

What we know about neonatal resuscitation? Randomized survey study

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Received: 2013.08.12 • Accepted: 2013.09.24 • Published: 2013.09.30

Summary

Introduction. Right after birth, approximately 10% of newborn infants need interventions making lung aeration and breathing commencement easier, whereas full resuscitation process is required in the cases of fewer than 1% of neonates. As the necessity of resuscitating cannot always be foreseen, a person trained to perform such operations should be present at each childbirth.

Purpose. The objective of this paper was to investigate the knowledge on resuscitating newborn infants among medical rescue staff.

Methods. The research was conducted among 482 people working in emergency medical services in Poland. The investigation took place in the period of January 2011 to June 2012. The method used was a randomized questionnaire requiring knowledge on neonatal resuscitation.

Results. 76% of the staff under investigation knew the time boundaries for using the term “neonatal”. All of the responders had knowledge on the resuscitation process (64-96%) and the compression to ventilation ratio in resuscitating newborn infants (60-99%). The group of nurses, in comparison to doctors and medical rescue workers, had significantly poorer knowledge on the following issues: atropine dose (24% vs 84% vs 86%), defibrillation energy (49% vs 100% vs 100%) and size of intubation tube (23% vs 9% vs 95%).

Conclusions. There is an urgent need to introduce mandatory training in neonatal resuscitation medical professionals. Among the best-studied groups of newborn resuscitation are prepared paramedics, while the worst nurse.

Key words: resuscitation, newborn, knowledge, medical personnel.

Introduction

Performing cardiopulmonary resuscitation of a newborn infant whose life is in danger, one essentially has to be aware of the anatomical differences of “little human beings” as well as the distinctness of the operation procedures in that situation [1-3]. The proper ability to assess vital signs and secure the airways patency as well as

lung aeration are a priority of the operation, as further steps may prove ineffective regardless of the cause of threat if the aforementioned actions are undertaken improperly or delayed.

In the case of circulatory arrest in neonates, pharmacotherapy may be necessary when chest compression and ventilation performed on little

patients bring no improvement of their state. In such a case, the lack of knowledge on medicine application, its doses and possible results is utterly unacceptable [4,5]. The number of applicable agents as well as their maximal concentration are strictly limited because of the different metabolism that is often disturbed in the cases of neonates in need of a medical intervention. Because of the fact that neonatal resuscitation is a difficult task and it requires a different kind of knowledge that in the case of adults, the each member of medical staff should be under obligation to take specialised courses.

Unfortunately, the professional literature is hardly ever concerned with cardiopulmonary resuscitation of newborn infants in the practice of medical emergency staff. Due to that fact, the introduction of means to assess medical rescue workers' knowledge on advanced newborn resuscitation procedures appears to be a sensible option.

It was to attempt to assess the knowledge of medical emergency staff on advanced newborn resuscitation procedures.

Methods

The investigation was conducted among the group of 482 people working within the Medical Rescue System. The period of the research was January 2011 to June 2012. 85 doctors, 140 nurses and 257 medical rescue workers took part in it. The age of the responders was between 21 and 65, its average being 30.19 years of age (SD \pm 7.2). The male to female ratio was 1:1. The most numerous group (32%) were the responders, whose work experience was between 5 and 10 years.

The method of the research was a diagnostic poll and more precisely – the questionnaire technique. The research instrument was a survey prepared specifically for the sake of this research. It was divided into a socio-demographic part (5 questions) and a theoretical part (18 questions).

The responders were divided into three groups depending on their profession. Group no 1 were doctors specialised in rescue medicine or those who graduated from the second year of it (n=85; 18%). The second group were nurses (n=140; 29%), and the third – medical rescue workers (n=257; 53%).

The research findings were coded in Microsoft Excel and processed in STATISTICA 8.0 statistic software package. The normality of variable distribution was measured using statistical significance p for the Kolmogorov-Smirnov test. In the case of distributional normality, the average discrepancies were subjected to the t-Student test. In order to assess the differences between the groups, a non-parametrical test was utilized. The statistically significant differences between the groups were measured using a non-parametrical Kruskal-Wallis test for independent groups (H). The results were considered statistically significant when p was below 0,05.

Results

The purpose of the first question was to obtain information on the self-assessment of the responders' knowledge on cardiopulmonary resuscitation of newborn infants. The interviewees could choose a grade between 1 and 5, "1" signifying lack of knowledge and "5" – vast knowledge. The average self-assessment grade amounted to $4,26 \pm 0,69$ point, while the group to claim the highest grade were group 2 – 4.74 points, the lowest self-assessment was obtained in group 3 – 3.91 points (Figure 1).

