

Lack of national consensus in preoperative airway assessment

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ABSTRACT

INTRODUCTION: Difficult airway management is associated with an increased risk of morbidity and mortality. Several preoperative risk factors associated with airway management difficulties have been proposed; however, no clear guideline for airway assessments exists. We therefore hypothesised that Danish airway assessment was lacking uniformity. We aimed to examine whether multivariable risk assessment tools and predictors for difficult intubation and mask ventilation were used systematically.

METHODS: Heads of anaesthesia departments were sent a six-question survey at the beginning of 2012. We asked if systematic risk assessment tools, particularly the Simplified Airway Risk Index (SARI), and predictors for difficult intubation and mask ventilation were used. Additionally, we asked if any risk factors were pre-printed on the anaesthesia record.

RESULTS: In all, 29 of 31 (94%) departments responded. The SARI was implemented in 8 of 29 (28%, 95% confidence interval (CI): 15-46%) departments with major regional differences. There was no significant association between using the SARI and a reduced number of unanticipated difficult intubation ($p = 0.06$). Mallampati classification (95.2%, 95% CI: 77.3-99.2%), history of airway management difficulties (85.7%, 95% CI: 65.4-95.0%), ability to prognath (81.0%, 95% CI: 60.0-92.3%) and neck mobility (81.0%, 95% CI: 60.0-92.3%) were the main predictors registered.

CONCLUSION: We found considerable inter-departmental variance in the standards employed for airway assessment and no uniform pattern in the registration of risk factors for airway management difficulties. Better prediction of difficult intubation could not be detected in departments that used the SARI.

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Difficult airway management is associated with increased patient risks [1, 2]. Improved prediction of difficult tracheal intubation and mask ventilation may reduce adverse events due to allocation of experienced personnel and correct use of equipment [3-5]. However, accurate prediction remains a pivotal challenge in anaesthesia, and numerous studies have sought to find reliable predictors for difficult intubation and difficult mask ventilation [6-9]. No single risk factor sufficiently pre-



ABBREVIATIONS

ASA = American Society of Anesthesiologists
BMI = body mass index
CI = confidence interval
DAD = The Danish Anaesthesia Database
NAP 4 = Fourth National Audit Project
SARI = Simplified Airway Risk Index
SE = standard error (of mean)

dicts difficult airway management, but by combining several risk factors the diagnostic accuracy may improve [6-8]. Multivariable risk assessment models have been proposed as reliable tools for prediction of tracheal intubation difficulties [6, 7, 9]. The American Society of Anesthesiologists (ASA) recommends a preoperative assessment of the patient's airway based on 11 anatomical variables [3] and the UK-based 4th National Audit Project (NAP4) also emphasises the importance of performing a preoperative airway assessment including bedside tests [5]. The NAP4 summarises that adverse events may arise when a preoperative airway assessment is not performed or when its prediction is imperfect.

Nevertheless, no elaboration is given on mandatory factors for examination, or on how they should be weighted in an overall assessment. The ASA argues that the decision to assess some or all risk factors depends on the clinical context. Like in the UK and USA, there is no specific national recommendation for preoperative airway assessment in Denmark [10, 11].

Consequently, airway assessment is ultimately left at the discretion of the individual anaesthesiologist and, if available, local departmental recommendations.

We therefore hypothesised that Danish airway assessment was of a non-uniform character across departments of anaesthesia.

The aim of this study was to examine guidelines for preoperative airway assessment in Danish departments of anaesthesia and to examine whether multivariable risk assessment tools were used systematically, in particular the Simplified Airway Risk Index (SARI) [6]. We also aimed to examine whether risk factors for difficult intubation and difficult mask ventilation were used and registered consistently. Finally, we wanted to explore

