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Journal Club Summary October 2020
"Developing a Profile of Procedural Expertise"

Expert Opinion: Dr Albert Chan

"Asking novices to mimic the movements of an expert profile during intubation may not necessarily lead to success"

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Journal Club Summary

Kerrey, Benjamin, MD, MS, Boyd, Stephanie, et al**. Developing a Profile of Procedural Expertise: A Simulation Study of Tracheal Intubation Using 3-Dimensional Motion Capture.**

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Simulcast Journal Club is a monthly/ series that aims to encourage simulation educators to explore and learn from publications on Healthcare Simulation Education.

Each month we publish a case and link a paper with associated questions for discussion.

We moderate and summarise the discussion at the end of the month, including exploring the opinions of experts from the field.

The Case :

It had been a month since Harvey had been unable to intubate an unstable, septic neonate but the memory of desperately yet unsuccessfully manipulating the laryngoscope remained fresh in his mind. He remembered the looks of polite confusion from his junior staff when he failed, as if their perception of him had dropped dramatically but they didn't know how to articulate it. Fortunately for him and the patient, it had been nothing an LMA couldn't fix and the baby had recovered beautifully. Much faster, in fact, than Harvey had recovered from that particularly bruising identity threat.

He'd realised that he'd reached an alarming state of unconscious competence as a NICU registrar, to the point where his muscle memory intubated so well his brain had contributed very little. 3 years as a Consultant without intubating though, had atrophied those particular neurones, and skills wise he'd seemed left with nothing.

Expertise, he thought to himself, was a funny thing. Hard to define, hard to measure, and even harder to maintain.

Discussion :

This month we're exploring procedural expertise, and simulation's role in describing and identifying what procedural expertise actually looks like in practice.

As always, enjoy the paper and we look forward to your thoughts!

Article Summary :

Most of us in healthcare education would be comfortable with the concept that safe tracheal intubation is an important, high stakes procedure in healthcare. The authors note however that despite the importance of teaching intubation well, a "recent systematic review, highlighted that there is no sufficiently valid approach to assess provider skill.". In essence, they argue that if we don't know what expertise looks like, it becomes significantly harder to teach, at least with a level of academic validity.

So the authors of this study created a "prospective investigation of 3D motion capture to characterise the kinematics of physicians performing tracheal intubation" on airway mannequins, arguing that by analysing the differences in the physical movements made by novice and expert intubators, that they could begin to create a 3D analysis of what expertise looks like during intubation.

They state that their study bases itself within the theory of 'radical embodied cognition', a complex and new term for many of us on journal club. From what we could gather, radical embodied cognition argues that our movements and our thoughts are embodied together inseparably. Within the article, they take the stance that one can draw inferences about our thoughts from the ways that we move.

So the study mapped out a number of different clinical movements during intubation of a mannequin, such as the path lengths of the laryngoscopy handle and R) hand, the joint angle variability at the wrist, elbow and shoulder in the sagittal plane, and hand acceleration.

By the end of the trial, they'd recruited 15 novices and 11 experienced subjects, each of which intubated some paediatric and adult mannequins 21 times. The experienced providers reported more than 100 lifetime intubations on patients, while almost all the novices had done less than 10. " For laryngoscopy, experienced providers exhibited shorter path length (total distance traveled by laryngoscope handle; 77.6 ± 26.0 cm versus 113.9 ± 53.7 cm; $P = 0.013$) and greater angular variability at the left wrist (7.4 degrees versus 5.5 degrees, $P = 0.013$) and the left elbow (10.1 degrees versus 7.6 degrees, $P = 0.03$). For intubation, experienced providers exhibited shorter path length of the right hand (mean = 61.1 cm versus 99.9 cm, $P < 0.001$), lower maximum acceleration of the right hand (0.19 versus 0.14 m/s2, $P = 0.033$), and smaller angular, variability at the right elbow (9.7 degrees versus 7.9 degrees, $P = 0.03$)."

The authors argue that "Experienced providers move differently in specific ways, which together lead to the procedure being shorter and with more economy of movement. Moreover, although most of the observed effect sizes were moderate, even small effects proximal in the kinetic chain will propagate.".

They argue this is the start of a longer term mission to map procedural expertise in intubation and to understand how to teach it better.

