ACLS / SIMULATION IN ANAESTHESIA

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Last year Associate Professor Sandy Garden delivered at this meeting an excellent presentation on "Human Factors in Advanced Cardiac Life Support," which skilfully provided an update on technical aspects (what-to-do) and behavioural skills (how-to-manage-it)[1]. This year the focus is on the imminent roll-out of updated global and local guidelines on cardiac resuscitation, and what simulation can tell us about practical application of these guidelines by experienced anaesthesia teams. As well as the literature, this presentation derives from repeated observations and debriefing of teams managing immersive simulated cases.

Do You Speak "ACLS Algorithm"?

In practical terms, Basic and Advanced Cardiac Life Support (ACLS) refers to cardio-respiratory resuscitation situations for which international management guidelines exist, have been widely promulgated, and certain aspects of which will have been rehearsed recently by your team members. Nurses, junior doctors and allied healthcare providers almost universally complete recognised courses in cardiac resuscitation as a condition of employment, typically annually or two-yearly. This frequency attempts to balance the well-documented decay of skills and knowledge seen in all levels of healthcare providers,[2] against practicalities. It is common now for support staff such as administrative assistants and orderlies to have been taught basic skills such as airway support and chest compressions.

ACLS includes adult, paediatric and neonatal cardio-respiratory arrest algorithms, and guidelines exist for peri-arrest conditions such as malignant arrhythmias and acute coronary syndromes.[3,4] National guidelines may be readily accessed.[5,6]

ACLS Training

In NZ there is some standardisation of course content and delivery, most commonly a one-day CORE course (Certificate of Resuscitation and Emergency Care) or version thereof, using skill stations and simple scenarios. For example in the year preceding July 2010, over 2,600 hospital staff completed a standard CORE course delivered by a qualified instructor who is subject to continuing education requirements under the aegis of the NZRC[7].

I hear and I forget, I see and I remember. I do and I understand.

(Chinese proverb)

ACLS and Anaesthetists

Anaesthetists enjoy a special status as resuscitation providers as described in this extract from the New Zealand Resuscitation Council (NZRC) site[5] listing provider levels 1-8.

> *Level 8. Advanced medical providers are medical practitioners involved on a permanent basis in the provision of emergency care and resuscitation. This group would include physicians working in the fields of emergency medicine, trauma, anaesthesia and intensive care etc.*

In aspects such as airway management, conventional intravenous access and fluid administration, as well as leading a healthcare team in less emergent situations, anaesthetists are certainly highly experienced. Individuals in the speciality continue to contribute to research and training in resuscitation. However continuing experience of cardiac arrest and peri-arrest management is very limited for most anaesthetists (perioperative cardiac arrest occurs in the order of <5 / 10,000 patients[8,9]) who nevertheless remain regarded, and generally regard themselves as expert resuscitation leaders.

Australasian anaesthetists are accustomed to lifelong learning and use a variety of methods to update themselves according to the individual's discretion. Regular completion of an ACLS course appears to be used by a minority. There is no NZ CORE course specifically for Level 8 providers such as anaesthetists.

ACLS International Guideline Development (due October 18th 2010)

International collaboration and agreement on standards and guidelines in medical management is gradually becoming more common. ACLS guidelines are a good example, with a transparent process of re-evaluation of evidence and development of guidelines led by the International Liaison Committee on Resuscitation (ILCOR) process in a five yearly cycle.[10] These guidelines have local variations developed by national resuscitation bodies according to local conditions / expert advice. For example NZ has a “3 stacked shocks for a witnessed arrest” guideline in the 2005 edition, partly due to the persistence of monophasic rather than biphasic defibrillators in healthcare facilities in NZ.

The best advice in this situation is “know what your team has been taught.”

Fortunately there is an ongoing trend to harmonise guidelines internationally and in other ways make them more user-friendly: this will apply to the 2011 iteration of ACLS algorithms in NZ and Australia. Taskforces privy to new ILCOR guidelines have been producing these algorithms which will be rolled out early next year by an army of resuscitation instructors.

The Updated Australasian Algorithms

These are not available ahead of the release date.

