The Egyptian Journal of Critical Care Medicine (2016) 4, 17–23

The Egyptian College of Critical Care Physicians

The Egyptian Journal of Critical Care Medicine

http://ees.elsevier.com/ejccm
www.sciencedirect.com

REVIEW

Simulation for ECLS

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Received 18 February 2016; revised 21 February 2016; accepted 22 February 2016
Available online 2 March 2016

KEYWORDS

ECLS;
Simulation

Abstract The indication and usage for Extracorporeal Life Support (ECLS) has increased significantly over the last 10 years, and more and more hospitals are now offering this service. Despite this trend, ECLS is a mature "daily business" in only a few centers.

In this context, the importance of simulation in the field of ECLS must be strongly emphasized for the following reasons:

- Infrequent use of the technology requires practicing of routine actions on ECLS, as necessary preparation for the moment that it will be actually used,
- Emergencies on ECLS are fortunately even rarer than its practice, but are potentially fatal and call for repetitive and frequent training targeting at identifying, interacting and solving these problems.

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Peer review under responsibility of The Egyptian College of Critical Care Physicians.

ELSEVIER Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.ejccm.2016.02.005
2090-7303

1. Introduction

The history of simulation spans back over several centuries. The game of chess (described in the sixth century AD) is considered to be one of the earliest attempts at simulating a battlefield environment in order to develop efficient tactics and strategies [1]. Over time, different approaches and training opportunities have developed, especially in the military, including early simulation tools such as the "Rolland" mannequin used for training knights to jousting and mounted combat.

At a more elaborate level, the aviation industry started using simulation techniques in 1929 [2], acknowledging the need of advanced practical training in a safety critical environment.

But only in the 1960 s did medical education simulators first appear, utilized primarily in resuscitation, and subsequently in anesthetic and clinical skills training [3]. It required some further time until the popularity of simulation in medical education really took on, to the point that it has now been increasing exponentially over the last 15 years. The scientific interest in this field has advanced accordingly, as demonstrated by publications about medical education showing a growth from less than 10 publications a year in the early 1990 s to over 130 publications in 2003 [4].

Simulation in the context of medical education can be defined as an education technique that allows interactive activity by recreating all or part of a clinical experience, without exposing patients to the associated risks [5].

There are many types of simulation and associated tools, with varying levels of details, realism, complexity or interactivity, leading to the natural question of what is needed and why.

But a still very valid and up to date quote from Professor David Gaba, Patient Simulation Center, Stanford University, summarizes the undisputed need for simulation in medicine:

> *"No industry in which human lives depend on skilled performance of responsible operators has waited for the unequivocal proof of simulation before embracing it"*

Often enough, high cost and unavailability of a highly equipped simulation center are used as an excuse not to start any type of simulation based training.

But efficient simulation for training and education does not necessarily entail such sophisticated and expensive setups. The question should rather be: what are the available tools to support and improve our training and education programs?

A highly complex but still not "every-day" used technology such as Extracorporeal Life Support (ECLS) is especially exposed to the risk of difficulties or disaster. The fact that the life of a person is completely dependent on the ECLS machine makes it absolutely mandatory to operate this equipment as safely and smoothly as possible, and to be able to react to complications in a fast, safe and professional manner. In such a context, simulation plays an important role in acquiring and maintaining skill sets, sharpening the awareness of potential problems, practicing resolution and avoidance of those problems, and implementing a team concept approach.

This article will describe different methods of simulation for ECLS with their different purposes (skill sets, problem identification, team approach, etc.), and identify their advantages as well as shortcomings.

2. Task trainer

For many purposes, especially for learning particular tasks and skills, it is only necessary to replicate specific portions of an action. Task physical trainers provide just the key elements of the procedure or skill being learned. While they cannot fully replicate performing the task on real patients, they do allow learners to acquire the basic skills needed to then be taught the finer points of doing the procedures under supervision and the skill set can be applied safely in real life. Examples of task trainers are shown in Figs. 1 and 2.

Although emergencies rarely occur in ECMO, it is nevertheless imperative to train physicians, technicians and nurses for such emergency situations as pulmonary embolism, or pump/oxygenator failure. For these scenarios, task training like removing the air from the circuit, changing to hand crank/different pump or oxygenator changes should be used during water lab drill to ensure the team is familiar with the utilized equipment and can safely handle the rare occurrence of the type of emergency considered in the scenario.

In our institution we further used the water lab drill session to develop algorithms for these scenarios, in order to define a standard action/procedure and train on its performance. Once settled, these algorithms can be later printed, laminated and displayed on the ECMO crash cart (Fig. 3).

Figure 1 Task trainer for intubation.

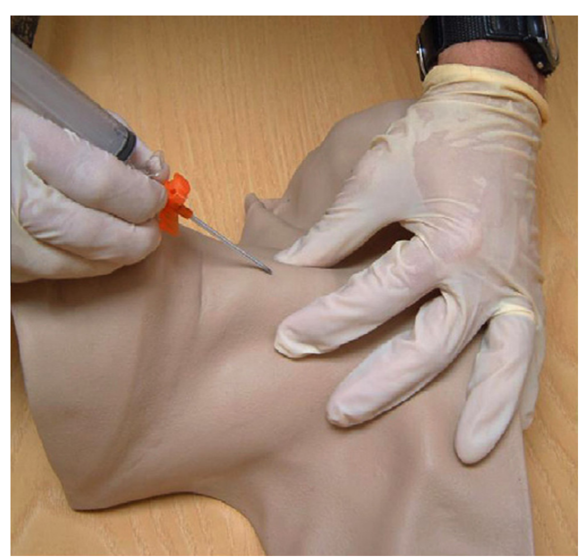

Figure 2 Task trainer for cricothyroidomy.