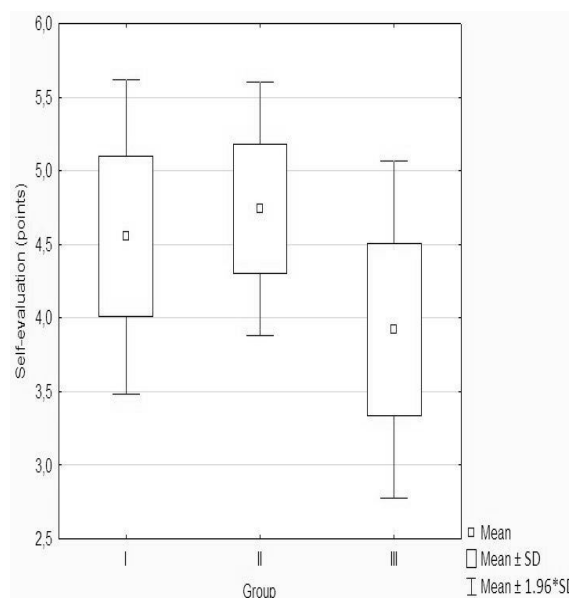


Figure 1: Average self-respondents on knowledge of neonatal resuscitation.

The analysis indicated statistically significant discrepancies in different groups' self-assessment (H=170.3084; p=0,000).

The interviewees were asked about their past participation in a course on cardiopulmonary resuscitation of newborn infants. 359 people (74%) declared they had participated in such a course. In the group 1, the percentage of people having participated in an NLS (newborn life support) course was 100%, in group 2 – 27% and in group 3 – 92% (H=234.3899; p=0,000). Moreover, the responders were asked if in their opinion NLS courses should be obligatory for medical staff. 87% of the interviewees' responses were positive, whereas 13% (n=64) decided that the courses should only be compulsory for the staff working at neonatological and paediatric units (H=164.7149; p=0,000).

Yet another question served to test the responders' knowledge of the term "neonate" and it pertained to the time boundaries in which that term can be applied to an infant. 367 people (76%) knew the correct definition – "neonates" are newborn infants of no more than four weeks of age. The greatest percentage of correct answers was obtained in group 3 – 91%, followed by group 1 – 89% and group 2 – 41% (H=136.1262; p=0,000).

The procedures undertaken right after a child is born include the evaluation of the neonate according to the Apgar score. 87% of the responders were capable of listing the criteria evaluated during that procedure. In group 1, 89% of answers were correct, in group 2 the count was 76%, and in group 3, 92% of correct responses were obtained. (H=21.04285; p=,0000).

The interviewees were also asked about the values of physiological parameters of newborn infants. The correct range of breaths per minute was indicated by 81% of the responders. The most correct responses were collected in group 1 (89%), followed by group 3 (85%) and group 2 (69%; H=18.88224; p=,0001). 84% of the interviewees (H=53.72705; p =,0000) knew the correct range of the neonates' heart rate. The detailed distribution of correct answers in each group can be observed in Table 1.

Moreover, the interviewees were asked what is the only indication of the need for the suction of oropharyngeal cavity in the cases of neonates born with asphyxia. The correct answer is the presence of thick meconium in the neonate's oro-

pharyngeal cavity, a response that was offered by 76% of the interviewees. The highest percentage was reached in group 3 – 92%, followed by group 1 – 89%. The percentage of correct answers was the lowest in group 2, in which it reached merely 39% (H=147.4290; p=0,000).

The following task was to indicate a correct sequence of cardiopulmonary resuscitation of newborn infants. 87% of the interviewees knew that the process should be initiated by 5 rescue breaths (94% of group 1, 64% of group 2, 96% of group 3; H=83.60858; p=,0000). The correct compression to ventilation ratio (3:1) was indicated by 87% of the responders as well. The interviewees in groups 1 and 3 were almost immaculate (99% and 98%, respectively). In the second group, merely 60% of the answers were correct (H=129.4000; p=0,000).

A crucial element of neonatal CPR is performing the initial 5 rescue breaths correctly. In order to inflate a newborn infant's lungs, such a breath should involve additional 2 or 3 seconds of pressure. 398 responders knew for how long should the extra pressure in neonate's airways be maintained. The highest percentage of right answers were obtained in group 3 (97%), whereas the lowest one was a result in group 2 (54%; H=114.8481; p =0.000).

In order to avoid excessive distention of neonate's alveoli, one should limit the inspiratory capacity to 4-8 ml/kg. The correct value was indicated by 71% of the interviewees; group 1 was correct in 92%, group 3 in 90%, and group 2 only in 24% (H=210.9414; p=0,000). 74% of the responders were familiar with the formula used for the selection of intubation tube. The percentage of correct answers in groups 1 and 3 was similar and amounted to 96% and 95%, respectively. Merely 23% of group 2 responded correctly (H=272.5018 p=0.000).