Technical Aspects – What Will Not Change

- The importance of starting early high-quality uninterrupted chest compressions in low or non-perfusion states
- Compression rate of 90-110 per minute
- Compression to ventilation ratio of 30:2 in unintubated patients
- Continuous compressions and slow ventilatory rate once intubated (8-10 per minute max)
- Widespread use of automated external defibrillators (AEDs) in basic and advanced life support in and out of hospital: these deliver a shock only for ventricular fibrillation
- Immediate defibrillation for ventricular fibrillation or ventricular tachycardia
- Electrical cardioversion / pacing for tachycardia / bradycardia with poor perfusion
- Immediate resumption of compressions (without checking the rhythm) after defibrillation for 1-2 min before reassessment
- A two min cycle of compressions and ventilation followed by review of rhythm
- Consideration of intraosseous access to the circulation in children and adults
- Adrenaline and amiodarone doses
- An emphasis on early consideration and correction of cause of arrest

What Can Simulation Tell Us About ACLS?

1. Gap Analysis

Although immersive scenarios may not entirely reflect how teams will perform in the clinical environment, debriefing after scenarios allows useful insight into knowledge, situational awareness and decision-making of team members. The technical and behavioural points below are seen in teams consisting of anaesthetists, anaesthetic technicians and nurses.

It is also worth noting that video-assisted scenario debriefing routinely highlights for participants the gap between their recall of events and the video record. This is unsurprising but a salutary reminder for us when critiquing our own or others' reported performances in crisis events.

Men engrossed in the game are blind: those on the sideline see clearly.

(Chinese proverb)

A) Technical Management

- Algorithms stress absence of response and breathing as a decision point to begin compressions and electrical therapy. This decision is problematic during anaesthesia not least because of the interruption to surgery. Teams tend to tolerate evidence of poor perfusion for inappropriately long periods.
- Chest compressions are commonly performed too low on the sternum: "the centre of the chest" is a simple and effective guide.
- Compressions are commonly performed too fast, at 120-140 per min. This exhausts the rescuer, does not appear to confer survival benefit and predisposes to "leaning on the chest" thus preventing adequate recoil. Rescuers utilising a strategy such as a song to guide rate do better at this.[11]
- Compressions are very commonly of insufficient depth. In fact a rescuer performing compressions finds it difficult to judge 1/3 the depth of the chest and frequent feedback from other rescuers is required. Those performing compressions are often not relieved when they are tiring and compressing less effectively: this decay begins after one minute.[12]
- Anaesthetists almost universally hyperventilate patients at 20-30 breaths per minute if they are multi-tasking eg thinking about other aspects of the situation as well as hand ventilating. The reduction in venous return this produces is profoundly detrimental in the peri-arrest or arrest setting.
- Airway experts such as anaesthetists are easily drawn to intubate with an associated interruption to compressions or delay to defibrillation. While establishing an airway is important where hypoxia is a cause, alternatives to intubation such as simple manoeuvres and use of LMA are often appropriate and do not interrupt compressions.
- Unfamiliarity with AED function, manual defibrillators and those hospital devices which have both options available frequently hampers teams. Few nurses can use the defibrillator manual mode unauthorised, although it allows more rapid rhythm diagnosis and defibrillation in *experienced hands* than the AED mode. Anaesthetists use these devices so rarely clinically it is irrational to expect decisive and accurate use without deliberate simulation practice, yet teams generally expect anaesthetists to troubleshoot defibrillators.
- External pacing for symptomatic bradycardia can be performed with some defibrillators. Again, familiarity with this function is required such as the need to attach separate ECG leads, and simulation demonstrates once again that the ergonomics of many medical devices is extremely poor.
- The immediate resumption of compressions after defibrillation is frequently delayed by anaesthetists who check the rhythm and discourage chest compressions if there is sinus rhythm. Conflict or at least confusion occurs in other team members well aware of the importance of compressions in supporting coronary perfusion.
- There is a high risk of drug administration error, almost always due to miscommunication within the team.
- Drugs need a period of effective compressions to circulate.
- Consider and correct: in the peri-operative setting it is unusual for arrhythmias to have a "simple" ischaemic origin as they do in the community: an early systematic search for and treatment of underlying causes while continuing resuscitation is not always present.

