Global Airway Management of the Unstable Cervical Spine Survey

Minor dissertation submitted in partial fulfilment of the requirements for the degree of Master of Medicine (MMed) in the Department of Anaesthesia & Perioperative Medicine

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Abstract

Background
Rapid growth in optical and video devices for indirect visualisation of the airway has expanded the options for emergency and elective endotracheal intubation in patients with unstable fractures of the cervical spine. Aiming to ascertain whether video laryngoscopy (VL) has replaced awake flexible intubation (AFI) as the preferred technique for airway management, we conducted a global survey to evaluate current clinical practice.

Methods
After ethics approval, we created a questionnaire featuring one emergency and one urgent elective hypothetical patient with unstable injuries of the cervical spine. Target sample sizes per country were estimated using data from the World Federation of Societies of Anaesthesiologists’ (WFSA) Global Anaesthesia Workforce Survey. Respondents were asked about their training, experience, airway skills, current clinical setting, and availability of airway equipment, as well as their preferred airway strategy in each case. The questionnaire was actively distributed for one year through the WFSA member societies and via social networks to physician anaesthesia providers (PAPs). Global and regional trends were assessed using descriptive statistics.

Results
Of a total of 1904 responses, 1153 (101 countries) were included in the final analysis. In the emergency case, 46.9% (95% confidence interval [CI]: 44.0–49.8%) of participants preferred VL and 39.8% (95% CI: 38.0–42.6%) chose AFI. In the urgent elective case, 51.3% (95% CI: 48.3–54.3%) selected VL as their preferred method, while 37.3% (95% CI: 34.4–40.2%) indicated AFI. Significant regional variations in preference were found.

Conclusion
The results suggest that practice in airway management of unstable cervical spine fractures is changing, and currently tends to favour VL over AFI. There is a statistically significant preference for VL in elective cases, traditionally considered to be a stronghold of AFI.
The manuscript for the prospective observational study has been formatted for the South African Journal of Anaesthesia and Analgesia. The ‘Author Guidelines’ for the journal can be found in Appendix 4 or online at http://www.sajaa.co.za/index.php/sajaa/about/submissions.
Global Airway Management of the Unstable Cervical Spine Survey (GAUSS)

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Preliminary results from this study were presented at the World Airway Management Meeting 2019 and were published as an abstract in Trends in Anaesthesia and Critical Care Volume 30, February 2020.

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Rapid growth in optical and video devices for indirect visualisation of the airway has expanded the options for emergency and elective endotracheal intubation in patients with unstable fractures of the cervical spine. Aiming to ascertain whether video laryngoscopy (VL) has replaced awake flexible intubation (AFI) as the preferred technique for airway management, we conducted a global survey to evaluate current clinical practice.

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The results suggest that practice in airway management of unstable cervical spine fractures is changing, and currently tends to favour VL over AFI. There is a statistically significant preference for VL in elective cases, traditionally considered to be a stronghold of AFI.

Keywords
Airway management; cross sectional survey; spinal fractures; tracheal intubation; bronchoscopy
Introduction

Spinal cord injury accompanying cervical spine fractures is a major concern in the trauma patient. On average, 1.8% of patients with blunt trauma will have cervical spine injuries.\(^1\) Spinal cord injury secondary to airway management is a rare but potentially devastating complication.\(^2^4\)

Unstable cervical fractures pose a twofold challenge: patients may present with a difficult airway, and the airway intervention itself could cause or exacerbate spinal cord injury. Reasons for a difficult airway may include limited mouth opening as well as limited movement due to cervical immobilisation techniques employed. Patients can be hypotensive, hypovolaemic, hypoxic, or present with a threatened airway due to spinal cord or associated injuries.\(^5\) Maxillofacial injuries and / or intraoral bleeding may further complicate management and it is suggested the mean blood pressure be maintained at 90 mmHg, or above.\(^6\) The clinician is tasked with multiple problems that require simultaneous management, so that these patients can often be challenging for the anaesthetist.

But what are the worldwide trends when PAPs manage patients with unstable cervical fractures? Are video laryngoscopes preferred, and if so, are they used primarily for awake intubation? Surveys prior to 2000 found that anaesthetists favour AFI in cooperative, stable patients for elective surgery, and direct laryngoscopy (DL) for emergency surgery.\(^7^9\) These surveys targeted anaesthetists in a single country only, and were done well before VL became readily available. The only recent study was a survey targeting PAPs in India, showing that 80% of respondents preferred AFI in the elective setting.\(^10\) Respondents were divided in their decision to use VL or DL for emergency cases. Since this survey with 122 respondents may not have been representative of global trends, we undertook to assess current worldwide clinical practice. We hypothesised that most PAPs worldwide used VL for tracheal intubation in both emergency and elective surgery cases.

The primary outcome for this study was to determine the worldwide PAP preference in the choice of airway management strategy and induction technique for patients with unstable cervical spine fractures, in their current clinical setting. Secondary outcomes included determining the rationale for the practitioners’ choice of intervention, and the availability of equipment and level of training in various settings, as well as identifying variation in responses from different regions.
Methods

The study population was PAPs in current anaesthesia practice worldwide. PAPs were included if they provided anaesthesia at least once per week and excluded if they were not qualified medical doctors.

Approval for the study was obtained from the Human Research Ethics Committee of the Faculty of Health Sciences of the University of Cape Town (HREC: 771/2018). The need for written consent was waived due to the nature of the study; agreeing to complete the survey was taken as evidence of consent. Investigators adhered to Ethical Principles for Medical Research Involving Human Subjects (as outlined in the Declaration of Helsinki and amended by the World Medical Association).

An anonymous online questionnaire consisting of 29 multiple choice questions was designed and piloted by sending it to a sample of airway experts for feedback. The aim was to include all the likely responses to questions in the multiple-choice options and to mitigate any lack of clarity in the questions or possible answers.

The survey gathered basic demographic data from respondents including their training, level of experience, airway skills, current clinical setting, and availability of airway equipment. PAPs were then presented with two hypothetical scenarios and asked about their preferred airway management strategy in their current clinical setting, and the rationale for their choices. The first patient had an unstable cervical fracture presenting for emergency pelvic surgery, and the second also had an unstable cervical fracture, presenting for urgent, semi-elective corrective surgery.

The survey was constructed and the data collected using REDCap® (Research Electronic Data Capture, https://www.project-redcap.org/), and the gathered data were stored on our institution’s secure servers.\textsuperscript{11} Data access was restricted to the three investigators, and the anonymity of the respondents was preserved.

Conduct of the study

The questionnaire was preceded by an information screen stating the purpose of the study and that completion of the survey would be regarded as an indication of consent (Supplementary Questionnaire). The 29 questions were presented over 3 subsequent screens, kept relevant
with piping logic. For example, a respondent would only be asked which VL blade they preferred if they chose VL as part of their management strategy. In questions dealing with reasoning for management choices, free text boxes were provided. The questionnaire was only available in English, and was not incentivised. A check was performed of the completeness of data entered, using the REDCap® software.

