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EDITORIALS

Prediction in airway management: what is worthwhile, what is a waste of time and what about the future?

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Nørskov and colleagues[1] randomized Danish anaesthesia departments in two groups, in order to investigate the effect of a structured airway examination on the ability to predict difficult intubation by direct laryngoscopy. The departments either continued with the pre-anaesthetic airway evaluation that they were used to, or applied the structured evaluation that consisted of five parameters (mouth opening, thyromental distance, Mallampati classification, neck movement and ability to prognath) and two questions (weight, previous difficult intubation) that culminated in the calculation of the Simplified Airway Risk Index (SARI).[2] This study found that clinicians were able to predict between nine and 50% of the patients where intubation with direct laryngoscopy was or would have been difficult. This success-rate in prediction difficulty was NOT different between the departments that continued with business-as-usual, and the departments where the evaluation of the seven predictive parameters was implemented.

Why this large range for predicting difficult airway? The large range, between nine and 50% is the result of two different methods of calculation/estimation. In their primary analysis, Nørskov and colleagues[1] excluded all the patients that were initially undergoing an alternative intubation method (videolaryngoscopic, flexible optical or other) and analysis of the remaining cohort revealed that 89 to 91% of difficult intubations were unanticipated and unpredicted. In a subsequent alternative analysis, 'Sensitivity analysis 1' of their data, they included the patients who had been 'planned to be intubated with an alternative method', on the premise that these patients had been pre-assessed to be difficult to intubate with direct laryngoscopy and alternative techniques to secure the airway had therefore been pre-planned (except where they believed that the alternative method was for educational training purposes only). The inclusion of these patients as 'true positives' in their analysis then revealed that clinicians actually predicted half (40% to 55%) of the difficult intubations.

So, which figure is correct and what is the truth? It is obviously not correct to just exclude the patients that were initially undergoing an alternative intubation method. By doing so, one would 'exclude the really interesting (=difficult) patients'[3] and only examine/ analyse the rest, a mistake that has often been made in studies exploring screening methods for predicting airway difficulty.[2–4] For example: in the original study that describes the SARI,[2] approximately fifty patients (Dr. El-Ganzouri, personal communication)[3] who were expected to be really difficult intubations were actually selected for awake intubation before inclusion of the other study patients that were then anaesthetized and analysed. The result was that the SARI became a tool with weaker predictive power than it could potentially have been, had it been applied to the whole study population that included the awake intubation group. However, that was not done in the original study[2] as it was judged unsafe to anaesthetize the most difficult patients before intubation. Hence, in order not to repeat that mistake, we should focus on the results from 'Sensitivity analysis 1' in the present[1] study where approximately half of the difficult intubations were predicted.

Therefore, the conclusion from the Nørskov-study can be summarized as this: with their usual practice of preoperative airway assessment, clinicians predicted around half of the difficult direct-laryngoscopy-intubations, and the implementation of systematic recording of the seven parameters that constitute the SARI did NOT improve the accuracy of this prediction. The result

of the Nørskov-study is not disappointing actually, and is in fact encouraging. It showed that with their 'usual practice', clinicians were able to predict about half of the patients where intubation with direct laryngoscopy was difficult. These are likely to be the most obvious and the most difficult patients that are being identified, analogous to the 'low hanging fruits' on a tree ready for plucking. This is clinically highly useful, as identification of these individuals allows the up-front selection of an alternative approach to intubation.

Regarding the parameters that are included in the SARI, there is good inter-observer agreement for Mallampati classification, mouth opening and ability to prognath, but only fair agreement when it comes to thyromental distance and neck movement,[5] so maybe what we see in the present study is 'as good as it gets' and we will have to accept that. However that does not mean that we can't improve on the clinical utility that we can further derive from our attempts at prediction.

So, how can we become better prepared in the future? How can we invest our time better than by sometimes fruitless[1] registration of additional parameters?

In the Nørskov-study[1] the physicians in the active group performed the SARI –investigations, but it was left to their individual judgement what consequences they should draw from the result of the investigations –(i.e. if they considered the findings indicative of difficult intubation or not, and if they did: what consequence to take from that consideration). First, we should realize that when predicting difficult intubation (or difficulty of other approaches to airway management), a false positive (where the patient is falsely judged to be difficult to intubate/manage) has very little negative consequences, whereas a false negative (where the patient turned out to be difficult/impossible to intubate/manage despite our prediction) may have more serious consequences.[6] It could thus be justified to choose a lower threshold, in the present case that would mean a lower SARI-score, for considering an airway as difficult to intubate/manage – and thus clinicians would then have a lower threshold for choosing an alternative approach to airway management, for example awake intubation.[6]

