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Who should perform an emergency surgical front of neck airway: Head & Neck Surgeon, General Surgeon or Anaesthetist?

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Complete List of Authors:	Groom, Peter; Aintree University Hospitals NHS Foundation Trust, Anaesthesia Schofield, Louise; Aintree University Hospitals NHS Foundation Trust, Anaesthesia Hettiarachchi, Natasha; Aintree University Hospitals NHS Foundation Trust, Anaesthesia PICKARD, SAMUEL ; Aintree University Hospitals NHS Foundation Trust, Anaesthesia Brown, Jeremy; Edge Hill University, Faculty of Health & Social Care Sandars, John; Edge Hill University, Postgraduate Medical Institute, Faculty of Health & Social Care, Morton, Ben; Aintree University Hospitals NHS Foundation Trust, Anaesthesia; Liverpool School of Tropical Medicine, Clinical Sciences
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Who should perform an emergency surgical front of neck airway: Head & Neck Surgeon, General Surgeon or Anaesthetist?

Peter Groom[1], Louise Schofield[2], Natasha Hettiarachchi[2], Samuel Pickard[3], Jeremy Brown[4], John Sandars[5] and Ben Morton[6]

Correspondence to: Dr. P. Groom (peter.groom@aintree.nhs.uk)

[1] Consultant Anaesthetist, Aintree University Hospital NHS Foundation Trust, Liverpool, UK.

[2] Anaesthesia Year 7 Specialty Trainee, Aintree University Hospital NHS Foundation Trust, Liverpool, UK.

[3] Anaesthesia Year 3 Core Trainee, Aintree University Hospital NHS Foundation Trust, Liverpool, UK.

[4] Professor of Clinical Education, Postgraduate Medical Institute, Faculty of Health & Social Care, Edge Hill University, Ormskirk, UK.

[5] Professor of Medical Education, Postgraduate Medical Institute, Faculty of Health & Social Care, Edge Hill University, Ormskirk, UK.

[6] Senior Clinical Lecturer, Clinical Sciences, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, UK. Honorary consultant Critical Care Medicine, Aintree University Hospital NHS Foundation Trust, Liverpool, UK.

Running Title

Who is best to perform a surgical cricothyroidotomy?

Keywords

Airway obstruction

Surgical Training

High-fidelity simulation training

Surgical cricothyroidotmy

Tracheostomy

Abstract

BACKGROUND The "Can't Intubate Can't Oxygenate" (CICO) emergency requires urgent front of neck airway access to prevent death. In cases reported to the 4th National Audit Project, the most successful front of neck airway (FONA) was a surgical technique, almost all of which were performed by surgeons. Subsequently, UK guidelines adopted surgical cricothyroidotomy as the preferred emergency surgical FONA technique. Despite regular skills-based training, anaesthetists may still be unwilling to perform an emergency surgical FONA.

AIM To compare consultant anaesthetists, head and neck surgeons and general surgeons in a high-fidelity simulated emergency. We hypothesised that head and neck surgeons would successfully execute emergency surgical FONA faster than anaesthetists and general surgeons.

METHODS We recruited 15 consultants from each specialty (total 45). All agreed to participate in an in-situ hi-fidelity simulation of an 'anaesthetic emergency'. Participants were not told in advance that this would be a CICO scenario.

RESULTS There was no significant difference in total time to successful ventilation between the three groups (median 86 vs. 98 vs. 126.5 seconds, p=0.078). However, anaesthetists completed the emergency surgical FONA procedure significantly faster than general surgeons (median 50 vs. 86 seconds, p=0.018). Despite this strong performance, qualitative data suggested some anaesthetists still believed 'surgeons' best placed to perform emergency surgical FONA in a genuine CICO situation.

CONCLUSION Anaesthetists regularly trained in emergency ~~emergency~~ surgical FONA function at levels comparable to head and neck surgeons and should feel empowered to lead this procedure in the event of a CICO emergency.

Introduction:

The "Can't Intubate Can't Oxygenate" (CICO) emergency is an acute life-threatening event. An emergency front of neck airway (FONA) is employed as a life-saving procedure in this situation with multiple methods described. The 4th National Audit Project (NAP4) [1] demonstrated low success rates for needle cricothyroidotomy (4/11) compared to emergency surgical FONA, which were all successful when performed by a surgeon (44/44) [2]. ~~that emergency surgical FONA had higher success rates (44/44) compared to needle cricothyroidotomy techniques (4/11) for patients in recorded CICO events [2].~~ Subsequently, surgical cricothyroidotomy was recommended as the optimal emergency surgical FONA procedure for CICO events by the Difficult Airway Society (DAS)[3]. However, in NAP4 almost all emergency surgical FONA's were performed by surgeons rather than anaesthetists[2] such that it is currently unclear if the improved procedural success is related to the procedure or the operator.