The survey was available online from 12 January 2019 to 11 January 2020. Links to the survey were distributed through multiple channels to achieve the maximum possible exposure to the study population. WFSA was contacted directly for assistance in advertising the study amongst their member societies. One hundred and thirty-six member societies representing 153 countries were individually contacted for assistance in distributing the survey amongst their members. Thereafter, six updates were sent to the societies to remind them about the study. Societies could either share links to the survey with their members or provide the investigators with their membership contact information. It is estimated that in these 153 WFSA member countries, only about 39% of the residing PAPs are members of the WFSA-affiliated society in that country. To compensate, the survey was also widely distributed via social networks.

Sample size calculation

WFSA has estimated the number of PAPs in the 153 member countries (out of a total of 197 countries included) to be 436,596. The 44 countries not included represent 2.5% of the world population. Therefore, for sample size calculation, it was assumed there are approximately 500,000 PAPs worldwide. To estimate the required sample size, the formula of Kreijchje and Morgan was used. Population proportion was taken as 0.5 to maximise sample size, degree of freedom was taken as 1, and the p-value was set at 0.05 (i.e. \(X^2 = 3.8416\)). If the margin of error was taken as 5%, the sample size needed was 384. For a margin of error of ± 3%, a sample size of 1065 respondents would be needed.

Statistical analysis

The data were presented as number (%) and analysed using descriptive statistics. Pearson’s chi square test and Fisher’s exact test were used where appropriate. Margin of error was calculated for all proportions and confidence intervals for differences between proportions were calculated using the Newcombe method. Correlations were sought between equipment availability and airway management skills, and the preference for equipment use. Countries were also analysed separately to identify regional differences. Criteria for a
country’s results to be reported separately was a sample size of at least 25 respondents as well as a statistically significant difference between the proportions of the primary outcome (i.e., choice in airway intervention). MedCalc® Statistical Software (Version 18.9.1 or later; MedCalc Software BVBA, Ostend, Belgium; http://www.medcalc.org; 2018), and Stata® Statistical Software (Version 16 or later; StataCorp, College Station, Texas; http://www.stata.com; 2019), were used for analysis.

Results

Eleven of the 136 WFSA societies could not be contacted. From the 125 reachable societies, only 14 responded to emails, and only 9 agreed to participate in the study. Judging by response patterns, at least 3 more societies who did not respond to our email communication did forward the study details to their members. Responses were a mixture of society members and PAPs receiving links to the survey via social networks (LinkedIn®, Facebook® and Twitter®).

Figure 1: (a) Respondent exclusion flow chart and survey completion rate calculation. (b) World map indicating countries from which responses were received in blue. Green indicates countries that fulfilled criteria to be reported separately.
The survey received 1904 responses from 111 countries. After exclusion of responses from non-PAPs, those with incomplete demographic details, and respondents who do not perform anaesthesia, 1153 responses from 101 countries were included in analysis (Figure 1a). Only 1094 respondents completed all questions. Nine countries fulfilled the criteria set out in methods to be reported separately (Figure 1b).

In web based surveys, view rate, participation rate and completion rate are more relevant than response rate. View rates and participation rates were however difficult to assess in this study, since distribution was over multiple social networks. Completion rate was calculated as 63.7% (Figure 1a).

Table 1 shows the demographic details of respondents, who were predominantly male (62.3% (n=718)) and over the age of 31. Most responses were from specialists working in tertiary and higher-level hospitals, the group likely involved in the management of patients with unstable cervical spine fractures.
### Table 1: Demographics of respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>718 (62.3)</td>
</tr>
<tr>
<td>Female</td>
<td>433 (37.6)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (0.2)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>30 years old or younger</td>
<td>126 (11.0)</td>
</tr>
<tr>
<td>31-40 years old</td>
<td>446 (38.7)</td>
</tr>
<tr>
<td>41-50 years old</td>
<td>336 (29.1)</td>
</tr>
<tr>
<td>51-60 years old</td>
<td>193 (16.7)</td>
</tr>
<tr>
<td>61-70 years old</td>
<td>47 (4.0)</td>
</tr>
<tr>
<td>Older than 70 years</td>
<td>5 (0.4)</td>
</tr>
<tr>
<td><strong>Highest qualification</strong></td>
<td></td>
</tr>
<tr>
<td>Medical degree</td>
<td>196 (17.0)</td>
</tr>
<tr>
<td>Diplomate Anaesthetist</td>
<td>167 (14.5)</td>
</tr>
<tr>
<td>Specialist Anaesthesiologist</td>
<td>790 (68.5)</td>
</tr>
<tr>
<td><strong>Experience in anaesthesia</strong></td>
<td></td>
</tr>
<tr>
<td>0-5 years</td>
<td>271 (23.5)</td>
</tr>
<tr>
<td>6-10 years</td>
<td>273 (23.7)</td>
</tr>
<tr>
<td>11-15 years</td>
<td>205 (17.8)</td>
</tr>
<tr>
<td>16-20 years</td>
<td>166 (14.4)</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>238 (20.6)</td>
</tr>
<tr>
<td><strong>Hospital level of current practice</strong></td>
<td></td>
</tr>
<tr>
<td>Community Health Clinic/Day Hospital/Primary level Hospital</td>
<td>76 (6.6)</td>
</tr>
<tr>
<td>Regional/Secondary level Hospital</td>
<td>185 (16.0)</td>
</tr>
<tr>
<td>Provincial/Tertiary level Hospital</td>
<td>342 (29.7)</td>
</tr>
<tr>
<td>National/Quaternary Level Hospital</td>
<td>550 (47.7)</td>
</tr>
<tr>
<td><strong>Frequency of anaesthesia administration</strong></td>
<td></td>
</tr>
<tr>
<td>Every day on duty</td>
<td>770 (66.8)</td>
</tr>
<tr>
<td>Three or four days per week</td>
<td>274 (23.8)</td>
</tr>
<tr>
<td>One or two days per week</td>
<td>85 (7.4)</td>
</tr>
<tr>
<td>Less than one day per week</td>
<td>24 (2.1)</td>
</tr>
<tr>
<td><strong>Frequency of managing trauma cases</strong></td>
<td></td>
</tr>
<tr>
<td>Every day on duty</td>
<td>68 (5.90)</td>
</tr>
<tr>
<td>Three or four days per week</td>
<td>114 (9.9)</td>
</tr>
<tr>
<td>One or two days per week</td>
<td>378 (32.8)</td>
</tr>
<tr>
<td>Less than one day per week</td>
<td>593 (51.4)</td>
</tr>
</tbody>
</table>

Respondents were asked to estimate the number of patients with unstable cervical spine fractures whom they had treated during their career. The median (interquartile range)
response was 20 (40) cases. The distribution of cervical cases was prominently skewed to the right and had several outliers. Twenty-four respondents estimated that they have been involved in 1000 cases or more, of which one specialist respondent estimated involvement in 10 000 cases. On the other hand, 25 respondents reported never having managed a patient with an unstable cervical fracture. The median number of patients was higher in the subgroup that identified themselves as specialists [30 (90)] compared with those with anaesthesia diplomas [15 (44)] and only a basic medical degree [10 (42)].

DL was the most commonly available airway intervention (94.7%), followed by a supraglottic airway (SGA) (91.1%) and VL (80.6%). Flexible bronchoscopes were available to 76.6% of respondents. Ninety two percent of respondents were confident using DL, 81.1% with VL and 64.9% with flexible bronchoscopy.