The next task required the participants to indicate the defibrillation energy level used for neonatal ventricular fibrillation. The correct value of 4 J/kg was the choice of 85% of the interviewees (n=411). Group 1 and group 3 were flawless (100% correct answers in each). In group 2, less than 50% of people were correct (n=69, 49%; H=202.9830; p=0.000).

The answers for the following questions were to indicate the participants' level of knowledge on applying pharmacological chemicals during the resuscitation of infants. First the interviewees were asked to state what is the adrenaline dose applied intravenously during neonatal CPR. In 89% of cases (n=414) the response was correct: 10-30 µg/kg. In group 3 all of the answers were correct; in group 2, 93% of them were right, whereas only 74% of group 1 were able to indicate the correct answer (H=75.53585; p=0.000).

The next tasks examined the responders' knowledge of the atropine dose required if neonatal ventricular fibrillation is observed. 84% of them knew, that the latest ERC2010 guidelines discourage using atropine during the resuscitation of paediatric patients (H=204.2063; p=0.000). As it was in the case of the previous question, group 3 was correct in 100%. Only 65% of the interviewees knew the atropine dose that may

result in paradoxical bradycardia (<100 µg). The correct answers were the most numerous in group 3 – 86%, followed by group 1 – 84%, and group 2 – 24%.

The responders were also asked to indicate the sodium hydrogen carbonate dose in the resuscitation of newborn infants. 74% of the interviewees correctly stated that it is 1-2 mmol/kg. The distribution of correct responses in each group was: 93% in group 1, 35% in group 2 and 89% in group 3 (H=156.9361; p=0,000).

The final question required the participants to indicate the correct fluid capacity used during neonatal fluid resuscitation. 74% of them correctly chose the answer 10ml/kg. In group 1 91% of responses were correct, whereas in group 2 40% of them were right. In group 3 it was 84% (H=119.3540; p=0,000).

Table 1: Statement of correct the replies given by respondents.

Question	Group I (n=85)	Group II (n=140)	Group III (n=257)
Participation in a course on advanced infant resuscitation procedures	100%	27%	92%
Should a course on neonatal resuscitation be compulsory for all medical staff?	98%	56%	100%
The term "neonate"	89%	41%	91%
The criteria of Apgar score	89%	76%	92%
The correct number of breaths per minute	89%	69%	85%
The correct heart rate of neonates	91%	64%	92%
The indication of the immediate need for the suction of oropharyngeal cavity in the cases of neonates born with asphyxia	89%	39%	92%
Neonatal resuscitation sequence	94%	64%	96%
The compression to ventilation ratio	99%	60%	98%
The time that the initial rescue breaths should last	86%	54%	97%
The right inspiratory capacity of neonates	92%	24%	90%
The size of intubation tube	96%	23%	95%
The defibrillation energy	100%	49%	100%
The adrenaline dose during neonatal CPR	93%	74%	100%
The atropine dose during neonatal CPR	98%	47%	100%
The atropine dose that may result in paradoxical bradycardia	84%	24%	86%
The sodium hydrogen carbonate dose in the CPR of newborn infants	93%	35%	89%
The fluid capacity during neonatal fluid resuscitation	91%	40%	84%

Discussion

In the practice of medical rescue teams, interventions in cases of cardiac arrest are very common. That state requires vast knowledge of the medical staff as well as the ability to use it in practice, as each minute of delay in undertaking resuscitation procedures decreases the chance of the patient's survival by 10-12% [2,6-8]. Medical rescue staff should be aware of the fact that there is a difference between resuscitating an infant and an adult. The physiological, anatomical and even pathophysiological discrepancies condition those differences in resuscitation procedures.

As it was mentioned before, specialist literature only rarely deal with the matter of neonatal cardiopulmonary resuscitation in the practice of medical rescue teams, unfortunately. Therefore it is difficult to compare the results obtained here with the outcomes of other authors' research.

Medical staff are under obligation of continuous education, which means they have to keep expanding their knowledge on medical aid in its broad sense. One of the forms of performing that duty are professional courses, also on resuscitating newborn infants. In the material under investigation, 74% of the interviewees declared having participated in this kind of courses. Similar results were obtained by Waisman [9]. The lowest score was observed by Goddet *et al.* – 51.3% [10].

The self-assessment of the medical rescue staff in the material was quite high and amounted to 4.26 points. The highest self-assessment was observed in the case of nurses (4.74 points). In that group, there was a large discrepancy between self-assessment results and the outcomes of the questionnaire. Therefore, one can conclude that nurses tend to overestimate their knowledge on neonatal resuscitation. In the cases of doctors and medical rescue workers, the actual level of knowledge was higher than their self-esteem.

