MEDICAL PRACTICE

Clinical Topics

The oesophageal obturator airway: a new device in emergency cardiopulmonary resuscitation

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Summary and conclusions

Experience with 29 000 cases in which the oesophageal obturator airway has been used in cardiopulmonary resuscitation indicates its safety, efficacy, and ease of use. Blood gases, fractional inspired oxygen, and pH were measured in 18 patients given both the oesophageal obturator airway and the endotracheal tube; there was no significant difference between the two. The former was found to be inserted more rapidly and reliably; moreover, paramedical staff are quickly trained to use it.

It is concluded that the oesophageal obturator airway provides the technique of choice whenever ideal conditions and facilities—and trained staff—for endotracheal intubation are not immediately available.

Introduction

Prompt and effective ventilation, essential for patients with cardiopulmonary arrest, may be provided by mouth-to-mouth ventilation or intubation. The former suffers from the disadvantages of inducing vomiting and causing gastrointestinal distension, with consequent elevation of the diaphragm. In addition, the knack of interposing one breath between every five cardiac compressions is difficult to acquire and constitutes a limitation, often resulting in a lower than ideal compression rate

that produces a fall in either cardiac output or the efficacy of ventilation (or both). Indeed, the art of interposing a breath has been likened by Safar to a musical skill, beyond some rescuers. Most therefore favour early intubation, which eliminates these disadvantages. While endotracheal intubation is the time-honoured and "preferred" technique, the feasibility of a global and universal use of this procedure is questionable since it needs a flaccid, supine, and immobile patient; a skilled endoscopist; adequate access to the patient; satisfactory lighting; appropriate instruments; and the ability to view the vocal cords rapidly.

The concept and application of a device to obstruct the oesophagus and simultaneously ventilate the lungs were first described by Don Michael in 1968.¹ Subsequent physiological testing and field trials were carried out by Gordon in 1972² and a clinically useful device was developed. The device was listed by the American Cardiopulmonary Resuscitation Committee in its standards for cardiopulmonary resuscitation and emergency cardiac care in 1974³ and its use endorsed.⁴

Material and methods

Retrospective data were obtained on the use of the oesophageal obturator airway from 1972 to 1976 in 29 000 cases in five institutions. The device (fig) is a 30 cm plastic tube mounted through an inflatable mask. The distal end of the tube is blocked by an obturator, just proximal to which lies an inflatable balloon. The balloon after insertion lies 22.5–26 cm from the incisors and below the tracheal bifurcation. There are 16 openings at the proximal end of the tube, equivalent in diameter to its cross-section, enabling the lung to be inflated with oxygen or air. The balloon is inflated through a non-return valve in communication with the external cuff. The tube with attached mask is inserted by grasping the back of the tongue and jaw between the thumb and forefinger and guiding it gently into the oropharynx and oesophagus. The neck is maintained in the neutral, semiflexed position. After insertion two breaths are given to confirm that the tube has entered the oesophagus, after which the balloon is inflated with 30 ml

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TABLE I—Mean tidal volumes during ventilation in apnoeic subjects during anaesthesia

Ventilatory method	No intubation (ml)	Oesophageal obturator airway (ml)	Endotracheal tube (ml)
Mouth-to-mouth	1050	1300	1350
Bag-valve mask	400	800	850
Robert Shaw valve-to-mask	1150	1350	1400

tion on failed insertions and inadvertent and unrecognised entry into the trachea and other complications.