In the emergency case, 46.7% (95% CI: 43.8–49.6%) of participants preferred VL, while 40.0% (95% CI: 38.2–42.8%) chose AFI as their management strategy. The remainder of respondents chose DL (11.2%) or other techniques (2.0%). Of the respondents that chose VL, 2.1% (n=24) chose awake VL. In the elective case, 51.1% (95% CI: 48.1-54.15) preferred VL, while 37.4% (95% CI: 34.5-40.3%) chose AFI. DL was chosen by 9.1% of respondents and other techniques by 2.3%. The differences in AFI and VL proportions were statistically significant in both the emergency [6.8% (95% CI: 2.7-10.8%)] and elective cases [13.7% (95% CI: 9.6-17.8%)].

For induction technique in the emergency case, 48.8% (95% CI: 45.9–51.7%) of participants chose rapid sequence induction (RSI), 44.0% (95% CI: 41.1-46.9%) awake techniques and 7.2% elective sequence induction (ESI). The difference between RSI and awake techniques was statistically significant [4.9% (95% CI: 0.8-8.9%)]. In the elective case, 51.6% (95% CI: 48.7-54.4%) of respondents preferred ESI, 40.3% (95% CI: 37.5-43.1%) chose awake techniques and 1.6% RSI. The difference between awake techniques and ESI were also found to be statistically significant [11.2% (95% CI: 7.1-15.4%)].

Considerable variation was seen between countries (Figure 2 and 3). Table 2 shows the confidence intervals of the differences of the proportions between AFI and VL. Negative values indicate that the proportion of participants who chose VL was larger and a confidence interval not crossing zero taken as statistically significant.
Table 2: 95% Confidence intervals of the difference between the proportions of respondents selecting Awake fibreoptic Intubation (AFI) and Video laryngoscopy (VL) in the emergency and elective case. Negative values denote VL > AFI.

<table>
<thead>
<tr>
<th>Country</th>
<th>Emergency Case % (95% CI)</th>
<th>Elective Case % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferred VL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>-64.1 (-76.8 to -43.3)</td>
<td>-65.8 (-78.2 to -44.8)</td>
</tr>
<tr>
<td>Estonia</td>
<td>-35.7 (-55.8 to -9.5)</td>
<td>-23.1 (-45.6 to 3.5)</td>
</tr>
<tr>
<td>South Africa</td>
<td>-56.9 (-64.8 to -47.1)</td>
<td>-58.4 (-66.4 to -48.5)</td>
</tr>
<tr>
<td>UK</td>
<td>-27.4 (-39.9 to -13.3)</td>
<td>-25.6 (-38.6 to –11.0)</td>
</tr>
<tr>
<td>USA</td>
<td>-22.2 (-42.1 to 0.01)</td>
<td>-25.7 (-45.4 to -2.4)</td>
</tr>
<tr>
<td><strong>Preferred AFI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>17.5 (0.00 to 33.5)</td>
<td>10.0 (-7.7 to 26.8)</td>
</tr>
<tr>
<td>India</td>
<td>20.6 (7.3 to 32.8)</td>
<td>10.5 (-3.5 to 23.9)</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>32.3 (7.4 to 52.1)</td>
<td>16.7 (-8.2 to 38.8)</td>
</tr>
<tr>
<td>Spain</td>
<td>31.3 (18.5 to 42.7)</td>
<td>24.0 (10.5 to 36.4)</td>
</tr>
</tbody>
</table>

Figure 1: Respondent airway management preferences worldwide and per country for the emergency case. Airway device preference is indicated in the left graph and induction method on the right. Note the light blue bars on the left graph are other devices, including method on the right. Note the light blue bars on the left graph are other devices, including supraglottic airways and emergency cricothyroidotomy. AFI: awake fibreoptic intubation, VL: video laryngoscopy, DL: direct laryngoscopy, RSI: rapid sequence induction, ESI: elective sequence induction, UK: United Kingdom, US: United States of America.
In the emergency case, of those respondents that chose AFI, 89% (n = 408) gave the need to minimise cervical movement as a reason for their airway management choice. All other reasons for the choice of AFI were given in <40% of respondents. Respondents who chose VL and RSI also valued the requirement to minimise movement of the cervical spine [83% (n = 321)]. The need to secure the airway quickly [70% (n = 268)], and the fact that the patient was at risk for pulmonary aspiration [68% (n = 261)] were also considerations given. When asked if respondents would change their strategy if the patient were fasted, 33% (n = 385) indicated that they would. Several of these [39% (n = 151)] changed their strategy from VL and RSI to VL and ESI. Forty eight percent (n = 272) of respondents who chose RSI techniques, indicated they would change their technique in a fasted patient. Of respondents who preferred AFI, 19% (n = 87) indicated that they would change their strategy if the patient were fasted. Of these 19%, 83% (n = 73) indicated they would use VL rather than AFI in these circumstances.

Regarding the elective case, of those choosing AFI, 90% (n = 366) cited the need to minimise cervical movement as a reason for their choice, and 43% (n = 174) chose the possibility that the patient would be cooperative as a reason for their answer. All other options in this subgroup were chosen by < 32% of respondents. The respondents that chose VL and ESI cited the need to minimise cervical movement [83% (n = 383)], the patient being fasted [71% (n = 328)] and being most comfortable with the technique [57% (n = 263)] as the reasons for their choice.
Forty one percent of respondents indicated that they would remove the hard collar in the emergency case and 86% would perform manual in-line stabilisation (MILS).

Respondents that opted for VL for either case were asked about which blade type they would prefer. Sixty two percent (n = 465) indicated hyper-angulated blades (e.g., C-MAC® D-blade or Glidescope®) and 25% (n = 188) standard blades (Miller/Macintosh e.g., McGrath MAC). Eleven percent (n=85) preferred channelled blades (e.g., Airtraq®, King Vision®), while only 12 respondents chose rigid intubating endoscopes (e.g., Bonfils).

A correlation was noted between equipment availability and its preference in the elective and emergency cases (Pearson chi squared = 345.8 and 300.4; p < 0.001). There was a correlation between preferred airway strategy and comfort with this strategy in the emergency case (Pearson chi squared = 131.0; p < 0.001). The correlation was less significant in the elective case (Pearson chi squared = 79.6; p = 0.158).

**Discussion**

Even though the ideal intubation technique remains an area of debate, AFI is traditionally regarded as the preferred technique in patients with unstable cervical fractures, especially in elective cases.\textsuperscript{1, 3, 17-19} Advantages of AFI include a high success rate and the ability to evaluate neurological status before and after airway intervention.\textsuperscript{3, 5, 17} Disadvantages include the need for patient cooperation, the requirement for special skills, the longer duration of the procedure, the risk of airway irritation with coughing, and obstruction of the airway. The choices of airway size are also limited and cannot be changed easily mid-procedure.\textsuperscript{17} AFI may not be available in under-resourced areas. For these reasons, AFI may be underutilised, which in turn erodes familiarity and competence with the technique.\textsuperscript{3}

Compared with AFI, VL is an easier technique and faster to master. The choice of endotracheal tubes is also unlimited, and these can be changed mid-procedure.\textsuperscript{17} A few cadaver studies suggest that both Airtraq® and Glidescope® VL cause less motion of the lower cervical spine in unstable injuries than DL. Motion at the atlanto-occipital and atlanto-axial joints is comparable.\textsuperscript{20, 21}

Several authors suggest that awake VL should be taught and utilised to a greater extent.\textsuperscript{17, 22, 23} Some even argue that AFI may soon become obsolete, since this skill is not adequately practiced.\textsuperscript{22} A recent meta-analysis compared the use of VL and the fibreoptic bronchoscope for awake intubation in patients with a difficult airway. VL was associated with shorter
intubation times and compared favourably with the fibreoptic bronchoscope in terms of success rate, safety profile and patient satisfaction.\textsuperscript{17}

This survey suggests that in most clinical settings the introduction of VL has changed clinical practice in the management of unstable cervical fractures. AFI still predominates in some areas but VL has become at least as popular. It appears that DL, while still favoured by some respondents, is used less often when more modern alternatives are available. Awake VL may be a future alternative but it is not currently widely used.

