

Tactical Aeromedical Evacuation

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Abstract

Aeromedical evacuation (AME) is a necessity in the Australian Defence Force and particularly in the Royal Australian Navy. Overwater distance is a major concern with medical evacuation. It is not a matter of 'swoop and scoop' as long distances can compromise patient safety. Advanced planning, thought and training are essential if these effects are to be minimised. Consideration as to the make-up of the AME team is important as helicopters can be dangerous.

Introduction

It is said that President Harry S. Truman had a plaque on his desk that read "The Buck Stops Here" (1). Almost all doctors have had the same feeling at some time in their lives but none more so than a military doctor on deployment and particularly the lone doctor or medic (the "Provider") deployed at sea or remote environment. The situation has improved in recent years with the advent of satellite phones and instant communication with senior medical support at home, but still the final responsibility of patient care and dispersal is reliant upon personal clinical judgement of the provider.

Recently the Australian Defence Force joined with the United States Navy in Operation Pacific Partnership 2011. During the commemoration of the ANZAC Dawn Service one of our own sailors collapsed. Stoic to the end he rejoined the ranks only to collapse again. The Sickbay on USS CLEVELAND (LPD 7) was on standby to receive him and did so. Bloods were taken, an electrocardiograph performed and intravenous fluids given. As it transpired the member had an innocent syncopal episode.

However what might have been the situation if the member had suffered a myocardial infarction and needed urgent medical evacuation? Considerations would have included: the accuracy of the diagnosis, the relative safety of care aboard versus evacuation, the current position of the ship and its distance from the nearest land-based hospital: this being a key determinant of helicopter evacuation.

These and numerous other questions are the ever present concerns of the General Duties Medical Officer, medic or coxswain on any of our warships.

Life at sea for the Royal Australian Navy has always entailed long transits to distant ports. There is a dual expectation by our government and the Australian Defence Force that every member should receive medical care commensurate with what they would receive at home. There is also a need to maintain the strength of our fighting force (2). But not all ships or sites are equal. Very few ships have sophisticated forms of diagnostic support available and distance at sea is a tyranny. Therefore, a robust AME capability is essential.

Phases of AME

Medical evacuation has three phases (3). They are forward, tactical and strategic.

i **Forward medivac** is the movement of the casualty from site of injury to a more secure site with better medical facilities but still within the area of operations (AO). At sea this may simply be from an engine space to the sickbay or returning from an incident on a SIEV (suspected illegal emigrant vessel) back to the ship. These may be dangerous and complicated. As part of standard operating procedure on board all ships they are tested on an almost daily basis.

It is the subsequent steps in evacuation that demand the most careful preparation and planning by the medical provider.

ii. **Tactical medivac** is the movement of the casualty from the AO back to intermediate level of medical care still within the AO

iii **Strategic medivac** is the final stage, returning the casualty to the highest level of care outside the AO. Strategic medivac has been formalised in the RAN and has now become the domain of the Royal Australian Airforce (4). A specialised team has been developed for this task. With input from



CMDR Bruce Greig RANR supervises an AME from Luganville to Port Vila, Vanuatu of a critically injured Australian tourist by French Puma helicopter from HMNZS Canterbury with NZDF surgical team and USN and NZDF flight nurses on Pacific Partnership 2011.

the providers involved including the primary contact provider and the Duty Fleet Medical Officer, strategic AME is organised from Australia by means of either a formally tasked transport mode or vehicle of opportunity(5). The major mode of evacuation transport today within the Navy is by air due to the overwater distances needed to be crossed. Thus the focus of this paper is Aeromedical Evacuation as it applies to our ships at sea.

