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

INTRODUCTION

Cricoid pressure (CP) has been widely practised since its introduction in 1961 by Sellick to prevent gastric regurgitation during induction of anaesthesia. Sellick[1] described it as a simple manoeuvre that consists of "temporary occlusion of the upper oesophagus by backward pressure on the cricoid cartilage against the cervical vertebra". Cricoid pressure 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. It is not a simple manoeuvre,[2,3] and its proper conduct requires preparatory instructions, thorough training and regular maintenance of skill.

In the last decade, published literature surrounding the Sellick manoeuvre was 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 CP.[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 have come under scrutiny, the quality of CP has received far less interest.

In clinical practice, CP is applied by anaesthetic nurses. It is pertinent that the polarity in opinion among anaesthesiologists does not lead to a decline in the quality of education and training of CP among anaesthesia nurses, thus compromising the standard of CP being practised on patients. Recognition of potential gaps in knowledge or training among anaesthesia nurses offers opportunities for both learners and teachers to collaborate to narrow the gap. Both nurse educators and anaesthesiologists 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 in the training and conduct of CP and 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 evaluate their current knowledge.

METHODS

The survey was carried out with institutional research board approval (SingHealth Centralised Institutional Review Board reference 2018/2139) among anaesthesia nurses in seven public restructured hospitals in Singapore between April 2018 and May 2018. The survey questionnaire consisted of questions that covered the demographic characteristics of the participants, the frequency of using CP in specified clinical situations and training of CP (format, landmark, technique and recommended force). The nurses 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. The nurses were informed 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. They were collectively returned to the principal 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 CP was accepted as appropriate recommended CP. These include the current recommendation of 30 N[13,17,19,21,25] or the range of 10 N when awake, and increasing to 30 N when anaesthetised.[2,3] Other range of CP such as between 20 N and increasing to 30 N or 40 N, or between 30–44 N[2,19,21,25-29] were also accepted as appropriate. There is little published data on the optimal CP to be used in children. In addition, paediatric practice covers a wide age spectrum. Walker *et al*.[14] found that the mean force required to compress airway in children was 10.5 N. They also cited other work that suggested a CP between 20 N and 25 N for children under anaesthesia. In this study, we accepted a CP range of 10–30 N 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 was reported as mean (standard deviation). Descriptive results (number and percentage) were used to show the distribution of educational programmes for CP, landmark of cricoid cartilage, techniques and recommended force. We evaluated the impact of years of experience (<5, 6–10 and >10 years) on nurses' training

Table 1. Frequency of use of cricoid pressure in clinical situations.

Situation	*n* (%)					
	Always	Often	Sometimes	Rarely	Never	Scenario NA[a]
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 ≥7 month (29 weeks)	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 aged <16 years	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

There were missing data (no response), so the numbers do not add up to 268. [a]Scenario was reported by nurses as 'not applicable (NA)' in their area of clinical practice. GA: general anaesthesia

and knowledge (such as anatomical localisation and CP) using chi-square test.

RESULTS

We received a total of 268 (88.2%) responses from seven institutions. All responses were included in the analyses. The mean age of respondents was 32.9 ± 8.64 years and they had 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 1. 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 summarised in Table 2. The prevalence of training on CP technique and recommended force was low. Training modality for CP was varied and occurred largely in a clinical setting, where it was either hands-on or observation on the job.

Results of landmark and finger technique, as well as the CP taught to and applied by nurses are summarised in Table 3. 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. The applied finger techniques reported by nurses were varied. There were 11 (4.1%) nurses who confused CP with the backwards, upwards and right pressure manoeuvre that is used to improve laryngoscopy view. Forty-nine (18.3%) nurses reported they were unsure of the CP taught. For 78 (29.1%) nurses, the recommended CP taught during training was appropriate. In comparison, 114 (42.5%) and 109 (70.3%) nurses (where anaesthesia is applicable in those aged <16 years) were 'unsure' or did not know the correct CP to apply in adults and children, respectively.

Table 2. Education (teaching and training) of cricoid pressure (CP).

Variable	*n* (%)
CP 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 CP	
No response	32 (11.9)
Preclinical: using manikin	8 (3.0)
Clinical: training based on observing others	55 (20.5)
Clinical: training on the job	62 (23.1)
No training, just theory	10 (3.3)
Combination	96 (35.8)
Others (include on each other, mentor, on self)	5 (1.9)
Methods used in training of force of CP	
No response	212 (79.10)
Weighing scale	21 (7.8)
Mannikin with CP measurement	16 (6.0)
Combination of weighing scale and CP measurement	1 (0.4)
Others (on the job, forehead on self)	18 (6.7)

Only 90 (33.6%) and 13 (8.3%) nurses were able to respond appropriately regarding the recommended CP to apply in adults and children, respectively.