Due to ease of use, availability, and lack of feasible alternatives, semi-rigid collars are often used to stabilise the cervical spine.\textsuperscript{5} When correctly applied, these devices can greatly limit mouth opening and are thought to be ineffective in preventing cervical spine movement during intubation when compared with MILS.\textsuperscript{24, 25} It is thus interesting to note that 46% of respondents in our study indicated that they would not remove the cervical collar but would apply MILS.

Immobilisation of the cervical spine prohibits normal positioning of the head and neck for intubation (‘flextension’). It follows that a prerequisite for airway intervention techniques employed in these patients is efficacy in the presence of limited mouth opening and limited or abnormal position and mobility of the neck. The chosen technique should allow for the airway to be secured in a controlled, definitive and timeous manner, with minimal cervical movement.\textsuperscript{3}

A recent similar survey conducted in India found that AFI was preferred in patients with unstable cervical cases and scheduled for elective surgery, while DL was favoured for emergency cases.\textsuperscript{10} In our study AFI was the preferred choice in both cases in the India subgroup (the difference between VL and AFI did not reach statistical significance in the elective case). A reason for this discrepancy could be that both studies had relatively small sample sizes in a large population of 16 500 PAPs in India. Some studies, conducted 15 to 20 years ago, found that AFI was preferred. Others preferred DL.\textsuperscript{7-9} None of these specified VL as this technology was not yet widely available. It is noteworthy that none of these studies involved more than one country, and sample sizes were relatively small.

There are limitations to our study. Firstly, the survey instrument has not been validated. Secondly, the validity of some answers may be questioned since respondents may have given ‘academically correct’ answers instead of recording their current clinical practice. One example of this is the question concerning availability of technology in a particular setting.
Of the respondents that indicated that they do not have flexible bronchoscopes available, 26% in the emergency and 28% in the elective case still chose AFI as their preferred airway strategy. A similar pattern was recorded amongst respondents who indicated that they do not have VL readily available, where 23% in the emergency and 27% in the elective case still chose VL as their preferred method. This could also have been due to misinterpretation of the question.

The survey was also susceptible to different forms of bias. It automatically excluded all PAPs who were unable to complete it in English; and PAPs that do not participate in social media, who are not WFSA society members or who live in non-WFSA member states less likely to have taken part. In addition, the data revealed that some PAPs prefer airway techniques not given as options in the questionnaire (e.g., blind nasal intubation mentioned by 2 respondents in the free text questions). Lastly, as can be expected in any survey, the validity of our results could have been affected by a general response bias.

Conclusion
The results of our survey suggest that practice in airway management of unstable cervical spine fractures is changing, and currently tends to favour VL over AFI. There is a statistically significant preference for VL in elective cases, traditionally considered to be a stronghold of AFI. Future similar studies may attempt to increase sample size by using multilingual questionnaires and more sophisticated distribution methods. It would also be worthwhile to investigate whether the recently introduced Difficult Airway Society guidelines on awake intubation and SARS-CoV-2 aerosolization have changed clinical practice. Those attempting similar surveys in future should note that LinkedIn® was the most effective means of recruitment in our study and has been used in large surveys with great success.

Acknowledgements
The authors thank the following anaesthesiologists for participating in the pilot survey: Andrie Alberts, Arnd Timmermann, Carin Hagberg, Imran Ahmad, Kariem El-Boghdady, Eric Hodgson, Johannes Huitink, John Law, James DuCanto, John Roos, Massimiliano Sorbello, Nesrine El-Refai, Nicholas Chrimes, Tino Greif and William Rosenblatt. We would also like to thank the WFSA for their assistance, as well as the following national societies: Australian Society of Anaesthetists (Australia), Society for Anesthesia and Resuscitation of Belgium (Belgium), Estonian Society of Anaesthesiologists (Estonia), Israel
Society of Anesthesiologists (Israel), Japanese Society of Anesthesiologists (Japan), Kenya Society of Anaesthesiologists (Kenya), Nederlandse Vereniging voor Anesthesiologie (Netherlands), Nigerian Society of Anaesthetists (Nigeria), Russian Federation of Anaesthesiologists and Reanimatologists (Russia), Serbian Association of Anaesthesiologists and Intensivists (Serbia), South African Society of Anaesthesiologists (South Africa), Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor (Spain), Association of Anaesthesiologists of Uganda (Uganda). A very special thanks to Marko Zdravkovic for his assistance in distributing the survey, to Leon du Toit and Anneli Hardy for their assistance with statistical analysis, and to Robert Dyer and Johan Coetzee for their valuable inputs in the editing of the manuscript.

Declaration of Interests
RH is the UCT-Storz Lead of the Fellowship in Airway and Thoracic Anaesthesia funded in part by KARL STORZ Endoscopy (South Africa).

All other authors declare no conflict of interest.

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Authors’ contributions
GS: Recruitment, protocol drafting, data management, drafting of article, approval of final version, agreement of accountability

RH: Conception and design, editing of protocol, editing of manuscript, additional recruitment, data analysis and interpretation, approval of final version, agreement of accountability

RL: Conception and design, editing of protocol, editing of manuscript, approval of final version, agreement of accountability
Appendix: Supplementary Data

The following files are supplementary data for this article:

GAUSS questionnaire.pdf

Consent and questionnaire used in study

References


List of appendices

Appendix 1: Human Research Ethics Committee approval
Appendix 2: GAUSS questionnaire
Appendix 3: STROBE checklist
Appendix 4: SAJAA Author Guidelines
Appendix 5: SAJAA Admission Acknowledgement
Appendix 1: Human Research Ethics Committee approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E83-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: humanethics@health.uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

23 November 2018

HREC REF: 771/2018

A/Prof R Hofmeyr
Department of Anaesthesia & Perioperative Medicine
D-23
NGSH

Dear A/Prof Hofmeyr

PROJECT TITLE: GLOBAL AIRWAY MANAGEMENT OF THE UNSTABLE CERVICAL SPINE
(MMed-candidate–Dr G Stegmann)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has formally approved the above-mentioned study.

Approval is granted for one year until the 30 November 2019.

- Please add the HREC contact details to the I/C document.
- Please add how confidentiality will be protected.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period. (Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Dr George Stegmann will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator must obtain appropriate Institutional approval, where necessary, before the research may occur.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Appendix 2: GAUSS Questionnaire

Global Airway management of Unstable cervical Spine Survey (GAUSS)

You are being invited to participate in this research study about the clinical management of the unstable cervical fracture airway.

This survey consists of 3 pages which includes two short case studies. It should not take more than 10 minutes to complete.

