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Respiration and the Airway

Suitability of a preserved human cadaver model for the simulation of facemask ventilation, direct laryngoscopy and tracheal intubation: a laboratory investigation

Z. Szűcs[1], C. J. László[4], G. Baksa[3], I. László[4], M. Varga[2], A. Szuák[2], Á. Nemeskéri[2] and E. Tassonyi[4,*]

[1]Department of Anaesthesia and Intensive Therapy, Péterfy Street Hospital and Trauma Centre, Budapest, Hungary, [2]Department of Human Morphology and Developmental Biology, Clinical Anatomy Research Laboratory, [3]Department of Anatomy, Histology and Embryology, Semmelweis University, Budapest, Hungary, and [4]Department of Anaesthesia and Intensive Therapy, University of Debrecen, Debrecen, Hungary

*Corresponding author. E-mail: tassonyie@freemail.hu

Abstract

Background: Using fresh or formalin-embalmed cadavers has not been generally accepted for the purposes of teaching airway management. We investigated whether cadavers 'preserved according Thiel's embalming method' (PATEM) are suitable for the simulation of facemask ventilation and tracheal intubation by direct laryngoscopy.

Methods: This observational cluster sampling, controlled simulation study, included eight PATEM cadavers and eight manikins in two clusters. Twenty experienced anaesthetists were randomly assigned to execute 80 facemask ventilations and 80 tracheal intubations in both groups. The ease of facemask ventilation was the primary endpoint. The secondary endpoint was the composite outcomes of laryngoscopy and tracheal intubation.

Results: The success rate at the first attempt at mask ventilation was 74% (59/80 attempts) on cadavers and 41% (33/80 attempts) on manikins ($P<0.0001$). Twenty one subjects received an oral airway in both groups and succeeded in facemask ventilation 20 times on cadavers and four times on manikins ($P=0.004$). Two-handed technique mask ventilation was required 24 times on manikins and once on cadavers ($P=0.0016$). In one attempt on a manikin the mask ventilation was impossible. Poor laryngeal view (Cormack-Lehane grade 3) occurred 14 times among cadavers (17.5%) and once in manikins (1.25%) ($P=0.007$), whereas difficulties in tracheal intubation were encountered 16 times in cadavers (20%) *vs* 17 times in manikins (21.25%) ($P=0.84$). In a subjective evaluation the participants preferred the cadaver model over the manikins ($P<0.0001$).

Conclusions: PATEM cadavers were better suited for facemask ventilation and provided a more realistic environment for laryngoscopy and tracheal intubation than the studied manikins.

Key words: airway management; education, medical; patient simulation

Despite increasing use of supraglottic devices, facemask ventilation, conventional laryngoscopy and tracheal intubation have remained the standard for airway management. Traditionally, novices have acquired these techniques in anaesthetised patients undergoing surgery.[1 2] Today this education is limited as a result of busy operation schedules and strict ethics.[3 4] Therefore, simulation outside the operating theatre appears highly desirable for the education of trainees. To this end, body-part manikins and full-body simulators are available and regularly used in many centres.[5] However useful they may be, they may

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Editor's key points

- For training of airway management, cadavers preserved with a new method (preserved according Thiel's embalming method (PATEM)) may be more suitable than fresh or formalin-embalmed cadavers and better than manikins.
- Anaesthetists attempted facemask ventilation and tracheal intubation in PATEM cadavers and in manikins.
- PATEM cadavers were better suited for facemask ventilation and provided more realistic environment for laryngoscopy and tracheal intubation than the manikins.

not realistically reflect patients' airway anatomy, compliance and appearance.[6–8] As alternatives, both fresh and embalmed human cadavers have been used for teaching,[9–11] but have not received widespread acceptance because of ethical considerations,[12] the short period of availability of the fresh cadavers, the rigidity of embalmed cadavers, and the risk of infection and smell.[13] These problems are less with cadavers 'Preserved According Thiel's Embalming Method' (PATEM).[14–16] This technique meets high standards of preservation without releasing harmful substances into the environment. The efficacy for disinfection of the method was confirmed by bacteriological tests.[16 17] The colour, the consistency and the transparency of the tissues are well preserved. The limbs and the neck of these cadavers are flexible their mouth opening is normal and air insufflations at low pressure into their lungs induce perceptible chest movements.[18]

However, these cadavers have not been validated for the simulation of basic airway management. The authors hypothesized that more preferable simulation conditions could be achieved in PATEM cadavers, primarily for facemask ventilation than on manikins. The aim of this investigation was to verify our presumption.