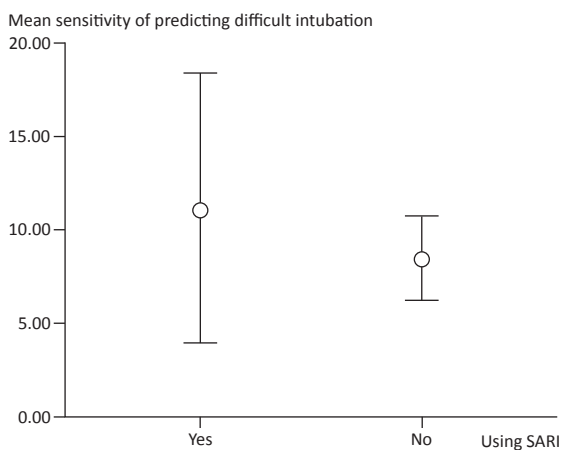
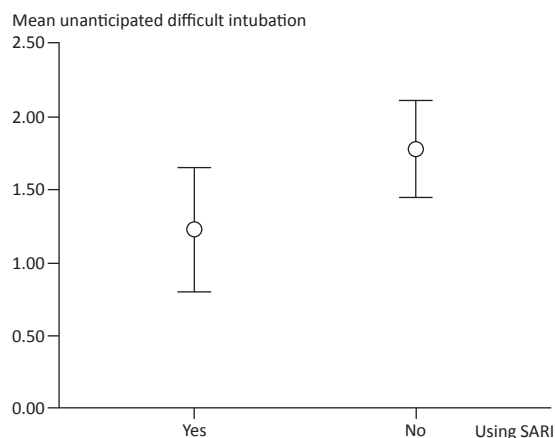
ORIGINAL ARTICLE

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FIGURE 1

Departmental mean of diagnostic accuracy using the Simplified Airway Risk Index and not using the index. Error bars: 95% CI.



CI = confidence interval.
SARI = Simplified Airway Risk Index.

whether departments using systematic risk assessment tools performed better in predicting airway management difficulties.

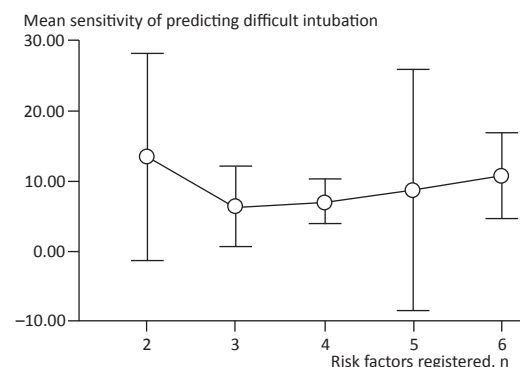
METHODS

A simple six-question form was sent to 31 heads of department at the beginning 2012. The inclusion criterion for receiving the survey was that the department was reporting data to the Danish Anaesthesia Database (DAD). In the DAD it is mandatory to record anticipations of difficulties with airway management for all patients scheduled for general anaesthesia.

The maximum response time was approximately six months and consequently the survey concluded by mid 2012. We asked whether the SARI was a mandatory tool for airway assessment of adult patients undergoing surgery, and if affirmed, whether the original cut-off value of the SARI sum score was used as a standard for anticipation of difficult intubation [6]. If the SARI was not

FIGURE 2

Sensitivity of predicting difficult intubation in relation to the number of risk factors registered. Error bars: 95% CI.



CI = confidence interval.

used, we asked if another systematic risk assessment tool was implemented. The SARI was our initial focus point since we perceived that this multivariable risk model might be implemented at some departments. Furthermore, we inquired whether the following risk factors for difficult intubation were pre-printed on the anaesthesia record: mouth opening, thyromental distance, Mallampati classification, neck movement, ability to prognath, body weight and history of difficult intubation. Additionally, we asked the respondents to specify these in case other variables were recorded. Finally, we inquired whether any of the following risk factors were being used systematically, specifically for prediction of difficult mask ventilation: age > 55 years, Mallampati III/IV, gender, beard, body mass index (BMI) > 26, toothlessness, snoring, sleep apnoea and neck radiation changes [9, 12, 13].

In addition to collecting the survey forms, a copy of the anaesthesia record from each department was retrieved in order to validate any pre-printed risk factors.

Primary outcome: The proportion of departments using the SARI as a standard for preoperative airway assessment.

Secondary outcomes: Whether using the SARI (or other risk models) was associated with a better prediction of difficult intubation, whether registration of additional risk factors was associated with better prediction of intubation difficulties, use of other risk assessment tools, regional differences in the use of the SARI, and use of risk factors for difficult intubation and difficult mask ventilation.

Data: We emphasised the importance of a high response rate in order to ensure good data quality and reliable results. The survey was sent by email and accom-

panied by an explanatory letter. If the survey was not returned within a month, an email reminder was sent. In case of no reply, the head of the department was finally contacted by telephone. The individual questions of the survey were validated by seven independent consultants of anaesthesia who were interviewed face to face about their perception of the individual questions [14]. A cohort from 2008 to 2011 counting 188,064 patients was extracted from the Danish Anaesthesia Database (DAD). In the DAD, it is mandatory to record anticipation of intubation difficulties and the actual conditions regarding intubation. Sensitivity and the fraction of unanticipated difficult intubation were calculated for each department.