The study is being conducted by Prof Ross Hofmeyr, Dr Richard Llewellyn and Dr George Stegmann from the Department of Anaesthesia and Perioperative Medicine, University of Cape Town, South Africa. The objective of this research project is to attempt to understand how the global anaesthetist manages the airway of unstable cervical spine fracture patients. It is being conducted online and the survey is being distributed to clinicians worldwide. The targeted population is medical doctors providing anaesthesia on a regular basis (also known as physician anaesthetic providers).

We request that you answer all questions and that your answers reflect your current personal clinical preference. Do not answer what you think to be correct according to the literature, but rather what you would do in your daily practice.

There are no known risks if you decide to participate in this research, nor are there any costs for participating in the study. The information you provide will help us to understand current anaesthetic practice, and what influences it. This survey is anonymous. Your email address will be recorded but will not be linked to your answers in any way. Your email will be used to distribute the result of the study to you once the study has been completed but will not be shared with any third party.

Your participation in this study is voluntary. By continuing to complete the survey, we will presume that you have given consent. You can withdraw from the study at any time by leaving the survey incomplete. Once the complete survey has been submitted, however, withdrawal shall no longer be possible, as your data will no longer be identifiable.

Please contact Dr George Stegmann with any questions or concerns at gstegmann@gmail.com.

This study has been approved by Human Research Ethics Research Committee (HREC), Faculty of Health Sciences, University of Cape Town. The HREC can be contacted at +27 21 406 6492 or at sumayah.riefdien@uct.ac.za. HREC Reference number: 771/2018.

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Preferred Language
- English
- Mandarin / 中文
- German / Deutsche
- French / Français
- Spanish / Español
- Portuguese / Português
- Russian / русский

Have you completed this GAUSS study before?
- Yes
- No
Section A: Basic Information

What is your highest qualification?

- Specialist Anaesthetist (Board Certified or Fellow of College)
- Postgraduate Diploma in Anesthesia
- Medical Degree (MD, MBBS, MBChB, MBBCh, etc.)
- Certified Registered Nurse Anaesthetist (CNRA or equivalent)
- I provide anesthesia services but I am not a medical doctor or nurse
Please select your country of obtaining highest qualification

- Afghanistan (AF)
- Åland Islands (AX)
- Albania (AL)
- Algeria (DZ)
- American Samoa (AS)
- Andorra (AD)
- Angola (AO)
- Anguilla (AI)
- Antarctica (AQ)
- Antigua & Barbuda (AG)
- Argentina (AR)
- Armenia (AM)
- Aruba (AW)
- Ascension Island (AC)
- Australia (AU)
- Austria (AT)
- Azerbaijan (AZ)
- Bahamas (BS)
- Bahrain (BH)
- Bangladesh (BD)
- Barbados (BB)
- Belarus (BY)
- Belgium (BE)
- Belize (BZ)
- Benin (BJ)
- Bermuda (BM)
- Bhutan (BT)
- Bolivia (BO)
- Bosnia & Herzegovina (BA)
- Botswana (BW)
- Brazil (BR)
- British Indian Ocean Territory (IO)
- British Virgin Islands (VG)
- Brunei (BN)
- Bulgaria (BG)
- Burkina Faso (BF)
- Burundi (BI)
- Cambodia (KH)
- Cameroon (CM)
- Canada (CA)
- Canary Islands (IC)
- Cape Verde (CV)
- Caribbean Netherlands (BQ)
- Cayman Islands (KY)
- Central African Republic (CF)
- Ceuta & Melilla (EA)
- Chad (TD)
- Chile (CL)
- China (CN)
- Christmas Island (CX)
- Cocos (Keeling) Islands (CC)
- Colombia (CO)
- Comoros (KM)
- Congo - Brazzaville (CG)
- Congo - Kinshasa (CD)
- Cook Islands (CK)
- Costa Rica (CR)
- Côte d'ivoire (CI)
- Croatia (HR)
- Cuba (CU)
- Curaçao (CW)
- Cyprus (CY)
- Czechia (CZ)
- Denmark (DK)
- Diego Garcia (DG)
- Djibouti (DJ)
- Dominica (DM)
- Dominican Republic (DO)
- Ecuador (EC)
- Marshall Islands (MH)
- Martinique (MQ)
- Mauritania (MR)
- Mauritius (MU)
- Mayotte (YT)
- Mexico (MX)
- Micronesia (FM)
- Moldova (MD)
- Monaco (MC)
- Mongolia (MN)
- Montenegro (ME)
- Montserrat (MS)
- Morocco (MA)
- Mozambique (MZ)
- Myanmar (Burma) (MM)
- Namibia (NA)
- Nauru (NR)
- Nepal (NP)
- Netherlands (NL)
- New Caledonia (NC)
- New Zealand (NZ)
- Nicaragua (NI)
- Niger (NE)
- Nigeria (NG)
- Niue (NU)
- Norfolk Island (NF)
- North Korea (KP)
- Northern Mariana Islands (MP)
- Norway (NO)
- Oman (OM)
- Pakistan (PK)
- Palau (PW)
- Palestinian Territories (PS)
- Panama (PA)
- Papua New Guinea (PG)
- Paraguay (PY)
- Peru (PE)
- Philippines (PH)
- Pitcairn Islands (PN)
- Poland (PL)
- Portugal (PT)
- Puerto Rico (PR)
- Qatar (QA)
- Réunion (RE)
- Romania (RO)
- Russia (RU)
- Rwanda (RW)
- Samoa (WS)
- San Marino (SM)
- São Tomé & Príncipe (ST)
- Saudi Arabia (SA)
- Senegal (SN)
- Serbia (RS)
- Seychelles (SC)
- Sierra Leone (SL)
- Singapore (SG)
- Sint Maarten (SX)
- Slovakia (SK)
- Slovenia (SI)
- Solomon Islands (SB)
- Somalia (SO)
- South Africa (ZA)
- South Georgia & South Sandwich Islands (GS)
- South Korea (KR)
- South Sudan (SS)
- Spain (ES)
- Sri Lanka (LK)
- St. Barthélemy (BL)
- St. Helena (SH)
- St. Kitts & Nevis (KN)
- St. Lucia (LC)
- St. Martin (MF)
- St. Pierre & Miquelon (PM)
- St. Vincent & Grenadines (VC)
- Sudan (SD)
- Suriname (SR)
- Svalbard & Jan Mayen (SJ)
- Swaziland (SZ)
- Sweden (SE)
- Switzerland (CH)
- Syria (SY)
- Taiwan (TW)
- Tajikistan (TJ)
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- Tokelau (TK)
- Tonga (TO)
- Trinidad & Tobago (TT)
- Tristan da Cunha (TA)
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- U.S. Virgin Islands (VI)
- Uganda (UG)
- Ukraine (UA)
- United Arab Emirates (AE)
- United Kingdom (GB)
- United Nations (UN)
- United States (US)
- Uruguay (UY)
- Uzbekistan (UZ)
- Vanuatu (VU)
- Vatican City (VA)
- Venezuela (VE)
- Vietnam (VN)
- Wallis & Futuna (WF)
- Western Sahara (EH)
- Yemen (YE)
- Zambia (ZM)
- Zimbabwe (ZW)
Please select your country of current practice

