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RESUSCITATION

The incidence of regurgitation during cardiopulmonary resuscitation: a comparison between the bag valve mask and laryngeal mask airway

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Abstract

The risk of gastric regurgitation and subsequent pulmonary aspiration is a recognised complication of cardiac arrest—a risk which may be further increased by the resuscitative procedure itself. The purpose of this study was to compare the incidence of gastric regurgitation between the bag valve mask (BVM) and laryngeal mask airway (LMA). The resuscitation data collection forms of 996 patients who underwent in-hospital cardiopulmonary resuscitation over a 3.5 year period were reviewed. Of these, 199 patients were excluded from the study because there was no airway management involving a BVM or LMA. The incidence and timing of regurgitation was studied in the remaining 797 patients. Regurgitation was recorded to have occurred at some stage in 180 of these patients (22.6%). However, 84 regurgitated prior to CPR (46.7% of those patients who regurgitated). These patients were excluded from further analysis as regurgitation could not have been affected by any form of ventilation. Of the remaining 713 patients, BVM ventilation was used in 636 cases. In 170 of these the LMA was also used following the BVM. Where the patient was ventilated with the BVM alone or BVM followed by ETT the incidence of regurgitation during CPR was 12.4%. The LMA was used during resuscitation in 256 cases of which 170 had BVM ventilation prior to the LMA. Where the patient was ventilated with the LMA alone or LMA followed by ETT the incidence of regurgitation during CPR was 3.5%. The study confirms experience reported in earlier studies that when an LMA is used as a first line airway device, regurgitation is relatively uncommon.

Keywords: Cardiopulmonary resuscitation; Regurgitation; Bag valve mask; Laryngeal mask airway

1. Introduction

Gastric regurgitation remains an acknowledged complication of cardiac arrest [1]. The risk is further increased during the resuscitation process by pressure changes generated during external chest compressions and positive pressure ventilation through an unprotected airway. In addition to this, cardiac arrest may well occur in patients with full stomachs. Normal protection from gastric regurgitation and consequent pulmonary aspiration is abolished by relaxation of the lower oesophageal sphincter and obtundation of the protective laryngeal reflexes.

During cardiac arrest initial ventilation is commonly performed using a self inflating bag valve mask (BVM), prior to the insertion of another device designed to provide definitive airway security [2]. The conventional definitive airway is recognised to be the cuffed tracheal tube (ETT), but placement requires a considerable period of training and regular practice to achieve competence. To provide training and practice for all health care professionals who might attend a patient suffering cardiac arrest is probably an unattainable goal. For this reason alternative airways, such as the laryngeal mask airway (LMA) and the combitube, which require less training for their use, have been studied to assess their effectiveness in comparison with BVM ventilation [3,4].

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The aim of this study was to assess the comparative incidence of gastric regurgitation associated with the BVM and LMA.

2. Patients and methods

2.1. Type of hospital

The Conquest Hospital, Hastings is a 490 bed district general hospital on the South Coast of England. The hospital, which was opened in 1992, serves a population of 168000 with a significant proportion of elderly residents. All of the acute services are situated on one site facilitating immediate response to cardiac arrests.

2.2. Resuscitation services

The hospital has employed a full-time resuscitation training officer (RTO) since 1985. Every ward and department is equipped with a standard cardiac arrest trolley and Lifepak 9 defibrillator. Included within each trolley are 2 LMAs, sizes 3 and 4, a disposable BVM and all the equipment required for emergency tracheal intubation. The RTO provides comprehensive training in every aspect of cardiopulmonary resuscitation. All nurses undergo mandatory training in basic life support, with training in advanced resuscitation methods, such as manual defibrillation and laryngeal mask insertion, fast becoming a prerequisite for nurses working in the acute areas. To date, 453 registered nurses have undergone LMA training in the hospital.

In addition to the teaching and clinical commitments, audit is also considered an integral part of the resuscitation service. The Anaesthetic Department employs a full time clinical audit and service development officer who collates all the resuscitation data and prepares bi-monthly reports. All data is transferred onto a database, specifically designed to enable detailed analysis of cardiac/respiratory arrest calls. The hospital has been collecting data on cardiac arrests since 1989.

2.3. Patient selection and data collection

Over a period of 3.5 years, details of gastric regurgitation were prospectively recorded on the hospital resuscitation data collection form which was completed routinely for every resuscitation attempt by a member of the cardiac arrest team (Figure 1). Regurgitation was recorded as occurring either prior to the resuscitation attempt (gastric contents in the mouth or pharynx prior to CPR), during the resuscitation attempt (gastric contents appearing in the mouth or pharynx or within the airway device), or after the resuscitation attempt (following the withdrawal of BVM ventilation or removal of the airway device).