Questioning of Appropriateness

The tactical AME involves the whole ship's company and entails a great deal of planning. The decision to medivac however, is the first step. This is the "stumbling block" as often the patient is in a secure environment on board and several questions must be asked. What extra care can be provided ashore? Is my diagnosis correct? Is the patient safer on board than in flight on a helicopter over water for a long period? At times the answer is straight forward such as with an acute abdomen or fracture dislocation with vascular compromise but what of a lower grade abdominal pain or fracture without neurovascular compromise? In recent times a member of the RAN developed renal colic in transit from Japan to Canada via the northern route close to the Aleutian Islands. Return to Japan would have prevented the ship from meeting a planned refuelling rendezvous at sea and subsequent ceremonies in Canada. A possible medivac to Vladivostok was dismissed in favour of a medivac via US Coastguard Cutter to the Aleutians and then by USAF C130 south. The question must be asked however, whether renal colic needed medivac in the first place.

Decision making therefore has to be made as a team. The ship and the medical provider must be the final arbiters although telephone assistance is always available. Nowadays there is a 24 hour phone link to the Fleet Medical Officer (FMO) or his/her deputy. These doctors are always happy to give both clinical advice and advice gained from years of experience at sea themselves. They will always seek further specialist advice when necessary. However they cannot make the decision: the provider beside the casualty has that responsibility, based on their own skill set and capabilities.

Considerations

So the decision for AME has been made. What must be considered and put in place?

1. There must be discussion with the receiving facility. As full a brief as possible is an imperative and comprehensive handover notes supplied. The Australian Defence Force has developed a Field or Transport Report (PM 377) which is succinct but has space to record in-flight notes.
2. Helicopter flight has its inherent problems the major one being the stress of flight itself. An acronym worth remembering is GHOSTBN(6,7). The physiology of flight cannot be given comprehensive treatment here but some of the potential problems include:

G	G forces
H	Humidity
O	Oxygen saturation
S	Shakes and vibration
T	Temperature
B	Barometric Pressure
N	Noise

Both patient and support personnel must be prepared.

- **G forces** and unusual movement can cause nausea and exhaustion. Consider preparing the patient with anti-emetics.
- **Humidity** changes play havoc with mucous linings. Decreased humidity dries mucosa causing swelling and necessitates superior airway control. Other inhalants must also be considered. Smoke and fumes can be part of the original injury but exhaust gases in the helicopter can also contaminate. For example in a Sea King helicopter the airflow when the cargo door is open is from aft forward admitting exhaust gases into the cabin.
- **Oxygen saturation** decreases with altitude. Blood loss results in decreased oxygen delivery to tissues. The combination of these two factors can prove problematic in AME. Altitudes of AME flight vary depending on need (8). Minimum flight altitude during the day is 50 feet and at night 100 feet. The more usual altitude is between 500 and 1000 feet for safety. The author was recently involved with an AME in northern Vanuatu where an Australian tourist virtually exsanguinated after his femoral artery was transected. The casualty was flown at an altitude 500 feet rather than at 1000 feet in order to maintain oxygen saturation. There was no available supplementary oxygen and climbing to an altitude greater than 500 feet caused dangerous elevations in the patient's blood pressure threatening his vascular anastomosis.
- **Vibration** is inherent to helicopter flight. Apart from exhaustion, effects on vision, back pain, numbness and nausea it must be remembered that vibration can displace clots causing further haemorrhage, dislodge monitoring equipment and IV lines, increase patient pain and generally render the job of medical monitoring more difficult (9). Remember to protect the unconscious patient from rub spots on stretchers.
- **Temperature** at altitude decreases contrary to the legend of Icarus. Over water this decrease is 2 degrees Celsius

per 1000 feet from ambient sea level temperature(8). It is necessary to prepare both patient and flight crew accordingly.

- **Barometric pressure** is inversely proportional to altitude in accordance with Boyle's Law. So as a helicopter ascends the ambient pressure decreases. Gas trapped in body cavities therefore expands. Sites of importance include teeth, ears, sinuses, lungs, gut and post surgical spaces. Of these the most important are the lungs and the potential for pneumothorax, air embolism and pneumomediastinum. Gas in the eye following penetrating injury is another major concern. Helicopters are often used for the transport of injured SCUBA divers so remember for decompression sickness (DCS) the flight needs to be low to prevent the expansion of nitrogen bubbles.
- **Noise:** Military helicopters are noisy to the point where normal speech is almost impossible. A series of hand signals is needed and hearing protection is essential. Even if the patient is unconscious and intubated, their hearing must also be protected. If at all possible communication via headset and microphone with the flight crew is useful. AME personnel should request this where it is available.