~~However, in NAP4 all 44 emergency surgical FONA's were performed by surgeons rather than anaesthetists [2] such that it is currently unclear if the improved outcome is related to the procedure or the operator.~~

In 2016, UK anaesthetists and head and neck surgeons adopted a unified approach to the CICO emergency, advocating surgical cricothyroidotomy as the optimal FONA technique [4, 5]. This recommendation emphasises a structured multidisciplinary approach, inclusive of anaesthetists, operating department practitioner's, theatre nurses and surgeons to prevent ~~cerebral~~ hypoxia and death [4, 5]. Subsequently, a survey of anaesthetists and surgeons demonstrated superior knowledge and training in surgical cricothyroidotomy amongst anaesthetists compared to their surgical colleagues [6]. Success of emergency surgical cricothyroidotomy depends on both procedure simplicity and regular rehearsal [7-9]. Anaesthetists are encouraged to undertake regular CICO and surgical cricothyroidotomy training ideally as part of multidisciplinary team simulation training [1, 3-5]. Regular training may improve anaesthetists performance compared to surgeons who may not have access to these courses, but this is not yet supported by evidence [10].

Our aim was to compare the performance and knowledge of anaesthetists, specialist head and neck surgeons and general surgeons in an in-situ, high-fidelity simulated emergency CICO scenario. We hypothesised that head and neck surgeons, some of whom regularly perform surgical

tracheostomies, would demonstrate superior performance compared to both anaesthetists and general surgeons.

METHODS

Participants

This study was conducted at Aintree University Hospital National Health Service Foundation Trust, a tertiary referral centre for head and neck surgery and a regional trauma centre. Aintree University Hospital has implemented biannual surgical cricothyroidotomy skills and multidisciplinary team CICO training for anaesthetic consultants and trainees in line with recommendations [1, 3-5]. Three groups of participants were recruited; anaesthetists, specialist head and neck surgeons (inclusive of both ear, nose and throat and maxillofacial surgeons) and general surgeons. All participants were employed as consultants at Aintree University Hospital with active General Medical Council specialist registration. To avoid selection bias, we employed a random sampling method by listing alphabetically all consultants for each specialty. We then employed GraphPad Prism (https://www.graphpad.com/scientific-software/prism/) to randomize these potential participants who were then approached in list order by email. The only exclusion criterion was participant refusal. The study was reviewed and approved by National Health Service's Health Research Authority (18/HRA/0122) and Health Education England Research Governance (North West Office).

All participants were consented to participate in an 'anaesthetic' emergency simulation. Full disclosure about the nature of the emergency was not offered at enrollment to avoid potential confounders (e.g. preparation or discussion) that could affect performance in the CICO simulation. We used a robust standardised high-fidelity scenario to simulate a CICO emergency (Figure 1). This scenario had been developed in a previous study that investigated surgical cricothyroidotomy performance [11] and focused on the induction of anaesthesia in an obese but otherwise healthy simulated adult patient with a normal airway assessment. Full details of the standardised simulation and debrief are provided in the supplemental data (Figures S1 and S2).

[FIGURE 1]

The scenario was performed in situ (operational anaesthetic room) with an operating department practitioner. The scenario facilitators (L.S, N.H & S.P) used a standardised approved script to ensure identical conditions across each simulation. The same scenario facilitator controlled and filmed the scenarios. A TruCorp® TruMan Trauma X (TruCorp® Ltd, Belfast) manikin was used with incorporation of a prosthetic bleeding neck to mimic a patient with an impalpable cricothyroid membrane [12]. DAS guidelines recommend a midline vertical incision in this situation [3]. Monitoring was displayed on a tablet device (iPad) and controlled remotely with SimMon (Castle+Andersen

ApS). Figure 2 demonstrates the orientation of the monitoring relative to the manikin and the bleeding neck prosthesis.

[FIGURE 2]

All participants consented to take part between cases on one of their normal working days in theatre. Participants were called from the theatre coffee room or office by either L.S, N.H or S.P and briefed on the nature of the scenario: A senior anaesthetist, P.G, was struggling to intubate the trachea of a patient and had called for help. P.G is the Aintree University Hospital trust airway lead and senior head and neck anaesthetist. P.G. assumed the simulated consultant anaesthetic role to improve the credibility that DAS algorithm plans A-C were performed competently and to discourage participants from 'taking over' these steps. The simulation was filmed (with consent) to facilitate quantitative assessment. Participants were directed not to discuss the nature of the simulation with colleagues. All participants were sent an email request to contact J.B. (qualitative researcher) by telephone and arrange a mutually convenient time for a semi-structured telephone interview.