- Afghanistan (AF)
- Åland Islands (AX)
- Albania (AL)
- Algeria (DZ)
- American Samoa (AS)
- Andorra (AD)
- Angola (AO)
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- Vatican City (VA)
- Venezuela (VE)
- Vietnam (VN)
- Wallis & Futuna (WF)
- Western Sahara (EH)
- Yemen (YE)
- Zambia (ZM)
- Zimbabwe (ZW)

**Gender**
- Male
- Female
- Other

**Age**
- 0-30 years old or younger
- 31-40 years old
- 41-50 years old
- 51-60 years old
- 61-70 years old
- Older than 70 years of age

**Years of Independant Practice in Anaesthesia (including training)**
- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- More than 20 years
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which of the following best describes the hospital where you provide</td>
<td>- Community Health Clinic / Day Hospital</td>
</tr>
<tr>
<td>anaesthesia on most days?</td>
<td>- District / Primary Level Hospital</td>
</tr>
<tr>
<td></td>
<td>- Regional / Secondary Level Hospital</td>
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<tr>
<td></td>
<td>- Provincial / Tertiary Level Hospital</td>
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<tr>
<td></td>
<td>- National / Quaternary Level Hospital</td>
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<tr>
<td></td>
<td>- Specialised Hospital (e.g. paediatric hospital, Women’s Health Hospital,</td>
</tr>
<tr>
<td></td>
<td>Cardiac Hospital)</td>
</tr>
<tr>
<td></td>
<td>- University Hospital</td>
</tr>
<tr>
<td>How often do you administer anaesthesia on average?</td>
<td>- Every day on duty</td>
</tr>
<tr>
<td></td>
<td>- Three or four days per week</td>
</tr>
<tr>
<td></td>
<td>- One or two days per week</td>
</tr>
<tr>
<td></td>
<td>- Less than one day per week</td>
</tr>
<tr>
<td></td>
<td>- I do not administer anaesthesia</td>
</tr>
<tr>
<td>How often do you anaesthetise trauma victims on average?</td>
<td>- Every day on duty</td>
</tr>
<tr>
<td></td>
<td>- Three or four days per week</td>
</tr>
<tr>
<td></td>
<td>- One or two days per week</td>
</tr>
<tr>
<td></td>
<td>- Less than one day per week</td>
</tr>
<tr>
<td>Estimate how many cases of known/ suspected cervical spine injury you</td>
<td>(Please enter number of cases)</td>
</tr>
<tr>
<td>have anaesthetised or assisted in managing the airway in your career</td>
<td></td>
</tr>
<tr>
<td>Which of the following are readily available to you to use in your</td>
<td>- Direct laryngoscopy with full set of blades</td>
</tr>
<tr>
<td>clinical setting?</td>
<td>- Indirect (video/optical) laryngoscopy (e.g. Airtraq, Glidescope, CMAC</td>
</tr>
<tr>
<td></td>
<td>or other)</td>
</tr>
<tr>
<td></td>
<td>- Flexible bronchoscope or intubating endoscope</td>
</tr>
<tr>
<td></td>
<td>- Rigid intubating endoscope (e.g. Bonfils/Shikan)</td>
</tr>
<tr>
<td></td>
<td>- Emergency cricothyroidotomy set</td>
</tr>
<tr>
<td></td>
<td>- Supraglottic airways (e.g. Laryngeal Mask Airways, Intubating</td>
</tr>
<tr>
<td></td>
<td>Laryngeal Mask Airways)</td>
</tr>
<tr>
<td>Which of the following equipment mentioned above do you feel confident</td>
<td>- Direct laryngoscopy with full set of blades</td>
</tr>
<tr>
<td>about using?</td>
<td>- Indirect (video/optical) laryngoscopy (e.g. Airtraq, Glidescope, CMAC</td>
</tr>
<tr>
<td></td>
<td>or other)</td>
</tr>
<tr>
<td></td>
<td>- Flexible bronchoscope or intubating endoscope</td>
</tr>
<tr>
<td></td>
<td>- Rigid intubating endoscope (e.g. Bonfils/Shikan)</td>
</tr>
<tr>
<td></td>
<td>- Emergency cricothyroidotomy set</td>
</tr>
<tr>
<td></td>
<td>- Supraglottic airways (e.g. Laryngeal mask airways, Intubating laryngeal</td>
</tr>
<tr>
<td></td>
<td>mask airways)</td>
</tr>
</tbody>
</table>
### Section B: Case Study 1
You are called to anaesthetise a 32-year-old male patient, who was involved in a high-velocity motor vehicle accident, for an emergency external fixation of his open book pelvic fracture. He has suspected ongoing internal bleeding, and an anterior teardrop fracture of his C4 vertebral body. The surgeon states that the cervical fracture is very unstable. The patient is immobilized in a hard cervical collar (Philadelphia). He has no neurological fallout, and the cervical fracture is not for surgical intervention at this time. The patient has no other known medical problems or associated injuries. He is alert and awake. His pulse is 125 beats/min and blood pressure is 100/55 mmHg. The patient is unsure when he last ate, but the accident was less than 6 hours ago.

<table>
<thead>
<tr>
<th>What would be your preferred strategy to manage this airway?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Elective sequence induction (routine induction) with direct laryngoscopy intubation</td>
</tr>
<tr>
<td>☐ Elective sequence induction (routine induction) with video/optical laryngoscopy intubation</td>
</tr>
<tr>
<td>☐ Awake fiberoptic/flexible endoscopic intubation</td>
</tr>
<tr>
<td>☐ Direct laryngoscopy intubation after rapid sequence induction</td>
</tr>
<tr>
<td>☐ Video/Optical laryngoscopy intubation after rapid sequence induction</td>
</tr>
<tr>
<td>☐ Awake video/optical laryngoscopy</td>
</tr>
<tr>
<td>☐ Emergency cricothyroidotomy</td>
</tr>
<tr>
<td>☐ Awake tracheostomy under local anaesthesia</td>
</tr>
<tr>
<td>☐ Supraglottic airway</td>
</tr>
<tr>
<td>☐ Intubation through supraglottic airway</td>
</tr>
<tr>
<td>☐ Dual endoscopy (Video/optical laryngoscopy with flexible bronchoscopy or rigid endoscopy back up) after rapid sequence induction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What type of video/optical laryngoscope blade would you use?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Standard blade shape (Miller/Macintosh, e.g. McGrath MAC)</td>
</tr>
<tr>
<td>☐ Hyperangulated blade (e.g. C-MAC D-blade or Glidescope)</td>
</tr>
<tr>
<td>☐ Channeled blade (e.g. Airtraq or King Vision)</td>
</tr>
<tr>
<td>☐ Rigid intubating endoscope (e.g. Bonfils or Shikani Optical Stylet)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Would you remove the hard collar for intubation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Would you ask an assistant to perform manual inline spinal motion restriction/immobilization?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes</td>
</tr>
<tr>
<td>☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What were the reasons for your choice of [cs1 pref_strag] as your airway management strategy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Emergency case, need to secure airway quickly</td>
</tr>
<tr>
<td>☐ Standard practice in my clinical setting</td>
</tr>
<tr>
<td>☐ This is how I was taught</td>
</tr>
<tr>
<td>☐ To minimize risk of movement of spine</td>
</tr>
<tr>
<td>☐ I am most comfortable with this technique</td>
</tr>
<tr>
<td>☐ Patient may be uncooperative</td>
</tr>
<tr>
<td>☐ Patient not fasted</td>
</tr>
<tr>
<td>☐ Limited equipment/resources available</td>
</tr>
<tr>
<td>☐ Preferred from personal experience</td>
</tr>
<tr>
<td>☐ Post-intubation neural testing can be performed</td>
</tr>
<tr>
<td>☐ Patient comfort</td>
</tr>
<tr>
<td>☐ Other (please specify)</td>
</tr>
</tbody>
</table>
Please specify the additional/other reason(s) for your airway management strategy