B) Human Factors Management

Among the resuscitation team members as a whole there is generally more than adequate knowledge and skills, but unaddressed human factors have a major detrimental effect on team performance in simulation. This is increasingly documented to be the case in real clinical care.[13] Human factors encompass individual perception and cognition, ergonomics, teamwork including communication, and organisational aspects.

- "Helmet fires" – From the point of view of the leader, resuscitation events impose a heavy cognitive and physical taskload on the leader. Coning or narrowing of perception, accompanied by slowed processing occur to at least some extent in most or all individuals. Loss of situational awareness is common. Anaesthetists find it difficult to leave their "position of comfort" at the head of the bed. In effective teams a leader is explicitly identified, relieved of physical tasks including airway management where possible, and stands back from the patient. This "hands-off leadership" results in increased cognitive capacity and

critical leadership functions become feasible: processing information and formulating a plan, prioritising and assigning tasks, managing errors (e.g. noticing and addressing inadequate compressions, turning off volatile agents and turning up oxygen), eliciting and centralising information from team members and keeping the team aware of his / her understanding of the evolving situation as it evolves. A subteam structure works well: nursing or other staff who have rehearsed the drill in their regular updates, continue with critical actions such as compressions / ventilations / defibrillation. The off-loaded leader can then monitor the big picture and delegate other tasks as much as number of personnel and skill mix allows eg "consider" differential diagnoses, "correct" underlying problems. Under pressure, the unconscious tendency of experts to perceive a recognisable pattern and ignore clinical information which does not fit their mental model is very evident. A mentally-rehearsed systematic approach to differential diagnoses is helpful in this aspect of "helmet fires."

- "Communication skills of many kinds" – The importance of closed-loop communication cannot be overemphasised. Asking for "anybody / somebody / someone / anyone.." frequently leads to no-one doing the required task, or several persons trying to do it at once. Verbalising clinical interventions performed by team members is a powerful aid to maintaining situational awareness eg "1mg adrenaline given". Effective teams have a climate such that members are confident to offer information to the leader and have the assertion skills to bring actual or potential errors to their attention without conflict. Although supporting the leader with decision-making is valuable, co-leadership as seen when two anaesthetists both receive information and give instructions reduces team effectiveness. Team members become confused as to who should receive critical information such as blood gas results, and frequently tasks are assigned more than once or not at all. A very powerful communication behaviour by the anaesthetist is repeated sharing of his / her assessment of the situation – the "recap". This aids other arriving rescuers to gain situational awareness, speeds their ability to assist appropriately and encourages all team members to cross-monitor the leader and to offer relevant information. The recap by a hands-off leader appears to reduce the serious risk of fixation errors by the leader or by the whole team (groupthink).
- "Cognitive aids" – Algorithms, protocols, guidelines, mnemonics etc are cognitive aids used in healthcare. Although ACLS algorithms are usually readily available to anaesthetists, they are infrequently used in simulated scenarios, including the less emergent ones. This is in striking contrast to the mandatory and ready use of cognitive aids in non-medical high-risk industries, which use "read- do' or "do- confirm" checklists in both crises and routine situations.[14] It appears that the medical culture supports relying on unaided recall, despite what is evident about the performance of humans under high taskload in a complex environment.

The modern world requires us to revisit what we mean by expertise...

Malcolm Gladwell

2. Research into ACLS

Simulation is currently a useful research tool into ACLS as in the following examples –

- Ergonomic studies into useability of equipment[15]
- Evaluations of effectiveness of team training interventions[16]
- Refinement of design of cognitive aids to maximise useability[17]

3. Assessment

Simulation is here to stay in ACLS education and assessment. It is important that research continues into the questions around the validity of simulation for high-stakes assessment.

Conclusion

In conclusion, anaesthetists are expected to have extensive expert knowledge in resuscitation events and take on a leadership role. Such events are rare for most specialist anaesthetists. Less senior team members are likely to be working from a shared rehearsed understanding. To get the most from the team, anaesthetists require specific behavioural skills. Simulated ACLS scenarios provide much relevant information in optimising ACLS management.

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