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Back to basics in cricoid pressure among anaesthesia nurses in public hospitals in Singapore: a prospective survey

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INTRODUCTION

Cricoid pressure (CP) has been widely practiced since its introduction in 1961 by Sellick to prevent gastric regurgitation during induction of anaesthesia. Sellick[1] described it as a simple manoeuvre which consists of 'temporary occlusion of the upper oesophagus by backward pressure on the cricoid cartilage against the cervical vertebra'. CP requires pressure at the correct anatomical landmark using the correct finger technique with the appropriate amount of force. In essence, both knowledge and skill are essential. Cricoid pressure is not a simple manoeuvre,[2,3] its proper conduct requires preparatory instructions, thorough training and regular maintenance of skill.

In the last decade, published literature surrounding Sellick Manoeuvre had been dominated by both proponents and opponents.[4-8] Opponents had called for its abandonment, and innovators in recent years have proposed a new paratracheal approach to cricoid pressure.[9] This controversy stems from the lack of quality evidence to support the effectiveness of CP, fuelled by safety concerns resulting from reported adverse effects of CP on the airway such as airway obstruction, difficult ventilation and intubation.[10-16] Paradoxically, CP has been reported to be improperly applied, with wide variation in practice.[17-24] While the safety and effectiveness of CP has come under scrutiny, the quality of CP has received far less interest.

In clinical practice, CP is applied by the anaesthetic nurses. It is pertinent that the polarity in opinion amongst anaesthesiologists does not lead to the decline in the quality of education and training of CP amongst the anaesthesia nurses.; thus compromising the standard of CP being practiced on patients. Recognition of potential gaps in knowledge or training among anaesthesia nurses offer opportunities for both learners and teachers to collaborate to narrow the gap. Nurse educators and anaesthesiologists both play important roles in education and training by imparting appropriate skills and up to date knowledge.

There is limited published data in recent years looking at training and conduct of CP among anaesthesia personnel. To identify gaps to improve the performance of CP, a nationwide survey was conducted among anaesthesia nurses in government restructured hospitals to determine their current practice of CP and the state of training as well as to evalute their current knowledge.

METHODS

This survey was carried out with institutional research board approval (Singhealth CIRB Number 2018/2139) among anaesthesia nurses in seven public restructured hospitals in Singapore, between April to May 2018. The survey questionnaire consisted of questions which covered the demographic characteristics of the participants, the frequency of use of CP in specified clinical situations, training of CP (format, landmark, technique and recommended force). They were also evaluated on how they apply CP in clinical practice (landmark, technique and force).

A designated nursing representative in each hospital obtained a head count of the anaesthesia nurses in each department and facilitated the delivery and return of the survey package between the nurses and the investigating team. Each survey package included one set of questionnaire, a cover letter of invitation and a return envelope. It was made know to the nurses that participation was voluntary and anonymous. Participants were asked to complete the questionnaire independently and respond as best as they could. Completed questionnaires were returned in sealed envelopes. These were collectively returned to the principle investigator. During this period, one reminder was given to the participating anaesthesia nurses by the nursing representative in each hospital.

For this survey, a range of cricoid force was accepted as appropriate recommended cricoid force. These include the current recommendation of 30 Newtons (N)[13,17,19,21,25] or the range of 10 N when awake and increasing to 30 N when anaesthetized.[2,3] Other range of cricoid forces such as between 20 N and increasing to 30 or 40 N, or range between 30-44 Newtons[2,19,21,25-29] were also accepted as appropriate. There is little published data on the optimal CP to be use in children. In addition, paediatric practice covers a wide age spectrum. A benchtop investigation by Francis suggested pressure applied should be between 20 and 25 N[14] while Walker found that the mean force required to compress airway in children was 10.5 N.[14] In this study, we accept cricoid force range of 10-30 Newtons as appropriate for children.