Methods

Recommendations of STROBE statement were considered in the report of this study. (http://www.strobe-statement.org) This cluster sampling observational two parallel arms operator randomized prospective controlled study was approved by the 'Regional and Institutional Committee of Science and Research Ethics' at the Semmelweis University, Budapest, Hungary (registration No 145/2015). We investigated the success rate of facemask ventilation and tracheal intubation in clusters comprising eight PATEM cadavers (study sample) and eight manikins (control sample) (Fig. 1). These cadavers were donated to the Department of Anatomy, Semmelweis University, Budapest, Hungary. Before they died, the donors gave written consent on the use of their bodies for education and for research. According to Hungarian

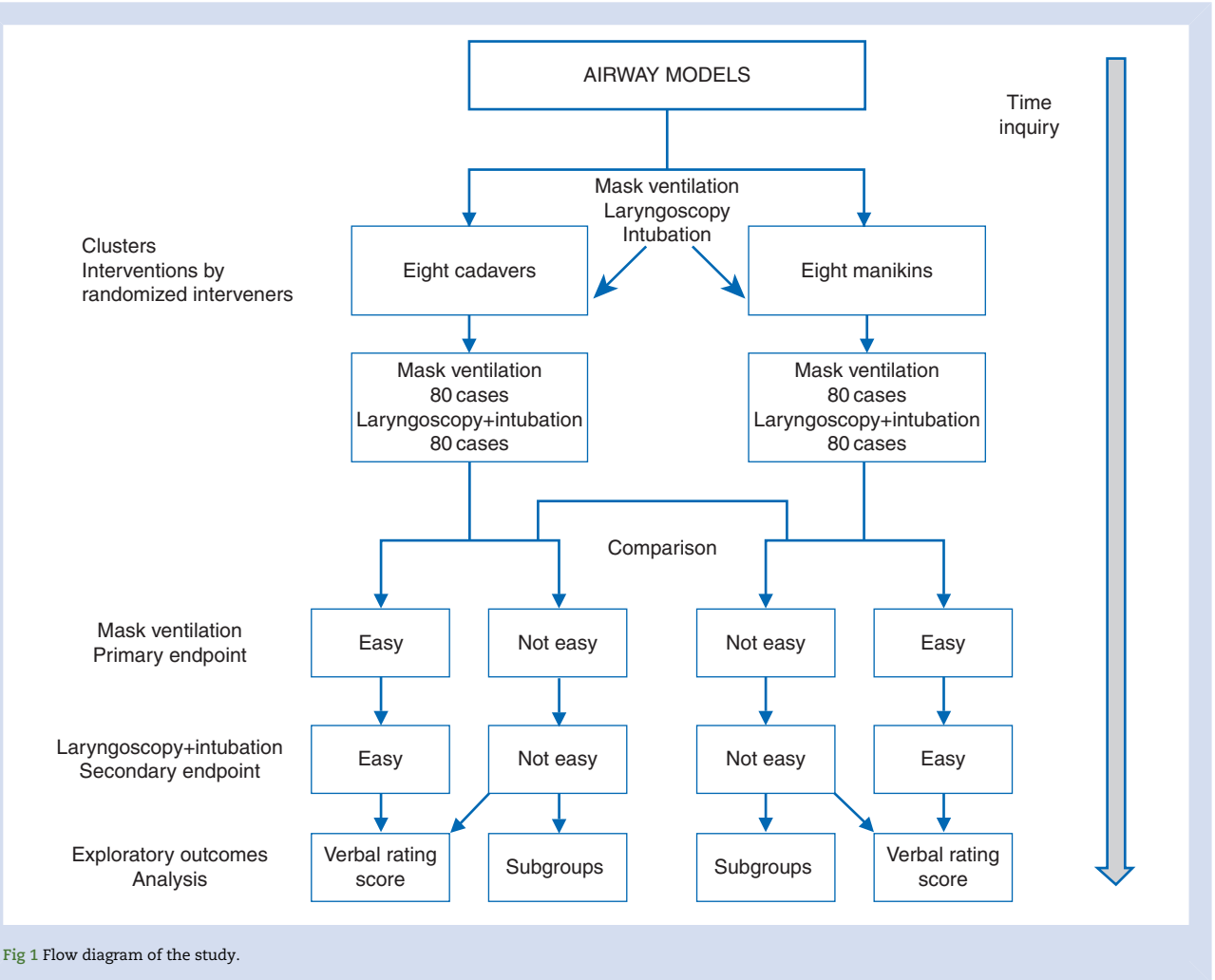

Fig 1 Flow diagram of the study.