The primary outcome was time to achieve ventilation of the mannikin's lungs after declaration of the CICO emergency. We hypothesized that anaesthetists and general surgeons would be significantly slower compared to head and neck surgeons. The secondary outcomes included the method of emergency surgical FONA, prior knowledge of guidelines for CICO management and qualitative enquiry to determine attitudes toward the simulation and perceptions of who is best placed to perform an emergency surgical FONA. We employed data from published work that investigated emergency surgical FONA performance on the same manikin, neck prothesis and simulation scenario to power this study [11]. We used a baseline hypothetical 'gold standard' time of 150 seconds to detect a 30 second difference between specialties from declaration of CICO to completion of the emergency surgical FONA. Based on three groups, significance at a p value of 0.05 and power of 80%, we calculated that 15 subjects per group would be required to demonstrate this difference. For each simulation we timed three phases of emergency surgical FONA performance:

1. **Deliberation time**: *Time from declaration of a CICO scenario to initiation of the* emergency surgical FONA
2. **Surgical time**: *Time from initiation of the* emergency surgical FONA *to completion*
3. **Total time**: Time *from declaration of a CICO scenario to completion of the* emergency surgical FONA

'CICO' deliberation time commenced when P.G declared his inability to oxygenate the patient, via intubation, supraglottic airway device or bag-mask technique with the standardised phrase "you have to do emergency front of neck access" (Figure 1). Completion of emergency surgical FONA was defined as confirmation of chest expansion following manikin intubation via the neck incision. Time to completion was calculated from the video recording for all participants. As a confirmatory measure, correct tracheal placement was also confirmed after the scenario before the model was dis-assembled. All data were analysed using STATA 13.1 (Statacorp, USA). Data were tested for normality (Shapiro-Wilk test) and appropriate statistical tests employed to determine differences between consultant groups. Specifically, we identifiedhere non-parametric data distributions ~~were identified we~~so used the Kruskall-Wallis test to test differences across the three groups and used Dunn's test to correct for multiple comparisons. For categorical data we used Chi-squared tests to examine for differences. We considered that a p value of <0.05 demonstrated a significant difference between comparison groups as is convention.

Qualitative Data:

After the simulation, study participants were asked to take part in an audio recorded telephone semi-structured interview with a member of the research team (JB, a non-clinician with expertise in postgraduate medical education). Full details of the telephone interview are provided in the supplemental data (Figure S3). Verbal consent was confirmed prior to the start of each interview. Each audio recording was transcribed for analysis. A thematic framework was devised by JB after initial reading of the transcripts and deliberations with the research team [13]. Construction of codes and thematic categories was cross checked by two independent raters (JB and JS) for inter-rater reliability [14]. This process identified areas of agreement to minimize any potential for bias in interpretation. Data analysis activities were recorded so the interpretation of qualitative data could be tracked, ensuring auditability. A number was allocated to each interviewee in order of participation. This number appears after each quotation in the results section along with the participant's specialty.

RESULTS

Forty-five consultants were recruited to this study, 15 anaesthetists, 15 head & neck surgeons (10 oral maxillofacial surgeons and 5 ear, nose and throat surgeons) and 15 general surgeons and median number of years since completion of clinical training was 5 years (IQR: 1-14) for anaesthetists, 12 years (IQR: 2-18) for head and neck surgeons and 11 years (IQR: 7-15) for general surgeons. All anaesthetists (15/15), 10/15 head and neck and 11/15 general surgeons had previously been trained in emergency surgical FONA. 15 (100%) of -anaesthetic consultants had participated in local departmental training and one -had also performed surgical cricothyroidotomy on a porcine cadaveric model. Eleven general surgeons (73%) had previously been trained in the performance of emergency FONA: one during a Royal College of Surgeons course, seven during Advanced Trauma Life Support courses and three did not specify. Ten head and neck surgeons (67%) had previously received emergency FONA training: one during a Royal College of Surgeons course, seven during Advanced Trauma Life Support courses and two on a human cadaveric course. The time elapsed since emergency surgical FONA training differed between specialties: all anaesthetic consultants had participated in training in the previous six months while the median time since training for head and neck surgeons was 2.5 years (IQR: 1-10) and 14 years (IQR: 4-20) for general surgeons, p<0.001. Anaesthetic participants were more likely to be aware of Difficult Airway Society Guidelines for CICO compared (15/15) to head and neck surgeons (5/15) and general surgeons (~~0/15, χ^2 [2, n=45] = 31.5, p<0.001~~).