There was no statistical difference between years of nursing experience and the frequency of teaching of anatomical localisation ($P = 0.16$), technique ($P = 0.80$) and CP ($P = 0.23$). There was also no statistical difference between years of nursing experience and knowledge of anatomical localisation ($P = 0.87$) and knowledge of CP for adult patients (know, don't know, not sure, $P = 0.09$).

DISCUSSION

Results from this survey show that CP is still prevalent in our local patient care. Cricoid pressure was reported to be 'often' or 'always' practised by more than 50% of our anaesthesia nurses during rapid sequence induction (RSI) in various clinical situations. The survey identified current deficiencies in knowledge as well as gaps in CP education and training among anaesthesia nurses in Singapore. We also found that years of nursing experience did 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 focused on CP. Our study found that the knowledge gap is prevalent across all domains, that is, anatomical localisation, finger technique and recommended CP, 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 that they 'often', 'always' or 'sometimes' applied CP.

Traditional instruction on the correct CP varied from description of 'firm pressure'[1] to 'pressure on the nose bridge causing discomfort' and 'pressure against one's cricoid which prevents swallowing'.[33] Various training modalities that had been practised 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 resulted in improvement in CP performance in both simulated[20,33,36,37] and clinical settings.[38] This improvement has been demonstrated in healthcare personnel, including nursing staff from emergency, anaesthesia and critical care departments,[20,33,36-38] after short periods of training. Conversely, retention of acquired skills is largely variable and reportedly ranges from 3 weeks to 3 months,[19,23,34,37] leading to retraining recommendation at intervals of 3–6 months.[31] In a recent study by Hersey and McAleer,[39] nursing competencies required for assisting RSI in the emergency department were identified by a multidisciplinary collaborative focus group (physicians and nurses in anaesthesia, emergency medicine and intensive care medicine). These identified key areas of competencies, which included CP, were then used to develop an interactive e-learning resource that had been found to increase self-reported measures of competency and confidence among nurses in the emergency department. Hersey and McAleer concluded that such a learning resource is useful as both an introduction to airway assistance and

Table 3. Landmark, finger technique, recommended force taught and applied by nurses.

Variable	*n* (%)		
	Taught to nurses	Applied by nurses	
Landmark			
No response	98 (36.6)	72 (26.9)	
Cricoid cartilage (CC)	100 (37.3)	74 (27.6)	
Below the 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 three fingers	6 (2.2)	6 (2.2)	
Press downwards with index, thumb and third finger, stabilise CC	179 (66.8)	94 (35.1)	
Pinch with two 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)	
	All	Adult	Child[a]
Knowledge of recommended force			
No response	124 (46.3)	41 (15.3)	26 (16.8)
Not sure[b]	49 (18.3)	90 (33.6)	87 (56.1)
Do not know	NA	24 (9.0)	22 (14.2)
Acceptable force range (N)[c]	78 (29.1)	90 (33.6)	13 (8.4)
30	13 (4.9)	11 (4.1)	2 (1.3)
10–30	1 (0.4)	3 (1.1)	1 (0.6)
30–40	15 (5.6)	14 (5.2)	NA
Reported force not accepted	23 (8.6)	23 (8.6)	9 (5.8)

Nurses in the All, Adult and Child groups reported the range of force as 5–50 N, 2–200 N and 2–50 N, respectively. [a]Data presented as percentage of responders, whereby paediatric practice is applicable. [b]Some nurses reported 'not sure' and a force simultaneously — six nurses in the All group (taught to nurses) and two nurses in the Child group (applied by nurses). [c]Acceptable cricoid pressure included recommendation of 30 N, or the range of 10 N when awake to 30 N when under anaesthesia, or 20 N when awake and increased to 30 or 40 N when under anaesthesia or a range between 20 N and 44 N. Cricoid pressure in the range from 10 N to 30 N was accepted as appropriate for children. BURP: backwards, upwards and right pressure, NA: not applicable (question not asked)

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; therefore, we could not appraise the actual performance of CP by nurses, such as localisation 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 CP 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 was not homogeneous, we have included results from all hospitals. A total of 155 nurses responded that they were involved in provision of anaesthesia care for children; these respondents included nurses practicing in general hospital setting in addition to specialist paediatric setting. Paediatric patients range from infants to adolescents (the appropriate CP therefore varies). 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 in knowledge. Lastly, our findings are limited to anaesthesia nurses and cannot be extrapolated to other clinical areas where CP is less frequently practised, such as the emergency department. In these areas, an evaluation of education and training needs should be performed.

Nevertheless, this study 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 CP. A collaborative effort between anaesthesiologist and anaesthetic nurses may be the way towards planning a robust training programme to foster updated knowledge and skill acquisition among the nurses.

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Conflicts of interest

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