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ORIGINAL ARTICLES

EFFICACY OF ESOPHAGEAL DETECTOR DEVICE IN VERIFICATION OF ENDOTRACHEAL TUBE PLACEMENT

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ABSTRACT

Aims of Study: To assess accuracy of esophageal detector device (EED) for detection of endotracheal tube placement and to compare its performance with that of capnography.

Patients and Methods: A prospective study in which 400 patients were divided into two groups. In group-I the patients were intubated as per routine, then the EDD and capnograph were again used to check both the tubes.

Results: The result showed 100% sensitivity, 100% specificity and 100% predictive value for EDD.

Conclusion: The EDD was found to be very effective device in differentiating esophageal from tracheal intubation.

Keywords: Esophageal intubation, endotracheal intubation, esophageal detector device, capnograph.

INTRODUCTION

Esophageal intubation may occur with a difficult laryngoscopy, inexperience, an emergency situation, accidental extubation with movement of the patient's head, or distraction of person intubating. An unrecognized esophageal intubation may result in gastric distension, regurgitation, and hypoxic damage to the brain. Early detection of the esophageal intubation will prevent or reduce the morbidity and mortality of this life-threatening situation. Early judgment of misplacement of the endotrecheal tube in the oesophagus remains one of the most important problems in anaesthesia. There are both clinical and technical tests that can be used to assess tracheal tube position [1]. Occasionally clinical tests prove unreliable and confirmation of the correct placement of endotracheal tube by technical means is useful. One of the simplest and most reliable method involves the use of an esophageal detector device (EDD), the best alternative to capnography in differentiating esophageal from tracheal intubation. Esophageal detector devices (EDD) are designed to aspirate air via the endotracheal tube and depend on the structural differences between the trachea and esophagus to indicate ETT position. The ability to aspirate air easily when connected to an ETT indicates tracheal intubation as the trachea and main bronchi have a rigid structure and do not collapse when a negative pressure is applied. Failure to aspirate air indicates esophageal intubation as the esophagus collapses around the end of the ETT.

Two different models of EDD exist, the syringe type and the bulb type. The syringe type EDD is made by connecting a 60 ml

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catheter-tip syringe to a right-angled endotracheal tube connector by a short length of rubber tubing [2,3]. Nunn [4] described an adaptation using an ELICK'S evacuator (a rubber bulb) and a connector. The bulb is squeezed and attached to ETT. Passive re-inflation indicates a tracheal intubation, while a failure to re-inflate occurs with an esophageal intubation. The bulb from a disposable bulb syringe may also be used. The bulb type EDD is used in the study (fig. 1).

Fig. 1: EDD (Rubber suction device attached with elbow connector)

Fig. 2: EDD connected with ETT placed in trachea (inflate immediately)

PURPOSE OF STUDY

To assess accuracy of the esophageal detector device (EDD) for detection of endotracheal tube placement and to compare its performance with that of capnography.

PATIENTS AND METHODS

Total 400 patients of ASA grade I & II undergoing elective surgery under general Anaesthesia with endotracheal intubation were studied. The patients were both male & female and were between the ages of 15 to 60 years. They were divided into two groups. In-group-I, two hundred patients were included. Anaesthesia was induced with thiopentone sodium 5mg/kg body weight and intubation was facilitated with suxamethonium (1.5mg/kg) or atracurium (0.5mg/kg). The EDD was attached with endotracheal tube in deflated state. Passive re-inflation of bulb was observed (fig. 2). Capnograph was then attached to ETT to confirm the endotracheal intubation.

In-group 11,200 patients were included & induction of anaesthesia & endotracheal intubation was done exactly in the same manner as in group-I. After tracheal intubation another endotracheal tube was intentionally placed in the esophagus. EDD was attached to both the endotracheal tubes in deflated state & response was noted. Both the endotracheal tubes were then attached to capnograph & response was observed. In-group-I, percentage of patients showing

Table: Comparison of esophageal detector device and capnography

	Capnography	
	Positive	**Negative**
EDD Positive	200	0
EDD Negative	0	200

Sensitivity = 100% *Positive Predictive value = 100%*
Specificity = 100% *Negative Predictive value = 100%*
Prevalence of disease = 50%

tracheal intubation with EDD was compared with that of capnograph. Statistical analysis by comparing the results using the EDD & capnograph in patients' in-group-II was performed.

