMONG NURSING AND URGENT HEALTH CARE STUDENTS

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Abstract: Abstract Defibrillation, cardioversion and cardiostimulation are the three most important procedures that use electric current in urgent and intensive care. Healthcare students start to study this issue during their Bachelor's studies. The objective of the present study was to identify and compare knowledge on the specifics of defibrillation, cardioversion and cardiostimulation in the third-year students of Urgent Health Care and Nursing. The research method was a non-standardised questionnaire. The data was analysed by the absolute and relative frequency, and chi-squared test. The sample consisted of 390 third-year students of Urgent Health Care and Nursing. Results: Overall, the students had 5,753 (86.77 %) correct and 877 (13.22 %) incorrect answers. More correct answers were given by the Urgent Health Care students. The difference was statistically significant at the value of the chi-squared test ($\chi^2(1.6630) = 30.639$; $p < 0.001$). Conclusion: Electrical therapies are life-saving medical procedures; every healthcare professional should have knowledge on them.

Keywords: cardioversion, cardiostimulation, defibrillation, urgent health care, nursing, student

1 Introduction

The essence of electrical therapy is the repeated rhythmic stimulation of the heart by electric current, supplied to the heart by an electrode from an external source. The tissue in the body behaves as an electrolyte which is an appropriate conductor of electric current. A prerequisite for successful electrical therapy is oxygenated myocardium. During contractions, cardiac muscle cells exhibit weak electrical tension. The slight potentials of a number of fibres are summed up and generate electrical tension that can be measured and taken on the surface of the body using an electrocardiograph (hereinafter ECG). The ECG curves can provide a lot of important information about the cardiac muscle activity and condition. On the other hand, an electrical shock can affect an impaired cardiac activity, and thus normalise it. Electrical therapy is also used in less severe heart rhythm disorders which do not result in the circulation failure immediately, but the patient is threatened by them. In this case, the patient is conscious and total desensitisation is required during an electrical shock (Dobiáš, 2012a). Defibrillation is defined as passage of electric current through the cardiac muscle. Its role is to eliminate the pathological electrical activity of the heart – ventricular fibrillation and non-pulsatile ventricular tachycardia. The defibrillation discharge represents an urgent solution to the cardiac arrhythmias. The cause of the non-physiological electrical activity of the heart is an impulse coming out from a location other than the sinoatrial node of the transmission system of the heart. Currently, the market offers monophasic and biphasic defibrillators. The difference between these two defibrillators is the time in which the voltage returns. The biphasic defibrillators are preferred. The reason is the lower defibrillation threshold. An important step is the adequate adjustability of the shock; in case of an inadequate setting, the desired effect would not be achieved, and therefore the arrhythmia would not be ended. A low gradient is insufficient, and a too high charge can cause damage to the myocardial muscle (Vančura, Rokyta, 2014). A biphasic defibrillator will give a lower energy shock than monophasic, and despite that it can still end ventricular fibrillation. The shock of 115-130 J given by a biphasic defibrillator has a greater effect than the shock of 200 J by a monophasic defibrillator. The monophasic defibrillator would have the same effect when charged to 360 J; also it has too short voltage duration. The biphasic defibrillators are used more often, because they are more compact, cheaper and more explored. Defibrillation itself can be classified as a

significant part of cardiopulmonary resuscitation (Dobiáš, 2012b). "Cardiostimulation is a therapeutic procedure used to treat bradycardia. It uses the principle of low voltage direct current. An electrical stimulus is sent from a pacemaker from one or more electrodes" (Bednáriková, 2012, p. 16; translated by the study authors). Synchronised electrical cardioversion (hereinafter SEC) is a therapeutic procedure used when the heart rhythm is irregular. The SEC indications are irregular rhythms such as fibrillation, atrial flutter and ventricular tachycardia. The result is an improvement in the manifestations of arrhythmias and haemodynamics, and a lower risk of thromboembolic events. Atrial fibrillation is the most frequent heart rhythm disorder. The SEC is an electric shock, carried out at the peak of the R oscillation, which in short time interrupts numerous so-called re-entry circuits while the activity of other bearings disappears (Remeš, Trnovská et al., 2013). Cardiostimulation should be adapted to each patient individually. If the patient has a stable pulse, the fixed frequency mode is set, i.e. the impulses are transmitted at the same level. If necessary, a pacemaker may transmit stimuli according to the patient's needs, i.e. in the absence of the stimulus, or if the impulse is slow. During physical exertion, it automatically increases the stimulation of the heart. Pacemakers are categorized as temporary and permanent. The temporary pacemakers are external, and the permanent pacemakers are implanted infraclavicularly on the left into the subcutaneous tissue. Complications of external cardiostimulation include the isolation failure and electrode break, also there is a risk of thrombosis and infection (Novotná, Majerníková 2010). The students of healthcare fields learn about the aforementioned life-saving conditions both theoretically and practically during their Bachelor's studies.