Would you have changed your management strategy if the patient was fasted?  
- Yes
- No

What would you change your management strategy to if the patient was fasted?  
- Elective sequence induction (routine induction) with direct laryngoscopy intubation
- Elective sequence induction (routine induction) with video/optical laryngoscopy intubation
- Awake fiberoptic/flexible endoscopic intubation
- Direct laryngoscopy intubation after rapid sequence induction
- Video/Optical laryngoscopy intubation after rapid sequence induction
- Awake video/optical laryngoscopy
- Emergency cricothyroidotomy
- Awake tracheostomy under local anaesthesia
- Supraglottic airway
- Intubation through supraglottic airway
- Dual endoscopy (Video/optical laryngoscopy with flexible bronchoscopy or rigid endoscopy back up) after rapid sequence induction

What type of video/optical laryngoscope blade would you use?  
- Standard blade shape (Miller/Macintosh, e.g. McGrath MAC)
- Hyperangulated blade (e.g. C-MAC D-blade or Glidescope)
- Channeled blade (e.g. Airtraq or King Vision)
- Rigid intubating endoscope (e.g. Bonfils or Shikani Optical Stylet)
Section C: Case Study 2
You are asked to provide anaesthesia for an urgent semi-elective case. A 35-year-old previously healthy male was involved in a high-velocity motor vehicle accident one week ago. He sustained a compression fracture of his C5 vertebral body. It is an unstable fracture, and the patient is currently in skull traction (Cones calipers / closed cervical traction) in the acute spinal injury unit. The patient has no other injuries, or any previous medical or surgical history. He has no neurological fallout. The patient is booked for a surgical decompression and fusion via an anterior approach. Patient is alert, calm and awake. Pulse is 82 beats/min and the blood pressure is 125/85 mmHg. He has been fasted for 10 hours.

Cones Calipers

What would be your preferred strategy to manage this airway?

- Elective sequence induction (routine induction) with direct laryngoscopy intubation
- Elective sequence induction (routine induction) with video/optical laryngoscopy intubation
- Awake fiberoptic/flexible endoscopic intubation
- Direct laryngoscopy intubation after rapid sequence induction
- Video/Optical laryngoscopy intubation after rapid sequence induction
- Awake video/optical laryngoscopy
- Emergency cricothyroidotomy
- Awake tracheostomy under local anaesthesia
- Supraglottic airway
- Intubation through supraglottic airway
- Dual endoscopy (Video/optical laryngoscopy with flexible bronchoscopy or rigid laryngoscopy back up) after rapid sequence induction
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of video/optical laryngoscope blade would you use?</td>
<td>☐ Standard blade shape (Miller/Macintosh, e.g. McGrath MAC)  &lt;br&gt; ☐ Hyperangulated blade (e.g. C-MAC D-blade or Gidescpe)  &lt;br&gt; ☐ Channeled blade (e.g. Airtraq or King Vision)  &lt;br&gt; ☐ Rigid intubating endoscope (e.g. Bonfils or Shikani Optical Stilet)</td>
</tr>
<tr>
<td>What were the reasons for your choice of [cs2 pref_strag] as your choice of management strategy?</td>
<td>☐ Standard practice in my clinical setting  &lt;br&gt; ☐ This is how I was taught  &lt;br&gt; ☐ To minimize risk of movement of spine  &lt;br&gt; ☐ I am most comfortable with this technique  &lt;br&gt; ☐ Patient is most likely cooperative  &lt;br&gt; ☐ Patient is fasted  &lt;br&gt; ☐ Limited equipment/resources available  &lt;br&gt; ☐ Preferred method from personal experience  &lt;br&gt; ☐ Post intubation neural testing can be performend  &lt;br&gt; ☐ Patient comfort  &lt;br&gt; ☐ Other (please specify below)</td>
</tr>
<tr>
<td>Please specify the additional/other reason(s) for your airway management strategy</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: STROBE Checklist

<table>
<thead>
<tr>
<th>STROBE Statement</th>
<th>Item No</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title and abstract</strong></td>
<td>1</td>
<td>(a) Indicate the study’s design with a commonly used term in the title or the abstract</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) Provide in the abstract an informative and balanced summary of what was done and what was found</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>2</td>
<td>Explain the scientific background and rationale for the investigation being reported</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>3</td>
<td>State specific objectives, including any prespecified hypotheses</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study design</td>
<td>4</td>
<td>Present key elements of study design early in the paper</td>
</tr>
<tr>
<td>Setting</td>
<td>5</td>
<td>Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection</td>
</tr>
<tr>
<td>Participants</td>
<td>6</td>
<td>(a) Give the eligibility criteria, and the sources and methods of selection of participants</td>
</tr>
<tr>
<td>Variables</td>
<td>7</td>
<td>Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable</td>
</tr>
<tr>
<td>Data sources/measurement</td>
<td>8*</td>
<td>For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group</td>
</tr>
<tr>
<td>Bias</td>
<td>9</td>
<td>Describe any efforts to address potential sources of bias</td>
</tr>
<tr>
<td>Study size</td>
<td>10</td>
<td>Explain how the study size was arrived at</td>
</tr>
<tr>
<td>Quantitative variables</td>
<td>11</td>
<td>Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why</td>
</tr>
<tr>
<td>Statistical methods</td>
<td>12</td>
<td>(a) Describe all statistical methods, including those used to control for confounding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) Describe any methods used to examine subgroups and interactions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(c) Explain how missing data were addressed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) If applicable, describe analytical methods taking account of sampling strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) Describe any sensitivity analyses</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td>13*</td>
<td>(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed</td>
</tr>
</tbody>
</table>
eligible, included in the study, completing follow-up, and analysed

(b) Give reasons for non-participation at each stage

(c) Consider use of a flow diagram

| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | X |
| | | (b) Indicate number of participants with missing data for each variable of interest | X |

| Outcome data | 15* | Report numbers of outcome events or summary measures | X |

| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included | X |
| | | (b) Report category boundaries when continuous variables were categorized | X |
| | | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |

| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | X |

**Discussion**

| Key results | 18 | Summarise key results with reference to study objectives | X |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | X |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | X |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | X |

**Other information**

| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | X |
Appendix 4: SAJAA Author Guidelines


Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission’s compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

- This manuscript has currently only been submitted to SAJAA and has not been published previously.
- This work is original and all third party contributions (images, ideas and results) have been duly attributed to the originator(s).
- Permission to publish licensed material (tables, figures, graphs) has been obtained and the letter of approval and proof of payment for royalties have been submitted as supplementary files.
- The submitting/corresponding author is duly authorised to herewith assign copyright to the South African Society of Anaesthesiologists (SASA).
- All co-authors have made significant contributions to the manuscript to qualify as co-authors.
- Ethics committee approval has been obtained for original studies and is clearly stated in the methodology as well as provided as a supplementary file.
- A conflict of interest statement has been included where appropriate.
- The submission adheres to the instructions to authors in terms of all technical aspects of the manuscript.
- Plagiarism: The submitting author acknowledges that the Editorial Board reserves the right to use plagiarism detection software on any submitted material.