Forty-four participants successfully completed an emergency surgical FONA. One participant (general surgeon) declined to attempt an emergency surgical FONA in the emergency scenario stating that this was outside of their training expertise. There was no significant difference in total time to complete a successful emergency surgical FONA across the three groups: anaesthetists (median 86s, IQR 69-135s), head and neck surgeons (median 98s, IQR 67-151s), and general surgeons (n=14, median 126.5s, IQR 93-187s), p=0.078 ~~(Kruskal Wallis)~~. Figure 3 displays box and whisker plots for deliberation time, surgical time and total time for each specialty. There were no significant differences in deliberation time between the groups: median 30s (IQR: 24-43) anaesthetists vs 31s (IQR: 16-38) head and neck vs. 23s (IQR: 14-45) general surgeons, p = 0.665 ~~(Kruskall Wallis)~~. However, surgical time was significantly different between the three groups: median 50s (IQR 45-80) anaesthetists vs.74s (IQR: 42-127) head and neck vs. vs. 86s (IQR: 76-163) general surgeons, p = 0.018 ~~(Kruskall Wallis)~~. When compared directly, anaesthetists completed the procedure significantly quicker than general surgeons, p = 0.0144 ~~(Dunn's test)~~ but not head and neck surgeons, p=0.4022 ~~(Dunn's test)~~.

[FIGURE 3]

Different techniques were used to complete the emergency surgical FONA between specialties (Table 1). The time taken to successfully complete an emergency surgical FONA was significantly impacted by procedural choice: vertical incision cricothyroidotomy (median 87.5s, IQR: 68-135), transverse stab incision cricothyroidotomy (median 115s, IQR: 90-161) and classical tracheostomy (median 131.5s, IQR: 113-185), p=0.05. ~~All anaesthetists (15/15), 10/15 head and neck and 11/15 general surgeons had previously been trained in emergency surgical FONA. 15 (100%) of anaesthetic consultants had participated in local departmental training and one had also performed surgical cricothyroidotomy on a porcine cadaveric model. Eleven general surgeons (73%) had previously been trained in the performance of emergency FONA: one during a Royal College of Surgeons course, seven during Advanced Trauma Life Support courses and three did not specify. Ten head and neck surgeons (67%) had previously received emergency FONA training: one during a Royal College of Surgeons course, seven during Advanced Trauma Life Support courses and two on a human cadaveric course. The time elapsed since emergency surgical FONA training differed between specialties: all anaesthetic consultants had participated in training in the previous six months while the median time since training for head and neck surgeons was 2.5 years (IQR: 1-10) and 14 years (IQR: 4-20) for general surgeons, p<0.001. Anaesthetic participants were more likely to be aware of Difficult Airway Society Guidelines for CICO compared (15/15) to head and neck surgeons (5/15) and general surgeons (0/15, χ^2 [2, n=45] = 31.5, p<0.001).~~

[TABLE 1]

Qualitative Findings

Twenty (44%) participants volunteered to be interviewed and were included in the analysis. Ten anaesthetists and 10 head & neck surgeons. Nine (45%) interviewees had real life experience of a can't intubate can't oxygenate scenario~~emergency FONA~~ (1 a~~A~~naesthetist and ~~,~~8 h~~H~~ead and neck surgeons~~&N~~). Five of these had performed an emergency surgical FONA (1 anaesthetist, 4 head and neck surgeons). Fourteen (70%) had previously experienced high-fidelity simulated emergency procedures. Six (30%) had participated in an emergency procedure on a cadaveric course (or on animals).

We found that the simulated scenario acted as a trigger for consultants to reflect on how they would perform when faced with this emergency situation:

> *So, I think the most useful aspect for anybody is actually just making people think about what they would do in that situation.* (5, Head and neck surgeon)

During the interviews, participants considered who should perform emergency surgical FONA in real life. A number of influential factors were listed including confidence levels, skillsets, clinical setting, experience, seniority of consultants, specialty and willingness to take the lead:

> *And so, depending on who the surgeon was, their seniority and their specialty versus who the anaesthetist was, their seniority and which areas they practiced in, it would determine who would be the best person in any one given circumstance*. (14, Anaesthetist)

> *There comes a point that the airway is actually lost and anaesthetists have a tendency to want to keep control, to want to keep trying* (5, Head and neck surgeon)

Head and neck surgeons perceived themselves to be the most appropriate person to lead on the basis that they operate on the neck regularly but suggested that the anaesthetist may be best if other surgical specialties were present:

> *I am one of the specialties that performs surgery in the head and neck so I feel that in that particular scenario, that I would probably be the best person to do that. I think if I was a surgeon who didn't practice in the head and neck, I think an anaesthetist or a surgeon would be equally placed, possibly the anaesthetist would be better placed because of the familiarity of airway anatomy* (4, Head and neck surgeon)

> *I know the anaesthetists are good at subcutaneous access, but I don't think, well, I would be surprised if they had the confidence to make an incision in the neck.* (20, Head and neck surgeon)

Anaesthetists had varied views on who should take the lead. One anaesthetist explained why they thought a surgeon was best placed to take the lead.