The objective of the present study was to identify and compare knowledge on the specifics of defibrillation, cardioversion and cardiostimulation in the third-year students of Urgent Health Care and Nursing.

2 Materials and Methods

The research method was a self-developed non-standardised questionnaire with 17 multiple choice questions. The questionnaire was divided into three thematic areas. The first one was the area on defibrillation with seven questions, the second area was on cardioversion with five questions, and the third part was on cardiostimulation with five questions. There was one identification question to find out the study field. The participants chose one response from the possible alternatives. The sample consisted of 390 third-year students of Urgent Health Care (220) and Nursing (170) in the Slovak Republic. The study was conducted in 2017 and 2018, and students' participation was voluntary. Data analysis methods were absolute and relative frequency. We used the descriptive statistical procedures to analyse the obtained data, and processed the responses using qualitative analysis. To compare the knowledge in the students of Urgent Health Care and Nursing, we used the chi-squared test.

3 Results

The first area of knowledge was on defibrillation, in which we focused on defining the procedure, defibrillation rhythm, first shock strength in biphasic defibrillation, electrode placement, a pause between rhythm analyses, the principles of proper manipulation with the automated external defibrillator (AED), and shock strength in a child weighing 4 kg. A specific degree of knowledge is shown in Table 1.

Table 1 Degree of students' knowledge on defibrillation specifics

Defibrillation	Correct answers		Incorrect answers	
Defining the procedure	351	(90 %)	39	(10 %)
Defibrillation rhythm	339	(86.92 %)	51	(13.08 %)
First shock strength in biphasic defibrillation	390	(100 %)	0	(0.00 %)
Electrode placement	351	(90 %)	39	(10 %)
Pause between rhythm analyses	370	(94.87 %)	20	(5.13 %)
Principles of proper manipulation with the AED	361	(92.56 %)	29	(7.44 %)
Shock strength in a child weighing 4 kg	311	(79.74 %)	79	(20.25 %)

There was a total of 2,473 (90.58 %) correct answers and 257 (9.42 %) incorrect answers related to defibrillation specifics.

The second area of knowledge related to cardioversion, in which we focused on defining the procedure, complications, contraindications, biphasic shock strength, and an interval between shocks. A specific degree of knowledge is shown in Table 2.

Table 2 Degree of students' knowledge on cardioversion

Cardioversion	Correct answers		Incorrect answers	
Defining the procedure	199	(51.02 %)	191	(48.98 %)
Complications	281	(72.05 %)	109	(27.95 %)
Contraindications	331	(84.87 %)	59	(15.13 %)
Biphasic shock strength	339	(86.92 %)	51	(13.08 %)
Interval between shocks	390	(100 %)	0	(0.00 %)

There was a total of 1,540 (78.98 %) correct answers and 410 (21.26 %) incorrect answers related to cardioversion.

The third area of knowledge related to cardiostimulation, in which we focused on defining the procedure, the use of external cardiostimulation, setting an external pacemaker, complications of an external pacemaker, and cardiostimulation electrodes. A specific degree of knowledge is shown in Table 3.

Table 3 Degree of students' knowledge on cardiostimulation

Cardiostimulation	Correct answers		Incorrect answers	
Defining the procedure	298	(76.41 %)	92	(23.59 %)
Use of external cardiostimulation	370	(94.87 %)	20	(5.13 %)
Setting an external pacemaker	390	(100 %)	0	(0.00 %)
Complications of an external pacemaker	370	(94.87 %)	20	(5.13 %)
Cardiostimulation electrodes	312	(80.00 %)	78	(20.00 %)

There was a total of 1,740 (89.23 %) correct answers and 210 (10.77 %) incorrect answers related to cardiostimulation.

Furthermore, our objective was to compare knowledge on electrotherapy between the Urgent Health Care students and the Nursing students. The numerical data on the responses is shown in Table 4.

Table 4 Comparison of degree of knowledge between Urgent Health Care students and Nursing students

Students' responses	Correct answers		Incorrect answers		Total
Urgent Health Care	3,321	(88.80 %)	419	(11.02 %)	3,740
Nursing	2,432	(84.15 %)	458	(15.85 %)	2,890
Total	5,753	(86.77 %)	877	(13.22 %)	6,630
Chi-squared test	30.639; $p < 0.001$				

There was a total of 5,753 (86.77 %) correct answers and 877 (13.22 %) incorrect answers in all three areas.

When comparing the frequency of the correct answers in the Urgent Health Care students and the Nursing students, we found out that the Urgent Health Care students significantly more frequently (χ^2 (1.6630) = 30.639; $p < 0.001$) stated correct answers (88.80 %) than the Nursing students (84.15 %).

4 Discussion

We use electric current both in everyday life and in medical disciplines. Almost every person has negative connotations in relation to this concept, but in these frameworks it is possible to speak about its positives in providing health care, provided that certain safety measures are taken. "An electric current is defined as the movement of electrically charged carriers, in an electrical circuit, consisting of two places with different electrical potentials (electrodes) connected by a conductor (tissue)" (Poděbradský, Poděbradská, 2009, p. 59; translated by the study authors). Electrons moving in the crystal grid of metals allow the flow of electric current in metal conductors. The fundamental unit of the flow of electric charge is ampere. Electrical therapy is a physical-based therapy, used in defibrillation, cardioversion, cardiostimulation, and others (Königová, Bláha et al., 2010).