Expert Opinion: Dr Albert Chan, FHKCA, FANZCA, FHKAM Anaesthesiology

Dr Albert Chan works as an Anaesthesiologist at the Department of Anaesthesia and Intensive Care in Prince of Wales Hospital in Hong Kong, where he is also the supervisor of training. He has special interests in cardiac anaesthesia, perioperative echocardiography and cardiac catheterization lab procedures, particularly minimally invasive structural heart procedures. He currently acts as Council Member of the Hong Kong College of Anaesthesiologists and the Chair of the Board of Education.

His greatest passion lies within medical education, especially simulation-based medical education. His experience as a Visiting Scholar at Center for Medical Simulation in Boston was not only transformative, but equipped him with better debriefing skills and understanding of medical simulation. He has taught in numerous simulation courses, including teaching as co-faculty with the Center for Medical Simulation.

With regards to simulation education, his current focus is on in-situ simulation and Clinical Debriefing, Interprofessional Education and Faculty Development. He is also one of the senior faculty members of the Comprehensive Simulation Educator Course at the Hong Kong Academy of Medicine, Hong Kong Jockey Club Innovative Learning Centre for Medicine.

I read this article with great fascination, both from the perspective as an anaesthesiologist and an educationalist! As the supervisor of training in my department, every July I am faced with the same challenge – how to better teach novices acquire airway management skills. This article certainly gave me some food for thought.

I have certainly never thought of intubation in terms of kinematics and have little experience with the science behind it – the closest is when I watch shows that use kinematics to analyze professional athletes movements. In that sense, I think kinematics provides analysis of movements to enhance athletes' performance goal – to run faster and more efficiently, to jump higher, to pitch the baseball harder and avoid injury. I asked myself – what then is the performance goal of laryngoscopy and intubation, and how would such kinematic data of the actions help novices attain expertise as postulated in this article?

Most studies, when comparing outcomes of intubation, look at first attempt success. I also think that this is an important performance goal for intubation as an anaesthesiologist, because certainly in clinical situations of difficult airway that I have experienced, patients may have very little reserve for repeated attempts at laryngoscopy and intubation – and with more attempts, the success rate is even lower due to airway swelling. Will such kinematic profiling of experts give insight into how one can achieve first attempt success? As rightfully pointed out by the authors – "although important differentiators of skill level, speed and efficiency are not specific measures of procedural performance." The outcome parameters in this study – speed, angular movement of the wrists and elbows, path length of the laryngoscope, or "economy of movement" – may be only providing a *glimpse* of what an expert does to successfully intubate.

As I think back to the times when I supervise trainees during tracheal intubation, I usually can subconsciously predict the possibility of success based on their posture and hand movement – the way they hold the blade, the way they insert the laryngoscope, the angulation of the laryngoscope and the direction of force that they are applying to lift the epiglottis. I probably cannot specifically spell it out, for instance what angle would work better for that circumstance, but I always get this "gut feeling" with their approach and it is usually correct. This study interestingly puts into perspective that perhaps, there are some objective measurements of what I am instinctively observing.

However, I think there are couple areas crucial to tracheal intubation that are missing in this article (some pointed out by the authors) – and these are, in my mind, what limits the applicability of simply using kinematics as a way to teach and assess this procedural skill.

First of all, from a technical standpoint, I think the kinematic movement is only part of what contributes to success of laryngoscopy and intubation. More importantly is the force that is applied to lift up the epiglottis, the area that the force is applied and the direction that the force is applied. Not to mention in older children and adults, you have to apply this force without chipping or knocking out a few teeth. The positioning of the head and neck position to align the intubation axis and the neck extension to open up the mouth are all contributors to first attempt success. Thus I think simply asking novices to mimic the movements of an expert profile during intubation may not necessarily lead to success.

Second of all, I am struggling with the "radical embodied cognition" as a theory to help us understand success in intubation through using kinematics, particularly with the statement "measurement of movement, therefore, can be a direct assessment of at least part of the underlying cognitive process." Now, I am not even going to pretend that I understand the theory of embodied cognition, but from my cursory reading of the theory, it considers cognition as a "product of dynamic interplay between neural and non-neural processes, with no general fracture between cognition, the agent's bodily experience, and real-life contexts." (https://plato.stanford.edu/entries/embodied-cognition/) In my mind, it means that movement seems to be a manifestation of cognition within a specific context or environment (e.g. intubating a mannequin vs intubating a sick child in the ED).