Results

Table I shows the data on tidal volume with three techniques for ventilation—mouth-to-mouth, bag-valve mask, and the Robert Shaw valve—for non-intubated patients and using the oesophageal obturator airway and the endotracheal tube. With the mouth-to-mouth method and the Robert Shaw valve the oesophageal obturator airway and

TABLE II—Blood gas data obtained during resuscitation with the oesophageal airway and the endotracheal tube

Group* and patient No	Oesophageal obturator airway				Endotracheal tube			
	F _I O ₂ †	P _a O ₂ (kPa)	P _a CO ₂ (kPa)	pH	F _I O ₂ †	P _a O ₂ (kPa)	P _a CO ₂ (kPa)	pH
Group 1								
1	1.0	18.3	7.5	17.19	1.0	18.0	4.8	7.41
2	1.0	46.1	4.9	7.19	0.4	20.0	4.0	7.16
3	1.0	68.0	4.1	7.48	1.0	74.5	3.1	7.57
4	1.0	18.0	9.2	6.99	1.0	14.8	8.0	7.10
5	1.0	26.3	4.9	7.34	1.0	14.0	4.5	7.43
6	1.0	53.2	3.1	7.51	0.4	32.3	4.0	7.42
7	1.0	20.7	3.7	7.35	1.0	32.4	4.5	7.30
8	0.4	8.93	6.5	7.22	0.4	12.5	4.1	7.41
9	0.4	7.5	5.2	7.38	1.0	14.0	4.5	7.39
10	0.4	8.7	4.8	7.32	0.4	7.9	6.4	7.25
11	0.4	14.9	4.9	7.32	1.0	54.5	4.4	7.30
12	RA	10.8	4.3	7.40	0.4	17.6	5.2	7.39
Group 2								
13	1.0	5.5	11.5	7.13	1.0	3.6	11.1	7.16
14	1.0	36.3	6.0	7.25	1.0	37.5	3.5	7.47
15	1.0	55.3	5.2	7.31				
16	1.0	10.4	10.1	7.02	0.4	7.7	7.3	7.23
17	0.4	3.2	8.9	7.19	0.4	5.1	6.1	7.32
18	0.4	7.6	8.0	7.10	0.4	8.4	4.7	7.24

F_IO₂ = fractional inspired oxygen; P_aO₂ = arterial oxygen pressure; P_aCO₂ = carbon dioxide pressure.

*Group 1: supraventricular rhythm; group 2: external cardiac massage. †1.0–100% oxygen via demand valve (Hudson Oxygen Therapy)—0.4–40% oxygen (estimated via bag-valve tube with 10–12 l/min supplemental oxygen); RA—room air delivered via bag-valve unit (after Schofferman *et al.*,¹⁸ by courtesy of the editor of *Chest*).

Conversion—SI to conventional units: 1 kPa = 7.5 mm Hg.

TABLE III—Data on the use of the oesophageal obturator airway (OOA) from different series

Programme	Duration of programme (y)	No of cases where OOA used	Unsuccessful (unable to pass or passed into trachea) (%)	Complications	
				Severe trauma	Trachea blocked
University of Maryland Institute for Emergency Medicine (helicopter crew)	2	45	8.8	0	0
Los Angeles County paramedic programme	5	22 500	5	5	1
University of Southern California Los Angeles County Hospital	3	5 850	5–10	2	0
Long Beach Fire Department	3	789	5	0	4
San Diego City Lifeguards	2	10*	10	0	0

*Five complete recoveries.

of air. The tube is withdrawn only after full deflation, with an endotracheal tube in place and with facilities for suction, the patient being on his side. The tube is not usually used for more than one to two hours.

In six human volunteers undergoing anaesthesia, tidal volumes were measured by one of us (ASG) with a calibrated pneumograph. The mean of three determinations was computed, three techniques of ventilation being used—the mouth-to-mouth method, oesophageal intubation, and endotracheal intubation. We measured blood gases, pH, and fractional inspired oxygen in 18 cases divided into two groups. The 12 patients in group 1 were suffering from respiratory arrests with a supraventricular tachycardia, and the six patients in group 2 had cardiorespiratory arrest. In addition, house staff (fully trained in both techniques) measured insertion times and first-pass success rates with both the oesophageal obturator airway and the endotracheal tube in 50 patients who had failed to be resuscitated. We also determined the time taken in six institutions to train paramedics to make them proficient in inserting the oesophageal obturator airway; and we collected data on 29 000 patients, including informa-

tion on failed insertions and inadvertent and unrecognised entry into the trachea and other complications.