Defibrillation is part of cardiopulmonary resuscitation, according to Vančura and Rokyta (2014). Therefore, it is necessary for students of healthcare fields not only to define the procedure but also to characterise the defibrillation rhythm, and to know exactly the first shock strength in an adult and a child, the exact placement of electrodes, and the length of pauses between individual rhythm analyses. The total 90.58 % success rate in the students' responses is a positive result. The students had the worst degree of correct answers in the question on shock strength in a four-year-old child. This result reflects a more prominent focus of the study programmes on adult patients than children. Kozuharov, I. et al. (2014) state that the cardiac resynchronization therapy at the childhood represents 0.5 – 1 % from the total number of implantations of cardiostimulators. The principles of proper manipulation with the AED were correctly stated by 92.56 % of the students, but we expected a higher degree of correct answers, given the presentation of the said procedures not only for professionals but also lay people (Dobiáš, 2011). Rapid defibrillation by nonmedical personnel using an automated external defibrillator can improve survival after out-of-hospital cardiac arrest due to ventricular fibrillation. Intervals of no more than three minutes from collapse to defibrillation are necessary to achieve the highest survival rates (Valenzuela, et al., 2000).

The interruption of the various supraventricular and ventricular tachyarrhythmias, in which cardiac output is maintained at a sufficient level, can be carried out by pharmacological or electrical cardioversion (Vančura, Rokyta, 2014). The said intervention is most often performed in intensive care units; the more severe the symptoms of arrhythmias, the more urgent the indications (Dobiáš, 2011). In the study, we focused on the students' knowledge on defining the intervention, complications and contraindications in patients, and the technical parameters related to biphasic shock strength and the interval between shocks. A surprising finding was that only a half (51.02 %) of the answers were correct in defining the procedure, but there were up to 100 % of correct answers in identifying the interval between shocks. Related to the statement (Morrow, Antman, 2000) that electrical cardioversion is an important treatment for the survival of patients with cardiac arrest due to ventricular tachycardia or fibrillation.

External cardiostimulation is a treatment method used in serious life-threatening bradycardias. One of the causes of bradycardia and also an indication of cardiostimulation is sick sinus syndrome. The disease resides in a sinoatrial node which does not adequately stimulate the electrical impulses of the myocardium. The result is bradycardia. The procedure of the insertion of an external pacemaker includes the insertion of a stimulation electrode into the right ventricle of the myocardium. At the other end there is an external pacemaker which makes it possible to set the parameters. The heart rate and heart voltage are set (Vančura, Rokyta, 2014). Another method of stimulating the myocardium is transthoracic cardiostimulation. Stimulation is done with the use of self-adhesive electrodes attached to the patient's chest. It is indicated for bradycardia not responding to pharmacological treatment, an atrioventricular block of the 2nd degree which is haemodynamically unstable, an atrioventricular block of the 3rd degree, "sick sinus syndrome", and in carotid sinus hypersensitivity syndrome (Bulíková, 2010). The overall degree of students' knowledge on the said method of electrotherapy was 89.23 %. The students encounter the said method during their clinical training most often, and we expected a higher degree of correct answers.

The aim of electrical therapy is to restore the rhythm and improve the symptoms (Remeš, Trnovská et al., 2013). Very often it is part of the cardiopulmonary resuscitation in the patient. "Cardiopulmonary resuscitation is a set of procedures to restore failing or failed vital functions" (Tischler, 2017, p. 106; translated by the study authors). In Europe, the most common causes of circulatory failure are cardiac disorders, with the prevalence of more than 80 % (Tischler, 2017); and electrotherapy is an effective option how to save a patient or affect patient's quality of life.

5 Conclusions

The questions verifying the knowledge on the specifics of the use of electrotherapy were answered in most of the answers correctly; only the low number of students had incorrect answers. The biggest problem was the question on defining cardioversion. The knowledge that addressed the issues of cardiostimulation was answered correctly by most respondents. Similarly as in the previous findings, also in this case, we found out the highest error rate in defining cardiostimulation. We found out that the most problematic questions for the students were those on the professional definitions of the terms, particularly in case of cardioversion and cardiostimulation; the questions on technical performance of the procedures were answered correctly, and in a high rate. On the basis of the information, it can be stated that students have good knowledge on electrical therapy in intensive care. To improve students' knowledge, we suggest to increase the number of lessons on urgent and intensive care in cardiology, to develop modern methodological materials with the use of e-learning, and to provide interactive selective seminars focused on defibrillation, cardioversion, and cardiostimulation. Electrical therapies in emergency and intensive care in cardiology are life-saving

medical procedures, and every healthcare professional should have knowledge on them.

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