From an educational standpoint, I don't think that kinematic movement provides a "direct assessment of cognitive process" – but rather it provides a window or opportunity for the observer/supervisor to take note and use this as a reference point to understand the underlying cognitive processes that led to this movement and success or failure in intubation, and teach from there. From the learner's standpoint, mimicking kinematic movement of experts during intubation will not lead to success unless there is a cognitive linkage with between the "action" and the "result" – that is if they move the laryngoscope in this way, and apply the force this way (the action), they are able to visualize the larynx better (the result).

Third of all, to define expertise of tracheal intubation based on movement is by far a simplification of a procedural skill – there are cognitive, psychomotor and affective components to it. An expert should be able to understand the anatomy of the airway well, how to assess the difficulty of an airway, predict the type of equipment or intubating aids that will enhance the success of the intubation, the positioning of the patient, have adequate planning and communication of the airway plan and recognize and manage complications, able to apply the skills in various contexts and environments, and even manage own stress responses when faced with a rapidly deteriorating patient. To me, a better way to understand expert performance in tracheal intubation, is to use cognitive task analysis (Velmahos et al., 2004) to identify expert skills and knowledge within the particular domain, and to determine the constituent skills that contribute to success. This is a more comprehensive approach to procedural expertise, and certainly using kinematics, as in this study, may contribute to better understanding of one of these constituent skills.

To end, I would like to use a little vignette of my own that made me understand the difficulty of learning a "skill". As I was telling Ben, it was by wife's birthday weekend last week and we went on a wakesurf "feast". I am relatively new to the sport, and trying to learn a few tricks. One of these tricks is the "360" where one goes up the wake and then does a 360 degree turn and continues surfing. I have looked at many, many youtube videos and Instagram posts to try to analyze how expert surfers move their bodies during this trick, and tried repeatedly to mimic what they do. Guess what? That got me nowhere. I started asking coaches to give me feedback on my body movement during the trick, and analyzed my own videos of the trick to form a mental model of what may contribute to success in the trick – and I am getting closer! Hopefully with this type of deliberate practice I will be able to land a 360 soon and I sure will let you know about it! (After 10,000 hours maybe?)

Reference :

Velmahos, G. C., Toutouzas, K. G., Sillin, L. F., Chan, L., Clark, R. E., Theodorou, D., & Maupin, F. (2004). Cognitive task analysis for teaching technical skills in an inanimate surgical skills laboratory. *American Journal of Surgery*. https://doi.org/10.1016/j.amjsurg.2002.12.005

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Journal Club Summary

Summary of this Month's Journal Club Discussion :

Blog Contributors :

- Lon Setnik, Sarah Janssens, Dan Hufton, Vic Brazil, Belinda Lowe, Ben Symon

Discussion this month was quieter than usual, perhaps reflecting that this was a very different type of paper. Overall there was a lot of appreciation for the methods and mission of the study, some debate about how well the results could be applied in teaching, and in particular debate about how much we agreed with the theory of radical embodied cognition.

Lon Setnik began the month's discussion with a beautifully specific break down of the article, as he raised concerns about the way intubation as a physical procedure was broken down in the analysis, vs the way he visualises it as a teachable skill with many more smaller components. He also flagged the importance of physical fidelity for this type of analysis, both in terms of the airway anatomy and the physics of the tissue itself. His concerns were mirrored by others, such as Sarah Janssens and Dan Hufton who flagged concern about over-emphasising physical movement over the adaptive expertise that might be required for different conceptual and physical challenges in real life intubations, although I think it's important to note this was acknowledged in the authors comments and limitation sections.

Belinda Lowe (who as we know has a large amount of expertise in procedural skills training through simulation, particularly in laparoscopic simulation training) validated the importance of the article, saying "clearly by defining expertise – there would be opportunity to then study the learning curves of intubation and also credentialing for novice practitioners using simulators." and described how similar data can be given to students rehearsing in VR simulations to inform them of their progress.

Vic Brazil also raised an important point, that the risk with this sort of study is that by defining expertise as what experts are already doing, we potentially stifle future innovations, giving us the example of the Fosbury Flop in high jump.

Finally there was much debate about this concept of radical embodied cognition and how much inference could be taken on our cognitive processes from our movements.

Acknowledgements :

Thank you to Dr Chan for his expert commentary this month.
Thank you to all commenters this month for sharing your thoughts and allowing us to learn from you.
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References :

1. Kerrey, Benjamin, MD, MS, Boyd, Stephanie, et al. Developing a Profile of Procedural Expertise: A Simulation Study of Tracheal Intubation Using 3-Dimensional Motion Capture. *Simul. healthc.*. 2020;15(4):251-258. doi:10.1097/SIH.0000000000000423