Statistical analysis was performed using SAS version 9.4 for Windows (SAS, Inc., Cary, NC USA). Statistical significance was set at $p < 0.05$. Use of CP in various clinical situations was reported as frequency and percentage. Continuous data is reported as mean (SD). Descriptive results (number and percentage) were used to show the distribution of educational programs for CP, landmark of cricoid cartilage, techniques and recommend force. We evaluated the impact of years of experiences (< 5 years, 6-10 years, > 10 years) on their training as well as their knowledge (knowledge of anatomical localization and cricoid force) using Chi-squared test.

RESULTS

We received a total of 268 (88.2%) responses from 7 institutions. All responses were included in the analyses. The mean age of respondents was 32.9 (8.64) years with 7.0 (6.06) years of experience. The frequency of use of CP in the nurses' overall practice and in specific clinical situations is presented in Table I. In a free text response, nurses stated appendectomy surgery as a clinical situation where CP is 'often' and 'always' applied. Education and training modalities are

summarized in Table II. The prevalence of training on CP technique and the recommended force was low. Training modality for CP is varied and occurred largely in a clinical setting, either hands-on or observation on the job.

Results of landmark and finger technique and force taught and applied by nurses are summarized in Table III. While 29.1% of the nurses reported applying pressure below the thyroid cartilage, only 13.1% reported being taught to apply pressure on this anatomical landmark. Applied finger techniques reported by nurses were varied. There were 11 nurses (4.1%) who confused CP with the backward, upward and right pressure (BURP) manoeuvre that is used to improve laryngoscopy view. Forty-nine nurses reported they were not sure what cricoid force were taught. For seventy-eight (29.1%) nurses, the recommended cricoid force taught during training was appropriate. In comparison, one hundred and fourteen (42.5%) and 109 nurses (70.3%;_where anaesthesia is applicable in less than 16 years old) were 'unsure' or don't know the correct cricoid for application in adults and children respectively. Only, ninety (33.6%) nurses and 13 (8.3%) nurses were able to respond appropriately the recommended force they would use for CP in adults and children respectively.

There is no statistical difference between years of nursing experience with the frequency of teaching of anatomical localization (p= 0.16), technique (p=0.80) and cricoid force (p= 0.23). There was no statistical difference between years of nursing experience with knowledge of anatomical localization (p=0.87) and knowledge of cricoid force for adult patients (know, don't know, not sure, p=0.09).

DISCUSSION

The results from this survey show that CP is still prevalent in our local patient care. CP was reported to be 'often' or 'always' practised by more than 50% of our anaesthesia nurses during rapid sequence induction in various clinical situations. The survey identified current deficiencies in the knowledge as well as a gap in the education and training for CP amongst anaesthesia nurses in Singapore. We also found that years of nursing experience does not significantly increase knowledge gain.

Studies in the past[21,30-32] have consistently highlighted the poor knowledge and performance of CP among anaesthesia personnel. Most of the studies focus on cricoid force. Our study found that the knowledge gap is prevalent across all domains, i.e. anatomical localization, finger technique and recommended cricoid force, the latter especially in paediatric practice. About 57.8% of nurses reported that paediatric practice is applicable in their work, of which 55.5% nurses described CP application was 'often' and 'always' and 'sometimes'.

Traditional instruction on the correct cricoid force varied from description of 'firm pressure'[1] to 'the pressure on the nose bridge causing discomfort', to 'the pressure against one's cricoid which prevents swallowing'.[33] Various training modalities since 1990s included use of syringe (50-mL) training technique,[33-35] infant scale model[19] and cricoid trainer.[20,33,36,37] In the 2000s, simulation training using cricoid simulator/trainer with real-time force feedback had resulted in improvement in CP performance in both simulated[20,33,36,37] and clinical setting.[38] This improvement has been demonstrated in healthcare personnel that included nursing staff from emergency department, anaesthesia and critical care[20,33,36-38] after short period of training sessions. Conversely, retention of acquired skills is largely variable and reportedly range from 3 weeks to 3 months,[19,23,34,37] leading to retraining recommendation at intervals of 3 to 6 months.[31] In a recent