Other factors that need to be considered for patient and support staff should include:

- i. **Patient comfort:** The patient will be invariably nervous. The author recently medivaced a young NZ Army signaller with appendicitis and septicaemia from HMNZS Canterbury during Pacific Partnership 11. Despite his pain he was terrified of the flight. Reassurance and explanation before loading are essential. Remember the unconscious patient in particular. These casualties are vulnerable. Measures must be taken to protect their hearing, cover their faces from rotor wash, cushion them from the vibration (by padding exposed body parts) and keep them warm.
- ii. **Distance:** Helicopter range is limited and as such can be a decisive factor. The S70 Seahawk has a range of 420 nautical miles (NM) on internal fuel tanks and 540 NM with external tanks attached. However, if the helicopter is landing on another ship, the external tanks can interfere with the RAST system needed to land in rough conditions so are usually not employed(7). Therefore the distance for a required medivac must be assessed early and quickly. Recently HMAS KANIMBLA en route to Hawaii needed to medivac a sailor with an acute abdomen. The distance to the next facility was excessive so HMAS WARRAMUNGA moved ahead to provide the medivac helicopter with an intermediate refuelling site. By doing this the target destination of Hawaii could be reached. Extended distances can also create the need for night flying. Military pilots employ night vision equipment but passengers in limited cabin light must be able to identify medical equipment easily.
- iii. **Preparing for failures.** Remember that batteries run flat and gases run out. Medications wear off and it is almost impossible to draw up more en-route. Be prepared before departure.

iv. **Confined space.** Medivacs are conducted in restricted spaces which prevent any real medical interventions during flight. Pre-flight preparation by the AME coordinator is essential and should not be hurried by undue pressure from the ship's commander. As mentioned earlier, during Pacific Partnership 11 we had to perform a tactical medivac of an Australian citizen from Luganville to Port Villa in Vanuatu. Those involved included a New Zealand surgical team, French helicopter from HMNZS CANTERBURY with both a New Zealand and US flight nurse, co-ordinated by the Australian OIC of the hospital medical site under the auspices of the US Navy command (DESRON 23) in USS CLEVELAND. The OIC stood his ground and the extra half hour on the ground was finally accepted by all stakeholders. Time in preparation; urinary catheter, central venous access, appropriately secured endotracheal tube and careful briefing prevented potential problems. Emphasis must be given to this as tracheal re-intubation is often more difficult. Aboard a helicopter in flight it is life threatening.

Who flies?

Flight in a helicopter is always exciting and dangerous. The default position is that the doctor needs to fly for the patient's safety. However this author believes that alternative health personnel may be equally satisfactory. If the preparation has been comprehensive then little more effort by the medical officer should be required. In the event of a dramatic deterioration of the patient during flight then the ideal strategy is to land. Over water that is not an option. The best option is to supply two escorts and on a ship this might include the senior medic and a SMET (member of the Ship's Medical Emergency Team). The health staff embarked must have the capacity to advise the flight crew correctly and be able to supervise patient movements. The loss of a helicopter with the lead medical officer on board could compromise a whole mission.

In Summary

Tactical and ultimately strategic medivacs are not a matter of "swoop and scoop". Advanced planning, thought and training are essential. From the moment a Navy medical officer joins his new unit he should assess the medivac capabilities of his new unit. He must ensure that the existing mechanisms for medivac are truly functional and achievable. If not then 'make it so'.

References

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8. My thanks to LCDR Stephen Dickfos RANR (Observer 816 Squadron) for flight and aircraft details.
9. Lecture by Dr Glenn Pascoe WGCDR RAAFSR
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