> *It may be that the surgeon is the best person to do it if they're an experienced surgeon in the field because with the best will in the world, I'm not a surgeon and I feel even though I've done tracheostomies and cricothyroidotomies on manikins and I've done tracheostomies on patients, in a controlled situation I still don't have the confidence to be able to say with certainty yes, I'm doing the right thing, I know what I'm doing surgically whereas a surgeon would have that benefit.* (6, Anaesthetiitst)

Other anaesthetists felt that a head and neck surgeon may be more appropriate to take the lead but if other surgical specialties were present it should be a member of the Anaesthetic team:

> *I think if you're up in B theatres with maxillofacial surgeons and ear, nose and throat surgeons, they're probably best equipped 'cause they're more familiar with performing practical procedures and surgical procedures. I think in other areas of the hospital, you know, general surgeons, orthopaedic surgeons, although they do surgery, they're maybe not that familiar with—I'm not sure that they'd be familiar with the guidelines, and it may be that the anaesthetist would be best placed.* (7, Anaesthetist)

> *If it is an ear nose and throat surgeon who does trachies [sic] then I think they're best equipped. If it was just a non-ear nose and throat or head and neck surgeon, then I think it would be the anaesthetist.* (10, Anaesthetist)

Other anaesthetists explained why they saw themselves as the Consultant Lead:

> *I think the person who's best practiced at doing it. It seems that we, I think anaesthetists are more familiar with emergency scenarios like that and I get the impression that surgeons don't regularly do drills like that so whilst they have the, in theory, the better technical skills, I think in a scenario like that where it's very time-sensitive, I think at the moment anaesthetists are probably better equipped. But that's not to say that if surgeons had regular front of neck access training, that they, I would imagine they would become the most appropriate person to do it.* (13, Anaesthetist)

Some of the head and neck surgeons explained the challenges they faced during the emergency surgical FONA ~~emergency~~ scenario when they were effectively forced to only use the equipment they had in front of them.

> *I'm an ear nose and throat surgeon, but I specialize in airway difficulty, so I would have got my rigid laryngoscope and done an assessment from the top, because I know I have that equipment there. It was in the theatre next door, but no one would go and get it for me. I kind of went along with it. So that's what I found difficult. I know it's kind of high fidelity, but it's also not exactly the way I would have done it in that setting, if that makes sense.* (3, Head and neck surgeon)

> *They said this is all encompassing, and you should do it with a scalpel with a bougie and a fixed tube and nothing else, were as in my previous experience I have done a lot of surgical airway management in emergency and non-emergency and I've had a much bigger range of equipment. So, my first thought on the sim was I know what I'm doing here so can I have a dish tray, a trachea tray open blah and I was looking for instruments and they said no you only have this and I was flummoxed by that, so I was confident to do it my way and I wasn't confident to do it their way obviously.* (4, Head and neck surgeon)

DISCUSSION

We found that anaesthetists performed the procedural component of an emergency surgical ~~(initiation to completion)~~ FONA significantly faster than general surgeons in a high-fidelity simulated emergency can't intubate can't oxygenate scenario. There was no significant difference in performance between anaesthetists and head and neck surgeons. Qualitative data suggests that despite this strong performance, some anaesthetists still perceived that 'surgeons' would be best placed to perform emergency surgical FONA in a genuine can't intubate, can't oxygenate situation. This study demonstrates that anaesthetists regularly trained and drilled to perform surgical cricothyroidotomy function at comparable levels to head and neck surgeons and should feel confident to lead this procedure in the event of a CICO emergency.

The CICO situation is a rare but acutely life-threatening event estimated to occur, on average, once in an anaesthetic career [11]. This frequency is likely to be increased for anaesthetists working in high risk areas such as head and neck cancer, trauma and critical care. Evidence from NAP4 suggests that emergency surgical FONA was more successful than needle-based techniques but all of these procedures were performed by surgeons [1, 2]. Following on from the NAP4 audit, the Royal College of Anaesthetists, Association of Anaesthetists of Great Britain and Ireland, the Difficult Airway Society and the UK's ear nose and throat and oral maxillofacial surgeons adopted surgical cricothyroidotomy as the most simple and expedient method for emergency front of neck airway access [3-5]. Both surgeons and anaesthetists may lack the skills and confidence to perform an emergency surgical FONA[11, 15-18]. Robust training on emergency front of neck airway access is vital to improve competence and confidence [8-11, 16-19]. In this study, all anaesthetists we aware of guidelines ~~new~~ and ~~regularly~~ practiced in the managementing the ~~a~~ CICO emergency and ~~y~~ and ~~performing an emergency~~ surgical FONA ~~according to current guidelines~~. This is reflected in our results, where anaesthetists more often correctly performed a vertical incision which was associated with improved speed. There is increasing evidence that structured training programmes for surgical cricothyroidotomy improve clinical performance for emergency FONA in both military deployment [8, 18, 20] and civilian environments [7, 9]. As a tertiary healthcare centre, we compared anaesthetists with expert head and neck surgeons (some of whom regularly perform elective tracheostomies) and general surgeons. Our results, demonstrating superior performance in anaesthetists compared to general surgeons, indicate that for general hospitals, without tertiary head and neck expertise, the trained anaesthetist may be best placed to perform the emergency surgical cricothyroidotomy procedure.