study by Hersey,[39] nursing competencies required for assisting rapid sequence induction (RSI) in the emergency department were identified by a multidisciplinary collaborative focus group (physicians and nurses in anaesthesia, emergency medicine, intensive care medicine). These identified key areas of competencies which included CP, were then used to develop an interactive e-learning resource which was found to increase self-reported measures of competency and confidence among nurses in the emergency department. Hersey concluded that such learning resource is useful as both an introduction to airway assistance and refresher training for nurses. E-learning resource may serve as an education pillar to target knowledge deficit.

Our study has several limitations. Firstly, our methodology was a questionnaire-based survey, we could not appraise the actual performance of CP by nurses such as localization of anatomy, use of finger technique or the amount of force applied. We were also unable to verify the respondents' understanding of responses such as 'Sellick manoeuvre' and 'cricoid cartilage'. Similarly, when a range of cricoid force of 10-30 N was quoted, we assumed that the understanding is '10 Newtons while awake and increasing to 30 Newtons' when anaesthetised. Secondly, six participating hospitals were general hospitals and one was a specialist hospital for women and children. While the patient population across the various hospitals were not homogenous, we have included results from all hospitals. This is because anaesthesia service for children was not limited to specialist children's hospital, 155 out of 268 nurses surveyed were involved in paediatric care, including those in general hospitals. We however did not elicit the age group of the paediatric patients in their practice from the respondents. There were also incomplete responses in the survey, we were not able to ascertain if the missing answers were due to deficiency of knowledge. Lastly, our findings are limited to anaesthesia nurses and cannot be extrapolated to other clinical areas

where CP is less frequently practiced such as the emergency department. In these areas, an evaluation of education and training needs is worth exploring.

This survey provided insight on nurses' overall knowledge and competency in CP which is critical for its safe practice. It is timely to revisit the basic competencies in cricoid pressure. A collaborative effort between anaesthesiologist and anaesthetic nurses maybe the way towards planning a robust training programme to foster updated knowledge and skill acquisition among the nurses.

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Table I. Frequency of use of cricoid pressure in clinical situation

Situation	Always N (%)	Often N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)	Scenario NA* N (%)
Unsure of fasting time	179(66.8)	45(16.8)	24(9.0)	7 (2.6)	3(1.1)	4(1.5)
Not fasted	219(81.7)	19 (7.1)	14(5.2)	9(3.4)	3(1.1)	1(0.4)
Emergency cases	141(52.6)	73(27.2)	41(15.3)	4(1.5)	5(1.9)	0(0.0)
Trauma cases	150(56.0)	51(19.0)	37(13.8)	9(3.4)	5(1.9)	8(3.0)
Elective Caesarean section under GA	72(26.9)	17(6.3)	27(10.1)	14(5.2)	18(6.7)	110(41.0)
Emergency Caesarean section under GA	107(39.9)	26(9.7)	15(5.6)	6(2.2)	8(3.0)	101(37.7)
All pregnant patients	65(24.3)	23(8.6)	33(12.3)	13(4.9)	19(7.1)	109(40.7)
Pregnant patients $\geq$ 7 months (29 months)	65(24.3)	25(9.3)	24(9.0)	20(7.5)	12(4.5)	115(42.9)
Unconscious patients	91(34.0)	39 (14.6)	46(17.2)	39(14.6)	23(8.6)	22(8.2)
Obese patients	52(19.4)	62(23.1)	112(41.8)	24(9.0)	6(2.2)	3(1.1)
Patients with reflux	160(59.7)	58(21.6)	28(10.4)	8(3.0)	7(2.6)	4(1.5)
Bowel perforation or bowel surgery	56(20.9)	48(17.9)	91(34.0)	35(13.1)	17(6.3)	15(5.6)
Patients with hiatus hernia	31(11.6)	40(14.9)	91(34.0)	46(17.2)	31(11.6)	21(7.8)
Children less than 16 years old	10(3.7)	10(3.7)	66(24.6)	42(15.7)	27(10.1)	78(29.1)
Overall practice by nurses	13 (4.9)	103(38.4)	82 (30.6)	13(4.9)	1(0.4)	NA