The correct use of nomenclature is of utter importance in rescue medicine. 76% of the people under research knew that the term “neonate” can be applied if a child is of no more than 4 week of age. The percentage of correct answers varied from 41 to 91%. Medical rescue workers achieved the best result, while nurses' percentage was the

lowest one. The knowledge on Apgar score constituents proved to be slightly more common. The Apgar score is used to evaluate the state of newborn babies and it is commonly utilized worldwide. Immediately after cutting the umbilical cord connecting child and the mother, a neonate is evaluated on the five criteria (skin colour, reflex irritability, pulse rate, breathing and muscle tone) and for each element of those components, 0, 1 or 2 points are granted. Infants are tested in that way three times – in the first, third and tenth minute of their lives [11-13].

As mentioned, the evaluation of a child (including neonates) requires medical staff to know the values of vital signs that are different than in the case of adults. The physiological breathing standard of a neonate is 30 to 60 breaths per minute. 81% of the responders had knowledge on that matter. In the case of heart rate, which around 140/minute in neonatal period, the answers were correct in 84%. Nurses were the group to indicate wrong breathing frequency and heart rate most often.

Medical staff is often forced to deliver on the spot, be it the house of the pregnant woman or a public place. Babies are often born with asphyxia. The directives of ERC2010 mention only one indication of a need for performing a suction of oropharyngeal cavity on a neonate with asphyxia[2]. That indication is the presence of thick meconium in the neonate's oropharyngeal cavity. Merely 76% responders were able to point out that exception.

The directives of the European Resuscitation Council contain procedure algorithms for situation when life is in danger, including cardiac arrest. Currently, the resuscitation of newborn infants has to be initiated by 5 rescue breaths, then the compression and ventilation must be continued with the ratio of 3:1 [14]. The vast majority of the participants (87%) had knowledge on that matters. Furthermore, doctors were the most correct (99%), medical rescue workers followed (98%) and nurses did fairly poor (60%). Grześkowiak *et al.* showed that merely 21.4% of nurses were able to perform closed chest massage on an infant, whereas in the case of doctors the percentage was 80.8% [15]. Much lower indicator of the knowledge on neonatal resuscitation was obtained by Murila *et al.* – 35.4% [16] as

well as Rojas *et al.*, who rated the knowledge on resuscitation sequence in the group of general practitioners to be as low as 12% [17].

A crucial element of advanced neonatal resuscitation procedures, compressions or rescue breaths excluded, is pharmacotherapy. Bearing in mind the fact that in the case of infants, the medicine doses are different than those applied to adults and calculated using a child's weight, the knowledge of neonatal pharmacotherapy appears to be a matter of utmost importance. For instance, the adrenaline dose used for neonatal resuscitation is 10-30 µg/kg [2,8,14]. In this research, 89% of participants knew what the intravenous dose of adrenaline is (in the doctor group, it was 93%, nurses – 74%, medical rescue workers – 100%). Those results were confirmed by other authors' studies: Goddet *et al.* – 89.3% [10], Heitmiller – 89% [18].

Similar to the above was the outcome of testing the knowledge of the atropine dose. 84% of interviewees were positive that the latest ERC2010 directives do not recommend the application of that chemical. The responders had the greatest difficulties with the sodium hydrogen carbonate dosage. 74% of the people under research chose the correct dose of 1-2 mmol/kg. The participants were equally familiar with the fluid capacity dur-

ing neonatal fluid resuscitation. In the study of Durojaiye *et al.*, 52% of the subjects had the knowledge on fluid resuscitation of paediatric patients [19]. In the research of Grześkowiak *et al.*, only 45% of nurses could name the correct fluid capacity in neonatal fluid resuscitation, whereas in the case of doctors that percentage amounted to 100% [20].

Despite the fact that in most of the cases the cause of neonatal cardiac arrest is the obstruction of airways, there are times when medical staff observes ventricular fibrillation or ventricular tachycardia with no pulse on the EKG scan. In that case, the defibrillation is usually performed. The correct energy level for a paediatric patient is 4 J/kg. The vast majority of participants (85%) were aware of that, the score which exceed those obtained by other authors: Durojaiye *et al.* – 61% [19] and Goddet *et al.* – 57.2% [10].

Conclusions

Nurses' limited knowledge on neonatal resuscitation stresses the urgent need for intensifying the training and courses in this profession. On the basis of the research, one can conclude that the best prepared group for resuscitating newborn infants are medical rescue workers and system doctors.

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