Our qualitative investigation identified variations in perception of roles amongst the anaesthetists and surgeons during FONA emergencies. These differing perceptions also related to the equipment available at the emergency; head and neck surgeons often requested a specialized laryngoscope or a tray of tracheostomy instruments. Anaesthetists may be in a more advantageous position compared to surgeons as they have more regular specific training on a single surgical cricothyroidotmy technique. Surgeons with a higher skill base may exercise greater procedural autonomy but this may increase complexity and time to successful tracheal cannulation in an emergency 'situation/event' ~~scenario~~. However, this potential advantage should be offset against the sense of personal failure that anaesthetists may experience if their conventional airway management techniques have failed (9). ~~As one of the head and Neck surgeons said at interview; "*There comes a point that the airway is actually lost and anaesthetists have a tendency to want to keep control, to want to keep trying*" .~~ Surgeons may be less likely to carry the emotional baggage of airway failure that may increase deliberation times (see above quote: "5, Head and neck surgeon"). However, no difference in deliberation time between specialties was observed in this study. As there are multiple factors that can influence performance, we recommend that roles should be agreed within theatre teams at the WHO team briefing. We also recommend multidisciplinary team training to facilitate the rehearsal of guidelines and prospective assignment of roles and responsibilities.

We choose to use in situ, high-fidelity simulation as a pragmatic tool to measure emergency surgical FONA performance. Our simulation was developed and refined during a previous study that examined optimal training tools to teach surgical cricothyroidotmy for anaesthetic trainees [11]. We incorporated a neck prosthesis within our manikin that made palpation of the laryngeal and cricoid cartilages impossible. In this circumstance, DAS guidelines recommend a vertical incision surgical cricothyroidotomy[3]. We observed that 13/15 anaesthetists, 7/15 head and neck and 6/14 general surgeons adopted this approach and successfully completed the procedure significantly faster than alternative techniques (horizontal incision or tracheostomy). Limited surgical training in a defined procedure may have been advantageous for anaesthetists in this respect. We deliberately did not inform clinicians of scenario specifics prior to their involvement and qualitative data suggests that participants did not discuss their experiences with one another. Our qualitative data demonstrates that clinicians strongly engaged with the scenario and that simulation information was not shared during the study. Participants were requested not to discuss the scenario with colleagues as part of the consent procedure. A potential limitation of the study is that different levels of exposure to simulation training between anaesthetists and surgeons may have impacted on performance [21]. The

duration between last training episode and the emergency simulation was longer for surgeons. We noted that deliberation times were short in our investigation this is likely because participants were exposed to protocolised airway management and then instructed to perform emergency FONA. Potentially, participants may have had prior knowledge of the scenario, however, our methodology was designed to prevent this eventuality and our post-procedural qualitative data suggests that inter-participant communication did not occur. Another limitation to the study is the lack of qualitative data from general surgeons. In addition, surgeons were less likely to be aware of recommendations and guidelines for the management of CICO situations compared to anaesthetists. These factors may have impacted on performance for general surgeons who rarely perform tracheostomy during routine clinical practice compared to head and neck surgeons. Further, subspecialisation of head and neck surgeons and resultant deskilling in the ability to perform an emergency surgical FONA has been previously described[22]. From a qualitative methodological point of view some participant opinions may have been better measured by asking some key closed questions at the start of each interview.

In conclusion, we have demonstrated that anaesthetists perform an emergency surgical FONA comparably to expert head and neck surgeons in an emergency simulated CICO situation. In addition, anaesthetists successfully completed an emergency surgical FONA faster than general surgeons. This study demonstrates that, in a unit with regular multidisciplinary CICO training and rehearsal, anaesthetists are well placed to perform an emergency ~~emergency~~ surgical FONA. However, there were varied perceptions on who should perform an emergency surgical FONA amongst the study participants if a genuine CICO event were to arise. We recommend regular multidisciplinary CICO training and drills for anaesthetists and surgeons. We also recommend prospective discussion between individual anaesthetists, surgeons and the multidisciplinary team to assign roles, responsibilities and planned procedures in the event of a CICO 'situation/event' ~~scenario~~.