Statistics: Percentages with 95% confidence intervals were used to present descriptive statistics. Comparison of means between dichotomous predictors was performed using independent t-test statistics, and one-way ANOVA was performed for categorical predictors with more than two categories. p -values ≤ 0.05 were considered statistically significant.

Trial registration: not relevant.

RESULTS

The questionnaire was sent to 31 departments and 29 had returned it by mid 2012, leaving two non-responding departments.

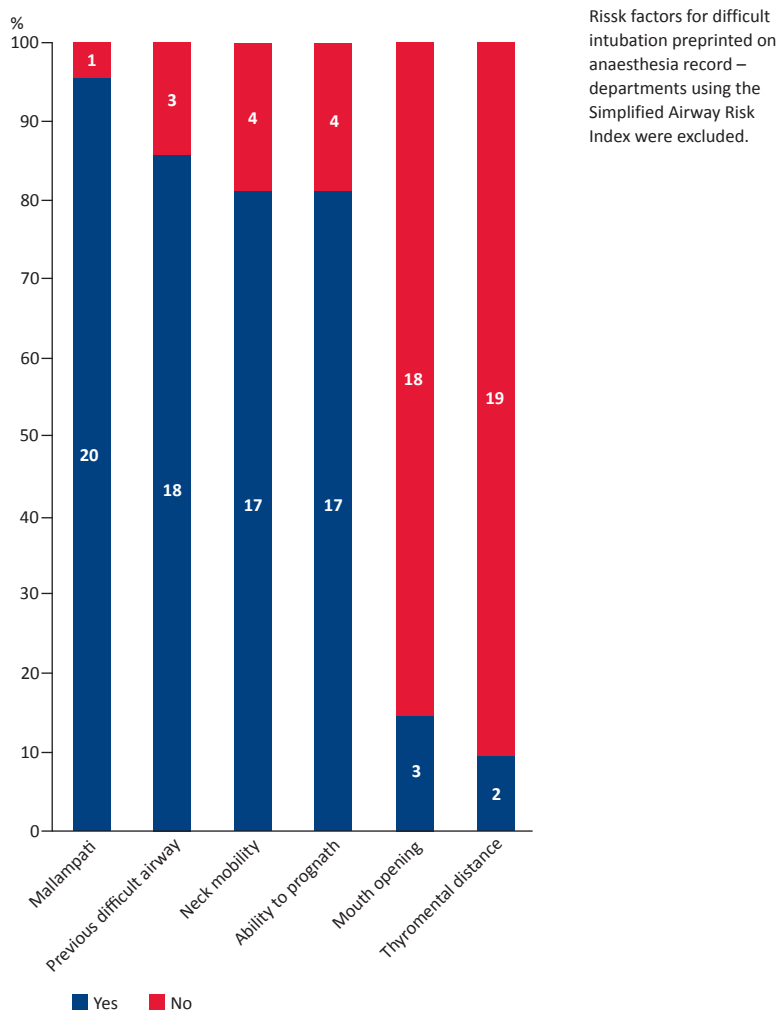
Eight of 29 departments answered that the SARI had been implemented as a standard for preoperative airway assessment, corresponding to 27.6% (95% CI: 14.7-45.7%) of the departments. One department had the full SARI model pre-printed on the anaesthesia record, but stated that it was not used as a standard. Regional differences were detected, i.e. in two out of five regions, the SARI was already implemented (six departments) or under implementation (three departments) as a mandatory tool for preoperative airway assessment. In the remaining parts of Denmark (20 departments), two departments had introduced the SARI (10.0%).

No departments had implemented other multivariable risk models for prediction of airway management difficulties aside from the SARI model.

The mean proportion of unanticipated difficult intubation was 1.2% (standard error (SE): 0.17) in departments using the SARI and 1.8% (SE: 0.16) in departments not using the SARI. T-test statistics revealed a mean difference of -0.55% (CI: -1.11 to 0.01), $p = 0.06$ (Figure 1).

The mean sensitivity for prediction of difficult intubation was 11.1% (SE: 2.96) in departments using the SARI and 8.4% (SEM: 1.06) in departments not using the SARI. The mean difference was 2.67% (CI: -2.49 to 7.84), $p = 0.30$ (Figure 2).

FIGURE 3



We found no linear correlation between the number of risk factors registered on the anaesthesia record and a better sensitivity of predicting difficult intubation ($p = 0.41$).