Over the 3.5 year study period, the records of 996 resuscitation attempts were reviewed. Of these, 199 were excluded from the study because there was no airway management involving a BVM or LMA, i.e. there was early restoration of circulation following prompt defibrillation or the patient was ventilated using an alternative airway device. Thus, the incidence of regurgitation in 797 patients was studied.

2.4. Definitions

Regurgitation was defined as the presence of gastric contents (dark stained secretions) requiring aspiration.

2.5. Statistical methods

In comparing the incidence of regurgitation between the BVM and LMA, χ^2 was used to test for significance. A P-value less than 0.05 was regarded as significant.

3. Results

3.1. Overall incidence and timing of regurgitation

Regurgitation was recorded to have occurred at some stage in 180 of the patients studied (22.6%). The timing of regurgitation is shown in Table 1. Those patients who regurgitated prior to CPR ($n = 84$) were excluded from further analysis as regurgitation could not have been affected by any form of ventilation. Analysis of the remaining 713 patients was split between those patients ventilated with the BVM, those ventilated with the LMA and those ventilated with both devices. The incidence and timing of regurgitation for these groups is show in Table 2.

3.2. Regurgitation in patients where a BVM was used

The BVM was used as the first line airway device in 636 cases. In 170 of these the LMA was also used following BVM ventilation. Of the remaining 466 patients who were ventilated with the BVM alone or

Table 1
Time of regurgitation in all patients studied

Time of regurgitation	% of all patients studied	% of patients who regurgitated
Prior to CPR ($n = 84$)	10.5	46.7
During CPR ($n = 81$)	10.1	45.0
After CPR ($n = 15$)	1.9	8.3

Table 2
Time of regurgitation by airway device excluding those patients who regurgitated prior to CPR

Airway device used	No. of patients	Regurgitation during CPR	Regurgitation after CPR
BVM (no LMA)	466	58 (12.4%)	7 (1.5%)
LMA (no BVM)	86	3 (3.5%)	0 (0%)
BVM and LMA	170	20 (11.8%)	8 (4.7%)

BVM followed by ETT the incidence of regurgitation during CPR was 12.4%. The incidence of regurgitation following CPR for the same group was 1.5%.

3.3. Regurgitation in patients where a LMA was used

The LMA was used during resuscitation in 256 cases of which 170 were initially ventilated with a BVM. Where the LMA was used as the first line airway device the incidence of regurgitation during CPR was 3.5%. No patients in this group regurgitated after CPR.

3.4. Regurgitation in patients where both devices were used.

For the 170 patients who were ventilated with a BVM prior to insertion of an LMA, the incidence of regurgitation during CPR was found to be 11.8%, with an incidence following CPR of 4.7%.

4. Discussion

Our results confirm that gastric regurgitation is a common complication of cardiopulmonary arrest. In this series which excluded patients who responded very quickly to CPR/defibrillation and patients ventilated without the use of a BVM or LMA, some 22.6% (180/797) had recorded evidence of gastric regurgitation. However, 46.7% (84/180) of these were known to have regurgitated before any form of airway management was attempted and it is difficult to suggest any measure to prevent this occurring.

Where the patient was ventilated with the BVM alone or BVM followed by an ETT the incidence of regurgitation during CPR was 12.4% (58/466). For patients ventilated with the LMA alone or LMA followed by ETT the incidence of regurgitation during CPR was significantly lower at 3.5% (3/86) ($P < 0.05$). There was no recorded incidence of regurgitation following CPR in patients who were ventilated with the LMA as a first line airway device.

These figures indicate a need to observe precautions in terms of posture and suction prior to removal of any protective airway device, especially if positive pressure ventilation has been provided previously through an unprotected airway.

It should be noted that no account has been made of unknown variable factors such as airway alignment, tidal volume, inspiratory inflation rates and the time allowed for expiration, all of which are known contributors to gastric inflation and subsequent regurgitation. It should also be noted that the patients were not randomised into two groups for the study period. Nevertheless, the paper does reflect current practice in the emergency situation.

If the recommendation of reducing tidal volumes to 400–600 ml during resuscitation is widely implemented this may go some way in reducing the incidence of regurgitation [5,6].

No data was recorded as to whether regurgitation resulted in pulmonary aspiration although clearly the risk is there. Even if aspiration could be recorded it would be difficult to link it with outcome because of the many other variables which would need to be considered (e.g. arrest rhythm, co-morbidity).

5. Conclusion

Our results show that, for patients suffering cardiac arrest, there is a high incidence of regurgitation occurring prior to cardiopulmonary resuscitation and during resuscitation with an unprotected airway and BVM. When the LMA is used as the first line airway device, regurgitation during CPR was found to be significantly less likely than when the BVM was used as the first line airway device. This confirms experience reported in earlier studies [3,7–10].

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