In addition, there are a plethora of devices and techniques for airway management; which one needs an airway prediction? Some may argue if it is even relevant to predict difficult direct laryngoscopy in the era of videolaryngoscopy, and indeed it still is! Because in most patients, intubation by direct laryngoscopy is still the fastest and cheapest[7] and on several occasions direct laryngoscopy has been the rescue method in case of failed intubation by videolaryngoscopy.[8] Notwithstanding, with videolaryngoscopy becoming fairly routine and prevalent in airway management, coupled by its incorporation into the major difficult airway management guidelines,[9–11] we need to concurrently predict the likelihood of success or failure with these techniques. To this end, we can use the same seven examinations/questions as in the study by Nørskov[1] as a high SARI also correlates with difficult/failed videolaryngoscopy with an angulated videolaryngoscope,[12] but with a higher cut-off value than for direct laryngoscopy. Neck pathology, scar, radiation or mass, is a challenge, even for an angulated videolaryngoscope[8] and may be a good reason for considering awake intubation.[13] A documented previous difficult tracheal intubation is a strong predictor for subsequent difficult intubation,[14] this is a reason for always documenting the ease or difficulty of a laryngoscopy/intubation. For videolaryngoscopy this can be done in a simple and clinically useful way by adding a 'v', so that a direct laryngoscopy Cormack and Lehane grade three or four view is reported as improving to 'CL 1v or 2v' supplemented with indication of the brand and size of the videolaryngoscope blade that was used and any adjuncts (stylet).[15 16]

The Canadian airway guidelines from 2013[10] did put more focus on airway prediction and introduced the 'inverse burden of proof': instead of merely attempting to identify difficulties with airway management, we should identify methods for intubation that will be successful in a maximum of three attempts, otherwise we should not induce general anaesthesia before intubation, and in case of concomitant predicted difficulty with face mask and supraglottic device ventilation, an awake approach is advisable.

Apart from evaluating the potential ease or difficulty of non-invasive methods of securing the airway, we must also do so with regard to tracheostomy[9] and/or cricothyroidotomy.[10] We should aim to identify the ultimate escape portal for oxygenation (i.e. the cricothyroid membrane, before initiation of airway management)[11 17 18]; if this cannot be done reliably by inspection and palpation alone, then ultrasonography[19] is currently the most useful adjunct.[10 11 17 18]

In conclusion: Nørskov and colleagues[1] have showed us that merely performing more investigations and recording more parameters does not improve difficult airway prediction. If we want to improve, we will have to invest our time otherwise as outlined in the discussion above, or choose a lower threshold for suspecting a difficult airway – probably we should do both.

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Skeletal muscle and plasma concentrations of cefazolin

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Surgical site infections are serious complications of surgery, particularly after orthopaedic surgery, where biomaterial infection has serious implications for the patient and poses a significant financial burden on society. Antibiotic prophylaxis is an important component of strategies to prevent surgical site infection, and although it has become part of routine practice before and during many surgical procedures, it has been insufficiently investigated.

The study published by Himebauch and colleagues[1] in this issue of the BJA is thus a very welcome and much needed addition to the literature on this topic. In their well written article the authors report skeletal muscle and plasma concentrations of Cefazolin during complex pediatric spinal surgery. These muscle concentrations are important, as insufficient concentrations may very well result in possible surgical site infections (SSI). Although data on the serum concentrations are well known, there are not many studies showing concentrations in the tissues surrounding the implant, which is where adequate antibiotic concentrations are necessary to prevent biofilm formation. The use of microdialysis in this study is innovative and safe and may represent an important adjunct in the quest to gain insight into the actual local tissue antibiotic concentrations.

The administration of prophylactic antibiotics is part of routine practice. Most commonly when permanently implanted biomaterial are placed, a cephalosporin is administered perioperatively. In large register-based studies of orthopaedic joint replacements, antibiotic prophylaxis has been associated with significantly reduced infection rates. Unfortunately the timing of administration before surgery, dosage and the administration of repeat perioperative dosage are debatable subjects, on which this article can cast some light. From the current article we can learn that in this vulnerable group of children with scoliosis, especially those with neuromuscular abnormalities, the concentrations are too low at the time of the incision. Also, given the duration of these operations, the local concentration of antibiotics decreases to an undesired low concentration during surgery. The measurements in table 3 show that the protection, especially against gram negative bacteria, is too low. Inadequate concentrations of antibiotics are not helpful in the prevention of biofilm formation, and may even induce bacterial resistance to antibiotics that are usually optimal for prophylactic treatment.

It is common knowledge that implanted biomaterials, such as those used in joint replacement are prone to infection. During the proceedings of the international consensus meeting on periprosthetic joint infection held in 2013, with virtually all the representatives of orthopaedic surgery present, consensus was reached on many subjects.[2] The efficacy of antimicrobial prophylaxis in preventing infections is a well-established,[3] and preoperative i.v. antibiotic prophylaxis is regarded as the corner stone for the prevention of infection in all patients undergoing biomaterial implantation.

In operations that last for more than one h, an increasing infection rate is found even in the absence of implantation materials. Therefore more rigid treatment regimens for longer operations, and for high-risk patients, such as patients with diabetes, severe obesity and other risk factors, are introduced. It is also important that preoperative measurements for reduction of the risk for an infection, such as decolonization for MRSA and/or other MSSA bacteria in patients, are introduced and implemented.

After the insertion of a prosthesis into the human body a race between bacteria and host cells for the surface of the implant begins. If bacteria get the chance they will develop a so-called biofilm around the implant, a self-produced extracellular polymeric