Definition; 1-true positive (TP) bulb remain collapsed, tube in esophagus; 2-false positive (FP) bulb remain deflated, tube in trachea; 3-true negative (TN)-bulb reinflate, tube in trachea, 4-false negative (FN)-bulb reinflate tube in esophagus.

The sensitivity [TP/(TP + FN) x 100), Specificity (TN/ (TN + FP) x 100) & positive

predictive value (TP/ (TP + FP) x 100) were obtained.

RESULTS

In group-I (n=200), Passive re-inflation of the EDD was observed in all patients, the accuracy was 100%. The result of both EDD & capnograph agreed & indicated that the ETT was in the trachea in all 200 patients.

In-group-II (n = 200), reinflation of squeezed bulb of EDD attached with the ETT in the trachea was observed in all cases and was confirmed by the waveform on capnograph. In the esophageal intubation EDD remained deflated in all patients & capnograph indicated flat line (table). The sensitivity, specificity & predictive value were 100%.

DISCUSSION

The EDD is highly sensitive & specific in distinguishing tracheal from esophageal tube placement [5]. This finding has been confirmed in a randomized trial using a cadaver model [6]. Our results also suggest that in none of the esophageal intubation the bulb reinflate. Passive reinflation of the EDD bulb is observed in all tracheal intubations, giving this device 100% accuracy. The results of our study confirm the previous study [7,8].

Zaleski in his study [7] has compared the esophageal detector device with capnography in distinguishing esophageal from tracheal intubation. The Capnography & esophageal detector device comparison demonstrated 100% correlation. The results of our study correlate with these findings.

EDDs provide a rapid assessment of ETT position. In Wee's original study 3, the time to test was 6.9 seconds (3-16 seconds). Nunn 4 obtained a result with the Elick's bulb in 3-6 seconds. The result of the EDD test is obtained more rapidly than that from capnography & relies solely on observation. In O, Leary JJ study [8] conducted in operating room undergoing elective intubation, all esophageal tubes and tracheal tubes were immediately detected by using EDD, giving this device 100% accuracy.

A variety of methods for verification of tube placement have been used, such as direct visualization, observation of chest movement, auscultation of breath sounds, absence of epigastric sounds with respiration, presence of an exhaled tidal volume, reservoir bag compliance, and tube condensation with exhalation, pulse oximetry, end-tidal carbon dioxide measurement and confirmation with the esophageal detector device. The utility of each method varies with clinical condition & none are completely reliable in all settings [9].

The advantages of EDD are: They can be easily assembled. They are easy to use, portable, non-electronic and provide reliable assessment of ETT position. They are ideal for use in countries where capnography is not routinely available. They may also be useful outside the operating room (e.g. in the recovery room, in the emergency room, intensive care unit and out in the field). They can be re-used after cleaning or sterilization [10].

The disadvantages of EDD include.

Some false results may occur. However, the incidence of this is low.

Regurgitation of gastric air, distension of the esophagus with air or an EDD that is not airtight may give false impression of tracheal intubation when the tube is in fact in the esophagus.

Thick secretions may occlude a tracheal tube 3 and give a false impression of esophageal intubation. Bronchial intubation, bronchospasm, tracheal compression, obesity, chronic obstructive pulmonary disease, may also cause resistance to aspiration or delayed refill of the bulb-type EDD.

The false positive results with EDD in adults do not seem to occur. The current studies reported a sensitivity, specificity and positive predictive value of discriminating

esophageal from endotracheal intubation of nearly 100% in healthy adults undergoing routine operations. This led to conclusion that false positive findings with EDD are probably nonexistent. In our study in healthy adults false positive results are not observed, giving this device 100% accuracy.

CONCLUSION

EDDs are ideal for use where capnography is unavailable in detecting endotracheal tube placement. They are useful in hospitals, which have a capnography in operating theatres, but not in the recovery rooms, wards & emergency rooms. It must be stressed that EDDs do not replace capnography, in differentiating esophageal from tracheal intubation. EDDs must not be used on their own, but always in conjunction with clinical methods to assess endotracheal tube position.

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