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Cognitive psychology, the multidisciplinary operating theatre team, and managing a cannot intubate, cannot oxygenate emergency

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This editorial will consider how an understanding of cognitive psychology can be used to improve management and training of the cannot intubate, cannot oxygenate (CICO) scenario. Cognitive psychology has been used to optimise performance within the military elite sport, and emergency medicine.[1–3] We will address strategies to optimise task performance of the individual and the team, and give an example of how this could be implemented.

Cognitive psychology is the study of how information is received, processed, stored in memory, and later used when required. Models of memory are complex, but at the simplest level can be divided into short- and long-term memory. Short-term memory, particularly working memory, allows us to do activities requiring conscious thought and is susceptible to disruption from acute stress.[4] Long-term memory, specifically procedural memory, involves unconscious thought, allowing activities to be performed automatically, and is therefore less affected by external stressors.[5,6]

The individual

Ideally, a skill must be taught right, learnt right, and practised regularly to be performed accurately when required (Fig. 1). Considering a stepwise approach to skill acquisition, Merrill[7] has described five prescriptive stages of learning: (i) learning, (ii) practice, (iii) practice under pressure, (iv) performance, and (v) performance under pressure.

Initial teaching focuses solely on the 'inflexible' content of the procedural skill being taught (Table 1). The inflexible content of any skill includes the fundamental constituent steps that must be performed in the right order for the task to be completed successfully. Using inflexible content to repeatedly and didactically 'drill' a skill ultimately results in it being performed unconsciously, because it is stored in the more stress-resistant long-term memory. The learner then practises this skill under conditions of increasing cognitive load by way of stress inoculation training: a process of deliberate practice.[8,9] As opposed to simply repetitively practicing a process, it involves systematic and structured practice towards a defined goal with immediate feedback to allow real-time alterations and improvements in technique.

In addition to skills training, performance-enhancing psychology techniques can be used 'in the moment' to help with concentration or to regain focus if situational awareness is lost. A group of four such techniques is summarised by the phrase Beat The Stress Fool[3] as follows: (i) **B**reathe (square or tactical breathing); (ii) **T**alk (positive self-talk); **S**ee (mental rehearsal of the task to be performed); and (iv) **F**ocus with a trigger word.

Respiration is the only autonomic function that can be consciously controlled, and the use of breathing techniques

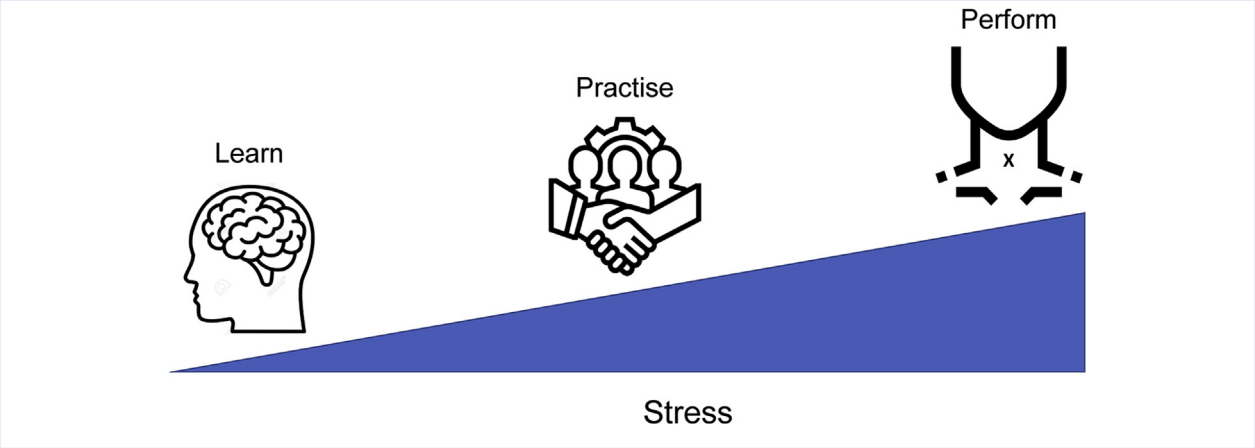

Fig 1. Skill acquisition, deliberate practice and stress inoculation facilitate later performance of cricothyroidotomy whilst under pressure.

offers a rapid method to attenuate the physiological arousal associated with acute stress. One such technique is square or tactical breathing, which involves inhaling deeply for 4 s, holding the breath in for 4 s, exhaling for 4 s, and holding in expiration for 4 s. Stress-induced tachycardia and associated tremor that may make skills necessitating fine motor control difficult or impossible to execute may also be controlled via breathing techniques.

Positive self-talk helps the user block and overcome negative thoughts. Individuals who are responsive to this technique become more relaxed, focused, and more able to achieve their goal.

'Seeing' or mental rehearsal is the process of creating a mental image of what the subject wants to happen in reality. It is crucial that the process and its outcome are mentally visualised in detail, including how it would feel to perform the task in real life. In training, mental rehearsal allows the user to learn a skill mentally and physically. In real life, the skill to be performed can be rehearsed quickly in the mind before being undertaken.[2,10]

A trigger word is a specific word said out loud when faced with an acutely stressful situation and a sense of loss of control of the situation. Verbalising the focus word triggers the use of breathing techniques, such as square breathing, positive self-talk, or seeing (mental rehearsal), and in doing so helps the individual regain control of the situation.