Author Guidelines

Submitted manuscripts that are not in the correct format and without the required supporting documentation specified in these guidelines will be returned to the author(s) for correction and will delay publication.

AUTHORSHIP

Named authors must consent to publication by signing a covering letter which should be submitted as a supplementary file. Authorship should be based on substantial contribution to:
(i) conception, design, analysis and interpretation of data;

(ii) drafting or critical revision for important intellectual content; and

(iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org); and

(iv) exact contribution of each author must be stated.

DECLARATION OF CONFLICT OF INTEREST

Authors must declare all sources of support for the research and any association with a product or subject that may constitute a conflict of interest. If there is no conflict of interest to declare please include the following statement: The authors declare no conflict of interest.

FUNDING SOURCE

All sources of funding should be declared. Also define the involvement of study sponsors in the study design, collection, analysis and interpretation of data; the writing of the manuscript; the decision to submit the manuscript for publication. If the study sponsors had no such involvement, this should be stated as follows: No funding source to be declared.

RESEARCH ETHICS COMMITTEE APPROVAL

The submitting author must provide written confirmation of Research Ethics Committee approval for all studies including case reports. The ethics committee as well as the approval number should be included.

STATISTICAL ANALYSIS

Authors are advised to involve medical statisticians at the protocol stage of their research project: to plan sample size, and the selection of appropriate statistical tests for analysis and presentation.

PROTECTION OF PATIENT’S RIGHTS TO PRIVACY

Identifying information should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or
guardian) gives informed written consent for publication. The patient should be shown the manuscript to be published. Refer to www.icmje.org.

ETHNIC CLASSIFICATION

The rationale for analysis based on racio-ethnic-cultural categorisation should be indicated.

CATEGORIES OF SUBMISSIONS

Shorter items are more likely to be accepted for publication, owing to space constraints and reader preferences.

Original articles

Original articles on research relevant to anaesthesia and analgesia should not exceed 3 200 words, no more than 30 references, with up to 6 tables or figures. A structured abstract under the following headings, Background, Methods, Results, and Conclusions is a requirement and should not exceed 300 words.

Clinical Review articles

Review articles relevant to anaesthesia and analgesia should not exceed 2 400 words, with a maximum of 20 references and no more than 6 tables or figures. A summary of 300 words or less is required.

Case reports

Case reports should not exceed 1 800 words with no more than 10 references. Figures are limited to 2 figures and may include images or photographs. The case report should have three headings: Summary (not exceeding 100 words), Case report (with no introduction) and Discussion. Case reports will be published online only. The summary and the URL will appear in the printed version.

Scientific Letters

Scientific Letters should not exceed 2 400 words with a maximum of 10 references. Only one table or illustration is permissible. A structured abstract under the following headings, Background, Methods, Results, and Conclusions, is a requirement and should not exceed 250 words.
**Letters to the editor**

Letters to the editor should be 800 words or less with only one image or table.

**MANUSCRIPT PREPARATION**

Refer to articles in recent issues for the presentation of headings and subheadings. If in doubt, refer to 'uniform requirements' - [www.icmje.org](http://www.icmje.org). Manuscripts must be provided in **UK English**.

**Qualification, affiliation and contact details**

This information must be provided for ALL authors and must be submitted as a supplementary file.

Email addresses of all author must be provided.

ORCID number of **ALL** authors must be provided – if authors do not have ORCID, please register at [https://orcid.org/](https://orcid.org/)

**Abbreviations**

All abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.

**Scientific measurements**

Scientific measurements must be expressed in SI units except blood pressure (mmHg) and haemoglobin (g/dl). Litres is denoted with a lowercase 'l' e.g. 'ml' for millilitres). Units should be preceded by a space (except for %), e.g. '40 kg' and '20 cm' but '50%'. Greater/smaller than signs (> and 40 years of age) should also be preceded by a space e.g. > 20 years. No spaces should precede ± and *, i.e. '35±6' and '19°C'.

**Numbers** should be written as grouped per thousand-units, i.e. 4 000, 22 160...

**Quotes** should be placed in single quotation marks: i.e. The respondent stated: '...'

Round **brackets** (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

**General formatting**
The manuscript must be in Microsoft Word or RTF document format. Text must be 1.5 spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes, except for Tables). The manuscript must be free of track changes.

**Disclaimers** should follow the Conclusion and it should be in the following order: Acknowledgements, Declaration conflict of interest, Funding source, Ethics declaration and ORCID.

**ILLUSTRATIONS AND TABLES**

If tables or illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.

**Tables** may be embedded in the manuscript file and provided as *supplementary files*. They must be numbered in Arabic numerals (1,2,3...) and referred to consecutively in the text (e.g. ‘Table 1’). Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged. Tables must be cell-based (i.e. not constructed with text boxes, tabs or enters) and accompanied by a concise title and column headings. Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

**Figures** must be numbered in Arabic numerals and referred to in the text e.g. ‘(Figure 1)’. Figure legends: Figure 1: ‘Title...’. All illustrations/figures/graphs must be of high resolution/quality: 300 dpi or more is preferable, but images must not be resized to increase resolution. Unformatted and uncompressed images must be attached as *supplementary files* upon submission (not embedded in the accompanying manuscript). TIFF and PNG formats are preferable; JPEG and PDF formats are accepted, but authors must be wary of image compression. Illustrations and graphs prepared in Microsoft PowerPoint or Excel must be accompanied by the original workbook.

**REFERENCES**

Authors must verify references from the original sources. Only complete, correctly formatted reference lists will be accepted. Reference lists may be generated with the use of reference manager software, but the final document must be delinked from the reference database or otherwise generated manually. Citations should be inserted in the text as superscript, e.g. These regulations are endorsed by the World Health Organization, and others. The superscript reference number should come after the punctuation mark and should not be in brackets.
All references should be listed at the end of the article in numerical order of appearance in the Vancouver style (not alphabetical order). Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus. Names and initials of all authors should be given; if there are more than six authors, the first four names should be given followed by et al. First and last page, volume and issue numbers should be given. Wherever possible, references must be accompanied by a digital object identifier (DOI) link and PubMed ID (PMID)/PubMed Central ID (PMCID). Authors are encouraged to use the DOI lookup service offered by CrossRef. Crossref DOIs should always be displayed as a full URL link in the form https://doi.org/10.xxxx/xxxx

Journal references:


Other references (e.g. reports) should follow the same format: Author(s). Title. Publisher place: publisher name, year; pages. Cited manuscripts that have been accepted but not yet published can be included as references followed by ‘(in press)’. Unpublished observations and personal communications in the text must not appear in the reference list. The full name of the source person must be provided for personal communications e.g. ‘...(Prof. Michael Jones, personal communication)’.

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Dr George Frederik Edehomann

Thank you for submitting the manuscript, "Global Airway Management of the Unstable Cervical Spine: Survey (GAUSS)" to Southern African Journal of Anaesthesia and Analgesia.

Thank you and kind regards
Robyn Marais
Journal Manager
SA Journal of Anaesthesia and Analgesia

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