When excluding the eight departments that had already implemented the SARI, all but one department had the Mallampati classification pre-printed on the anaesthesia record (95.2%, CI: 77.3-99.2%). A history of airway management difficulties (85.7%, CI: 65.4-95.0%), neck movement (81.0%, CI: 60.0-92.3%) and jaw protrusion (81.0%, CI: 60.0-92.3%) were also frequently pre-printed risk factors. Mouth opening and thyromental distance were recorded in three (14.3%, CI: 5.0-34.6%) and two (9.5%, CI: 2.7-28.9%) departments, respectively (Figure 3).

No departments stated that they had explicit standards for preoperative assessment for mask ventilation difficulties or specific risk factors for this purpose pre-

 TABLE 1

Distribution of risk factors for difficult intubation registered in Danish anaesthesia departments – body-weight not included.

Risk factors on anaesthesia record, n	Anaesthesia departments, n
1	1
2	3
3	2
4	12
5	2
6 (complete SARI)	9

SARI = Simplified Airway Risk Index.

printed on their anaesthesia record. However, several risk factors for difficult intubation are also risk factors for difficult mask ventilation and were therefore to some extent recorded. Although this was not exclusively a predictor for difficult mask ventilation, 55.2% (CI: 37.6–71.6%) of the departments stated that they examined the patients for toothlessness preoperatively. The patients' weight was registered routinely in all departments. The median number of risk factors pre-printed on the anaesthesia records (weight excluded) was four, ranging from one to six (Table 1). No other risk factors than the ones comprised in the SARI were pre-printed on anaesthesia records in any department.

DISCUSSION

The scope of this paper was to elucidate whether there was national consensus on preoperative airway assessment in Denmark. The SARI model was under implementation in two out of five regions in Denmark. In the remaining parts of the country, two departments had implemented the SARI. Although, the point-estimates were in favour of departments using the SARI, we found no statistically significant difference in the accuracy of predicting difficult intubation in departments using the SARI compared with departments not using the SARI. Nor was registration of additional risk factors correlated with better prediction.

We found a considerable discrepancy in the standards for assessment of risk factors for difficult airway management and a great variation in the number of risk factors printed on the anaesthesia records. No department had explicit standards for assessing risk factors for difficult mask ventilation. However certain risk factors for difficult intubation are also predictive of mask ventilation difficulties [9, 15].

Few studies elucidate the topic of consensus on airway assessment. A study on individual anaesthesiologists' routines on airway assessment showed similar patterns of favoured risk factors and discrepancies [16]. It seems that the Mallampati test is well incorporated in

practice in Denmark and throughout Europe and North America [16, 17]. However, there is no evidence of the Mallampati test being a superior tool for prediction of difficult intubation compared with other known risk factors. Like most other bedside tests, the Mallampati test has a poor-to-moderate sensitivity and a moderate-to-good specificity [8, 18]. The general application of the Mallampati test may be due to tradition and the fact that it was introduced as one of the first risk assessments for difficult intubation.

Examination of mouth opening was only done in 14.3% of the departments in Denmark that did not use the SARI. This is surprising compared with data from Europe, where mouth opening is the most commonly assessed risk factor [16].

Studies have shown that by combining risk factors for difficult intubation, the diagnostic accuracy increases [6, 8]. Therefore, it was not surprising to discover that most departments had more than one risk factor printed on their anaesthesia record. However, the variance of standards for preoperative airway assessment was to some extent surprising.

We found no statistically significant improvement in difficult airway prediction in departments using the SARI. This is in keeping with results from a large cluster-randomised trial previously conducted [11].

Since tracheal intubation, placement of a laryngeal mask airway and mask ventilation serve as escape strategies for each other in case of difficulties, it was surprising that no departments had standards for assessing difficulties with laryngeal mask placement and mask ventilation. Different risk factors than those associated with difficult intubation have been suggested for these techniques [9, 19].

The survey had a good coverage, including approximately 70% of Danish anaesthesia departments from all regions and also achieved a response rate of 29 out of 31. The questionnaire was kept simple and limited to six simple questions that were mainly answerable by Yes or No. We retrieved anaesthesia records from each department in order to validate the answers and the understanding of the questions [14].

However, the study has some limitations: We asked only those departments that registered data in the DAD. Since it is mandatory to give a Yes/No response to questions on anticipated difficulties with intubation and mask ventilation in the DAD, we assumed that these departments had taken some kind of stand regarding the topic of preoperative airway assessment. The departments represent a wide selection of patient demographics and we believe that they are representative of the anaesthesia practice in Denmark. There was only one respondent per department and it might have been valuable to have more than one respondent per department

in order to further validate the answers from the respondents.