The team

A group of people become a team when they share both a common sense of purpose and a clearly defined goal. Teams in world-class sport manage complex time-critical tasks impeccably.[11,12] They train closely as a whole unit and in doing so exhibit unrivalled levels of understanding, interdependence, trust, and communication. The use of cognitive psychology science within teams performing at an elite level aims to enhance three important elements: *team cohesion*, *team confidence*, and the use of *shared mental models*. These three elements are closely inter-related, and improvements through training in one aspect can lead to improvements in the others.[12]

Team cohesion is built from a combination of *social cohesion* and *task cohesion*.[13,14] *Task cohesion* is improved during training by establishing specific, measurable, attainable, realistic, and timely goals for the whole team to achieve, whilst following a clear shared mental model. Crucially, individual team members need to be assigned roles with responsibility for specific tasks and coached individually. Only in this way do all team members come to understand their position in the broader task and feel motivated to contribute. *Social cohesion* provides the basis for a sense of collective trust and a mutual support network, in turn engendering a positive atmosphere for learning and a free exchange of knowledge between team members.

Training together improves communication skills. Verbal communication within the team aimed at improving performance needs to be instructional and positive.[15] Non-verbal communication between teammates during task performance depends on their understanding of each other's roles and so relies on a robust shared mental model.

Shared mental model and simulation training

The vortex approach[16] is based around an algorithm specifically designed for use during a clinical airway emergency. It offers a visual, team-based, consistent template for restoring oxygenation as rapidly as possible, culminating where necessary in emergency front-of-neck access. These skills are then honed by repeated rehearsal through simulation, until the whole team's actions become automatic and coordinated.

Simulation and mastery of procedural skills are crucial for both individual self-confidence, but also the whole team's confidence.[17] Training should recognise and concentrate on each individual's unique contribution towards achieving the ultimate goal. In terms of a CICO emergency, this means the operating theatre team using the vortex as a shared mental model, in which team members have well-defined roles.[16]

Experiencing not only success as a team, but facing adversity, leads to a growth in team confidence and therefore *collective efficacy*, which describes a team's belief in its ability to perform a task. Collective efficacy itself is an element of team

Table 1 Inflexible elements in teaching surgical cricothyroidotomy and their rationale.

Inflexible content	Rationale
Preparation	
(i) Remove pillow, insert sandbag/fluid bag under shoulders	(i) Optimises the exposure of the cricothyroid membrane
(ii) Laryngeal handshake: mark cricothyroid membrane position	(ii) Identifiable cricothyroid membrane or not? Governs method to be used
(iii) Size 10 scalpel blade	(iii) Correct size to create adequate-sized stoma to admit tracheal tube
(iv) 6.0 tracheal tube	(iv) Smooth passage over bougie with minimal 'catch' on insertion
(v) Think blood	(v) Mental preparation for bleeding
Performance	
(i) Right-handed stand on left; left handed on right. If impalpable cricothyroid membrane, cut caudal to cranial	(i) Offers best ergonomics for bougie and tracheal tube insertion
(ii) Keep scalpel perpendicular to skin when performing stab technique in palpable cricothyroid membrane	(ii) Increase chance of hitting cricothyroid membrane
(iii) 8 cm midline incision if cricothyroid membrane impalpable beginning 3 cm above sternal notch	(iii) Cricothyroid membrane may be surprisingly deep; good exposure needed and exact location of cricothyroid membrane variable
(iv) Keep scalpel vertical whilst passing bougie alongside	(iv) If off-vertical, blade will close the available space making bougie passage more difficult
(v) Advance tracheal tube over bougie until 1–2 cm only distal to the opening of the cricothyroid membrane	(v) Easy to endobronchially intubate as we are habituated to seeing 21–24 cm at the skin

resilience that can help protect against negative effects of encountered stressors. Team simulation provides both the opportunity to face adversity and to overcome it.

Debriefing allows the team to discuss their collective and individual performance, providing an open forum to suggest ways to improve. Through such open discussion, a strong sense of collective team confidence can be engendered. Team confidence or collective efficacy is a reflection of the whole team's understanding of their overall shared level of competency. It is the global shared confidence amongst all team members in their ability to perform, not the sum of each individual team member's confidence, which is important.[18]

Putting it all together

Cannot intubate, cannot oxygenate training has been aimed primarily at the anaesthetist and sometimes the operating department practitioner. The whole team is rarely involved, and the importance of the roles played by the healthcare assistant and scrub nurse are largely overlooked. Such training takes place largely out of context, in a classroom, using tabletop mannequins of questionable fidelity without simulating the conditions of stress and time pressure synonymous with a CICO emergency. Appreciation of this failing has led to the design of more robust training programmes that incorporate cognitive psychology to improve team performance, not just the performance of the anaesthetist.[19–21]

We have incorporated these concepts into a tailored 3 h CICO training programme for the operating theatre multidisciplinary team.[21] The objective is to improve the performance of the whole team under stress, and in doing so reduce deliberation time, procedural time, and any lost time spent managing a CICO emergency. Time savings can be found by addressing both individual and team competencies, capabilities, and readiness to act in this evolving emergency, and early identification of latent errors in the system that might lead to unanticipated delays.

Conclusion

We suggest that CICO training should embody the principles of cognitive psychology and adapted techniques regularly used by other high-performing groups, to train clinical teams in these high-stakes events. It is only through shared learning, practice, and performance of these events under increasing levels of stress that specialist skills and tasks are embedded into the unconscious long-term memory. Using long-term memory in this way frees up short-term attentional bandwidth to be directed at the peculiarities of the situation and unexpected problems that need to be resolved rapidly.

Authors' contributions

Writing the paper: ThM, TaM, MS, PG.
Editing the paper: all authors.
All authors have reviewed and approved the final manuscript.

Declarations of interest

The authors declare that they have no conflicts of interest.

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