endotracheal tube produced tidal volumes 30% higher than in the non-intubated patients, and with the bag-valve mask tidal volumes 100% higher. Blood gas data (table II) in both group 1 and group 2 indicated a mean P_aO₂ of 240 mm Hg with 100% oxygen and of 68 mm Hg with 40% oxygen, no significant difference being seen between the oesophageal obturator airway and endotracheal tube in either category of patients. In the test on the 50 patients who had failed to be resuscitated more rapid and reliable insertions were achieved with the oesophageal obturator airway (mean 5 and maximum 20 seconds) than with the endotracheal tube (mean 20 and maximum 68 seconds); 90% of the former but only half of the latter attempts were successful at first insertion.

Clinical data were available for 29 000 insertions (table III). The oesophageal obturator was inserted in most cases by paramedical personnel. Most insertions were carried out in the field and the patients were stabilised before reaching the emergency room with effective ventilation and cardiac compression. Large numbers of paramedics have already been trained, only a few hours' instruction being needed (table IV).

Discussion

The importance of rapidly establishing an effective means of ventilation after cardiopulmonary arrest has been widely recognised. Massive gastric and intestinal distension from mouth-to-mouth resuscitation was recognised by Dr John Curry over 10 years ago, and subsequently the disadvantages of regurgitation and of having to synchronise rhythmic compression and ventilation became evident. When early blind defibrillation or cough or thump is unsuccessful and prolonged cardiopulmonary resuscitation is needed, prompt intubation appears to be

The oesophageal obturator airway.

place before 1975 with the long-ended tube.⁶⁻⁸ The perforations were located at 30 cm from the incisors, corresponding to the end of the tube and not to the balloon, which lies 22-27.5 cm from the incisors.⁸ In reporting the only case described after the tube had been modified, Strate and Fischer submit that rupture followed insertion of a nasogastric tube after oesophageal intubation.⁷ They have seen no ruptures since 1976. Harrison *et al*⁹ recently surveyed published papers and found a total of 19 cases of oesophageal rupture. They point out that the incidence of rupture in failed resuscitations is unknown, and that subcutaneous emphysema is a common physical sign in these cases. In an estimated total of two million insertions, they argue, the incidence has been low; and no cases of rupture have been seen with the modified oesophageal obturator airway, which enables stomach aspiration to be carried out.⁹

Nevertheless, rupture of the oesophagus does constitute a potentially lethal complication. Gastric regurgitation after withdrawal of the tube is not a great problem when an endotracheal tube is used, and laryngeal spasm has not been encountered. With proper instruction, entry of the tube into the trachea can be promptly recognised. The complications of endotracheal intubation are known: laryngeal spasm; collapse of the left lung; trauma to the pharynx, larynx, and trachea including rupture¹⁰⁻¹²; and above all delays in rapidly establishing an effective airway. Nevertheless, no data on its use in the field have yet been forthcoming; and where the two techniques are compared it is clear that a time-honoured method that works in an operating theatre cannot be axiomatically accepted in the field. When cases of sudden death in hospitals and nursing homes throughout the country and in the field—as distinct from specialised intensive care units—are examined, the scope for prompt insertion of endotracheal tubes in patients who might be saved is seen to be limited. Moreover, endotracheal intubation may be precluded in certain circumstances such as cervical trauma; clenched jaw; difficulty in intubating; victims in the sitting or supine position; and lack of facilities, instruments, or a skilled endoscopist. The oesophageal obturator airway may be capable of use in these circumstances. The oesophageal obturator airway is currently contraindicated in infants, in cases of known

TABLE IV—Programmes for training paramedics with the oesophageal obturator airway