GA; general anaesthesia, NA; not applicable.
*Scenario was reported by nurses as ‘not applicable’ in their area of clinical practice.
Missing data (no response) are reasons why numbers do not add up to 268.

Table II. Education (teaching and training) of cricoid pressure

	Response N (%)
Cricoid pressure Taught	
Landmark taught	227 (84.7)
Technique taught	226 (84.3)
Recommended force taught	152 (56.7)
Training of force done	58 (21.6)
Methods used in training of cricoid pressure	
No response	32 (11.9)
Pre-clinical: using manikin	8 (3.0)
Clinical : Training using observation	55 (20.5)
others apply pressure on pressure	62 (23.1)
Clinical : Training on the job on patients	10 (3.3)
No training just theory	96 (35.8)
Combination	5 (1.9)
Others (include on each other, mentor, on self)	
Methods used in training of force of cricoid pressure	
No response	212 (79.10)
Weighing scale	21 (7.8)
Mannikin with cricoid force measurement	16 (6.0)
Combination of weighing scale cricoid force measurement	1 (0.4)
Others (on the job, forehead on self)	18 (6.7)

Table III. Landmark, finger technique, recommended force taught and applied by nurses

	Responses N (%)		
Landmark	**Taught to nurses**	**Applied by nurses**	
No response	98 (36.6)	72 (26.9)	
Cricoid cartilage, CC	100 (37.3)	74 (27.6)	
Below Thyroid cartilage	35 (13.1)	78 (29.1)	
Others (mild/anterior neck, below CC, thyroid cartilage or above, unsure)	35 (13.1)	43 (16.0)	
Technique			
No response	64 (23.9)	103 (38.4)	
Press downwards with 3 fingers	6 (2.2)	6 (2.2)	
Press downwards with index, thumb and 3rd finger stabilize CC	179 (66.8)	94 (35.1)	
Pinch with 2 fingers	4 (1.5)	0 (0.0)	
Combination of techniques	12 (4.5)	0 (0.0)	
Others (BURP, middle finger to press, Sellick, unsure)	4 (6.0)	65 (24.3)	
Knowledge of recommended force	**ALL**	**Adult**	**Child***
No response	124 (46.3)	41 (15.3)	26 (16.8)
Not sure	49+(18.3)	90 (33.6)	87+(56.1)
Do not know	NA	24(9.0)	22 (14.2)
Acceptable force range, Newton^	78 (29.1)	90 (33.6)	13 (8.4)
30 Newtons	13 (4.9)	11 (4.1)	2 (1.3)
10-30Newtons	1 (0.4)	3 (1.1)	1 (0.6)
30-40 Newtons	15 (5.6)	14 (5.2)	NA
Reported force not accepted,	23 (8.6)	23 (8.6)	9 (5.8)
Range of force, Newton	5-50	2-200	2-50

* Data as % of responders where paediatric practice is applicable. NA; not applicable (question not asked) + Nurses who reported 'not sure' and a force simultaneously, 6 nurses in the ALL group (taught to nurses) and 2 nurses in the Child group (applied by nurses)
^Acceptable cricoid pressure included recommendation of 30 Newtons (N), or the range of 10 N when awake to 30N when anaesthetised, or 20 N when awake and increases to 30 or 40 N when anaesthestised or a range between 20-44 N. Cricoid force in the range from 10-30 Newtons was accepted as appropriate for children. CC; cricoid cartilage, BURP; Backwards upwards right pressure.