Authors' Contributions and Authorship:

P.G.: Study Design and Concept; Design of Data Collection Method; Participant Recruitment; Simulation design and running; Data Collection; Data Analysis; Writing First Draft of Manuscript, Revising the Manuscript

L.S.: Simulation design and running; Data Collection; Data Analysis; Writing Manuscript, Revising the Manuscript

N.H: Simulation design and running; Data Collection; Data analysis; Writing Manuscript, Revising the manuscript

S.P.: Simulation design and running; Data Collection; Data analysis; Writing Manuscript, Revising the manuscript

J.B.: Design of Data Collection Method; Data Collection; Data Analysis; Revising the Manuscript

J.S.: Design of Data Collection Method; Data Analysis; Revising the Manuscript

B.M.: Study Design and concept; Design of Data Collection Method; Statistical Analysis, Revising the Manuscript

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TABLES:

[TABLE 1]

	Front of Neck Airway Technique Employed			
	Vertical surgical cricothyroidotomy	Transverse surgical cricothyroidotomy	Tracheostomy	Refused
Head & Neck Surgeon	7	5	3	0
General Surgeon	6	3	5	1
Anaesthetist	13	2	0	0

Table 1: Emergency surgical front of neck airway technique by specialty. Table describes the surgical technique used according to specialty. Techniques include vertical incision surgical cricothyroidotomy, transverse incision surgical cricothyroidotmy, classical tracheostomy and refused to perform procedure. Chi^2 analysis demonstrated no significant difference in technique between specialties: χ^2 (6, n=45) = 11.46, p=0.075.

LEGENDS TO ILLUSTRATIONS:

Figure 1: Standardised can't intubate can't oxygenate high-fidelity simulation scenario sequence of events. This simulation scenario was delivered in an operational theatre anaesthetic room by a consultant anaesthetist and regular operating department staff. Each participant was exposed to an identical scripted scenario during this study. SAD: supraglottic airway device; ODP: operating department practitioner; LMA: laryngeal mask airway.

Figure 2: Figure shows the orientation of the tablet (iPad) monitor relative to the manikin in the anaesthetic room (2a). The close up shows how the manikin's neck prosthesis was adapted to bleed when incised (2b).

Figure 3: Deliberation, surgical and total time to successful emergency surgical front of neck airway according to specialty. Figure demonstrates box and whisker plots (median, interquartile and range) of deliberation, surgical and total time to an emergency surgical FONA by clinician specialty. The Kruskall-Wallis test was used to determine if there was a difference across the three groups. The Dunn's correction~~Mann-Whitney U~~ test was used to determine difference between anaesthetists and general surgeons.

LEGENDS TO SUPPLEMENTAL FIGURES FOR ON LINE PUBLICATION ONLY:

Supplemental Figure S1: Can't Intubate Can't Oxygenate Scenario Simulation

Supplemental Figure S2: Structure of Post Simulation Debrief

Supplemental Figure S3: Semi-structured interview schedule

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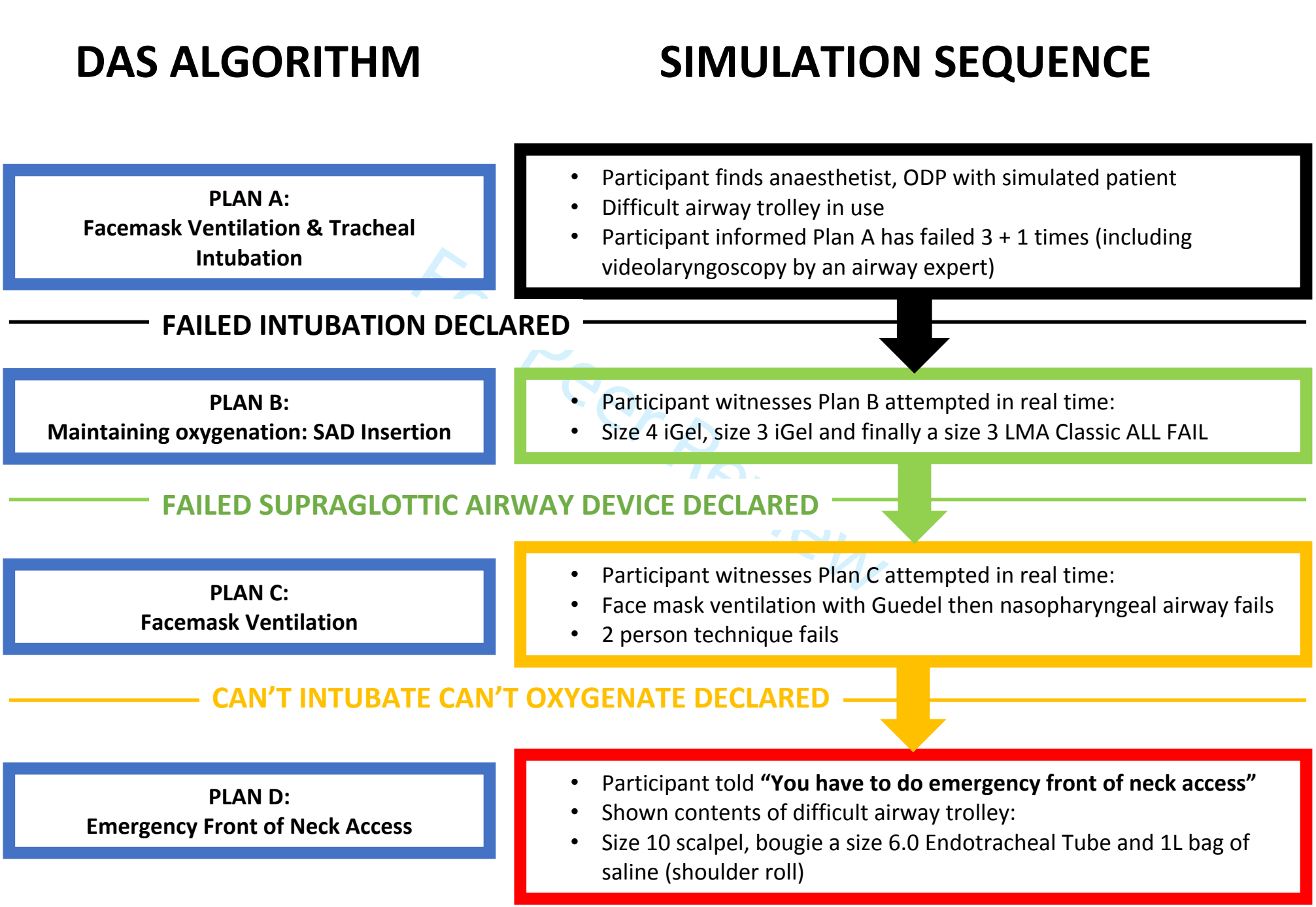
DAS ALGORITHM
SIMULATION SEQUENCE
PLAN A:
Facemask Ventilation & Tracheal Intubation
• Participant finds anaesthetist, ODP with simulated patient
• Difficult airway trolley in use
• Participant informed Plan A has failed 3 + 1 times (including videolaryngoscopy by an airway expert)
FAILED INTUBATION DECLARED
PLAN B:
Maintaining oxygenation: SAD Insertion
• Participant witnesses Plan B attempted in real time:
• Size 4 iGel, size 3 iGel and finally a size 3 LMA Classic ALL FAIL
FAILED SUPRAGLOTTIC AIRWAY DEVICE DECLARED
PLAN C:
Facemask Ventilation
• Participant witnesses Plan C attempted in real time:
• Face mask ventilation with Guedel then nasopharyngeal airway fails
• 2 person technique fails
CAN'T INTUBATE CAN'T OXYGENATE DECLARED
PLAN D:
Emergency Front of Neck Access
• Participant told "You have to do emergency front of neck access"
• Shown contents of difficult airway trolley:
• Size 10 scalpel, bougie a size 6.0 Endotracheal Tube and 1L bag of saline (shoulder roll)

Figure 2

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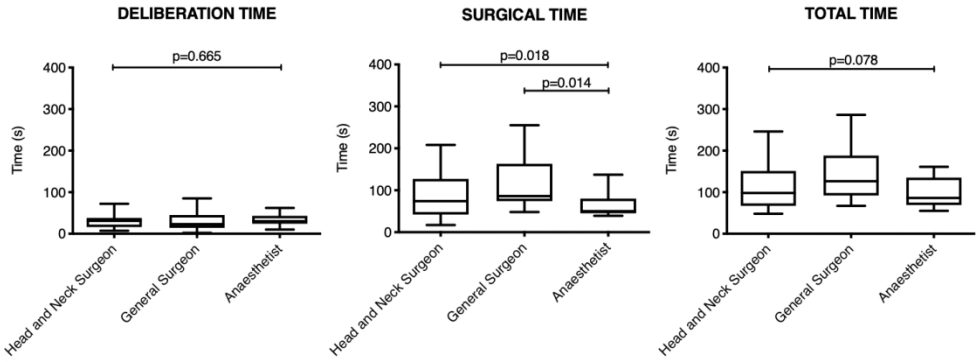

Figure 3

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