The results reveal large variation in departmental standards for preoperative airway assessment. In keeping with UK and European data, we assume that further variation is present between the individual anaesthesiologists within each department [16]. The variation in preoperative airway assessment found in this paper is most likely not an isolated Danish issue [16, 17].

From 2008 to 2011, only 6-25% of all difficult airway management in Denmark was predicted [10]. The rare nature of airway management difficulties makes prediction a continuous challenge for the anaesthesiologist [20]. However, there may be room for improvement. Better, evidence-based and uniform guidelines may be warranted [16, 17].

CONCLUSION

We found a wide discrepancy in preoperative airway assessment between regions and departments in Denmark. The SARI was implemented in eight Danish departments, and no other risk model was implemented anywhere. No statistically significant difference in predictive accuracy was detected between departments that were using the SARI and those that were not. Large variations in the standards for assessment of risks of difficult intubation were found, and no departments had specific standards for assessment of the risk of difficult mask ventilation.

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LITERATURE

- Pandit JJ, Cook TM. Guest editors' commentary: 'State of the art' in airway management in 2011. *Anaesthesia* 2011;66(suppl 2):1-2.
- Rosenstock C, Møller J, Hauberg A. Complaints related to respiratory events in anaesthesia and intensive care medicine from 1994 to 1998 in Denmark. *Acta Anaesthesiol Scand* 2001;45:53-8.
- Apfelbaum JL, Hagberg CA, Caplan RA et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* 2013;118:251-70.
- O'Sullivan E, Laffey J, Pandit JJ. A rude awakening after our fourth 'NAP': lessons for airway management. *Anaesthesia* 2011;66:331-4.
- Cook T, Woodall N, Frerk C. Major complications of airway management in the United Kingdom. *Natl Audit Proj* 2011;106:617-31.
- El-Ganzouri AR, McCarthy RJ, Tuman KJ et al. Preoperative airway assessment: predictive value of a multivariate risk index. *Anesth Analg* 1996;82:1197-204.
- L'Hermite J, Nouvellon E, Cuvillon P et al. The Simplified Predictive Intubation Difficulty Score: a new weighted score for difficult airway assessment. *Eur J Anaesthesiol* 2009;26:1003-9.
- Shiga T, Wajima Z, Inoue T et al. Predicting difficult intubation in apparently normal patients. *Anesthesiology* 2005;103:429-37.
- Kheterpal S, Han R, Tremper KK et al. Incidence and predictors of difficult and impossible mask ventilation. *Anesthesiology* 2006;105:885-91.
- Nørskov AK, Rosenstock CV, Wetterslev J et al. Diagnostic accuracy of anaesthesiologists' prediction of difficult airway management in daily clinical practice: a cohort study of 188 064 patients registered in the Danish Anaesthesia Database. *Anaesthesia* 2015;70:272-81.
- Nørskov AK, Wetterslev J, Rosenstock CV et al. Effects of using the simplified airway risk index vs usual airway assessment on unanticipated difficult tracheal intubation – a cluster randomized trial with 64,273 participants. *Br J Anaesth* 2016;116:680-9.
- Langeron O, Masso E, Huraux C et al. Prediction of difficult mask ventilation. *Anesthesiology* 2000;92:1229-36.
- Kheterpal S, Martin L, Shanks AM et al. Prediction and outcomes of impossible mask ventilation: a review of 50,000 anesthetics. *Anesthesiology* 2009;110:891-7.
- Kelley K, Clark B, Brown V et al. Good practice in the conduct and reporting of survey research. *Int J Qual Heal Care* 2003;15:261-6.
- Kheterpal S, Healy D, Aziz MF et al. Incidence, predictors, and outcome of difficult mask ventilation combined with difficult laryngoscopy: a report from the multicenter perioperative outcomes group. *Anesthesiology* 2013;119:1360-9.
- McPherson D, Vaughan RS, Wilkes AR et al. A survey of anaesthetic practice in predicting difficult intubation in UK and Europe. *Eur J Anaesthesiol* 2012;29:218-22.
- Hung O, Law JA, Morris I et al. Airway assessment before intervention: What we know and what we do. *Anesth Analg* 2016;122:1752-4.
- Lundstrøm LH, Vester-Andersen M, Møller AM et al. Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177 088 patients. *Br J Anaesth* 2011;107:659-67.
- Ramachandran SK, Mathis MR, Tremper KK et al. Predictors and clinical outcomes from failed Laryngeal Mask Airway UniqueTM: a study of 15,795 patients. *Anesthesiology* 2012;116:1217-26.
- Yentis SM. Predicting difficult intubation – worthwhile exercise or pointless ritual? *Anaesthesia* 2002;57:105-9.