Training programme	Duration of programme (y)	No trained	Amount of training (h) didactic mannequin or cadaver	
University of Maryland Institute for Emergency Medicine (helicopter crew)	2	16	2	1
Los Angeles County paramedic programme	5	1166	2	1
University of Southern California Los Angeles County Hospital	3	980	2	3
Long Beach Fire Department	3	55	1½	1
San Diego City Lifeguards	2	24	1½	1

mandatory. While highly trained paramedics can perform endotracheal intubation, their use is limited by their need of supervision and of opportunity to maintain their skills, the time taken to train them, and the shortage of training facilities. Paramedics can do endotracheal intubation, and even put in subclavian lines, as Cobb and Alvarez with their group in Seattle have shown.⁵ Ensuring quality control and medicolegally acceptable standards by paramedical personnel, however, would require considerable resources and training. The problems of a paramedic in the field, working in less than ideal, often cramped, circumstances and sometimes obsessed with the need to succeed are far removed from those of the anaesthetist in the operating room with years of training and the "ideal" patient.

Since its introduction in 1972 the oesophageal obturator airway has been used in an estimated 1.5 million insertions. There have been 15 documented ruptures, of which nine took

oesophageal pathology, and where good endoscopic equipment and a skilled endoscopist are available, as well as in the conscious patient. But the rapidity and ease of insertion and the equally effective ventilation,¹³⁻¹⁶ with oxygenation comparable to that provided by the endotracheal tube,^{17 18} constitute a strong case for using the oesophageal obturator airway in all circumstances except where ideal endotracheal intubation facilities are available. Newer modifications include a device for aspirating the stomach and a paediatric model as well as devices for oesophageal pacing and defibrillation.

Oesophageal blockage and endotracheal ventilation, then, not only can be rapidly accomplished in 5-10 seconds but also provide a safe and effective alternative to emergency endotracheal intubation. Moreover, the technique can be applied on a worldwide basis, matching resources for emergency airway ventilation to demand.

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Occasional Review

Care of the diabetic child in the community*

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Summary and conclusions

Brief admission of the new diabetic child and of a parent to an enlightened hospital for stabilisation, preliminary education, and familiarisation with hospital and community staff is well worth while. The greater the demand for constant control of the highest quality, the greater the need for a close understanding of the psychosocial factors concerned and for clinical skill. The nature of the home and the family relationships should in theory be available from the child's general practitioner at the time of the first referral since he has so much information about the whole family. With the virtual disappearance, however, of mutual consultation in the patient's home in many places, the opportunity for oral communication has declined, and availability on the telephone is not always easy. The busy general practitioner (far less an unknown physician from a deputising service without access to the records) has little time to write a comprehensive letter. In practice a relatively small hospital-based mobile team of specially experienced sisters who are keen to communicate in the home, the GP's surgery, and the school makes a major contribution to the diabetic

care of a young population vulnerable to major handicap in what should be the prime of life. Their cost effectiveness may be difficult to prove but it is not at all in doubt—especially when the sisters as in this area deal in the community with a wider range of chronic illnesses and handicaps in children.

Insulin-dependent diabetes affects more than one in every thousand British children under school-leaving age. This makes it a common disease when judged against the prevalence of other endocrine and metabolic disorders. It cannot be dismissed as unimportant—since juvenile diabetes is now the commonest single cause of registered blindness in the age group 30-45 years. The increasing evidence that such personal and national burdens may be prevented or indefinitely deferred by achieving new standards of strict control emphasises the need for the best treatment day and night throughout the years.¹ Yet the proportion of child diabetics in a general clinic is small, and it can be difficult to find for them and their parents the time they need. Family doctors have less experience and even less time since the average individual NHS list is unlikely to include even one, while the numbers of other sick people to be seen are large especially at times of epidemics when young diabetics too are likeliest to be in trouble. Care therefore touches on several sensitive issues. Should the child diabetic be looked after by a consultant paediatrician or a consultant physician? Should the consultant be a generalist or have a special interest in diabetes and be in regular touch with advances in the field? Should generalists refer child diabetics to specialists? Who should accept responsibility for giving such day-to-day

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