Clinical Review

What do we need for airway management of adult casualties on the Primary Casualty Receiving Facility? A review of airway management on Role 3 Afloat

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Abstract

The Primary Casualty Receiving Facility (PCRF) of the Royal Navy (RN) is currently based on Royal Fleet Auxiliary (RFA) ARGUS and provides a functioning hospital with surgical teams and a CT scanner (Role 3) within the maritime environment. The case mix could include complex trauma, critically ill patients returning to theatre several times, as well as non-battle injury procedures. This paper describes how we have used national guidelines, evidence from recent military experience, and the Clinical Guidelines for Operations (CGOs) to review and rationalise the airway equipment that is available and that would be required for the PCRF in its current configuration, whilst maintaining capability in a deployed setting.

Introduction

The Primary Casualty Receiving Facility (PCRF) of the Royal Navy (RN) is currently based on Royal Fleet Auxiliary (RFA) ARGUS. It provides a hospital facility within an echelon of care denoted as Role 3; having the capability to receive patients in the Emergency Department (ED), undertake imaging such as Computerised Tomography (CT) and then perform surgery with a move to critical care if required. It is effectively a medical platform within the maritime environment. Guidelines on the timing for escalating levels of treatment from the point of wounding are defined in the North Atlantic Treaty Organisation (NATO) doctrine MC 326/2 and Joint Doctrine Publication (JDP) 4-03 "Joint Medical Doctrine" (3rd Edition May 2011) (1). The '1:2:4' model is used which stipulates advanced resuscitation within 1 hour, damage control surgery within 2 hours and primary surgery within 4 hours. These 3 levels of care are generally provided at Role 1 (field dressing station), Role 2 (damage control surgery facility) and Role 3 facilities respectively, although the operational environment may allow for casualty evacuation directly to Role 3.

RFA ARGUS effectively provides the RN, Royal Marines and other personnel ashore with rapid access to deployed, hospital-based, consultant-delivered care. Advanced resuscitation and trauma surgery have been the main focus of operational medical activity for the last decade and the capability of the PCRF is comparable to what was available at the Role 3 hospital in Camp Bastion. Depending on the configuration, the PCRF is able to take 4 seriously injured casualties in the Emergency Department (ED), run 2 cases simultaneously in the operating theatre and occupy up to 10 Intensive Care beds and 20 High Dependency beds. As well as the core trauma specialties of general, orthopaedic and plastic surgery, the PCRF can be augmented with other specialists such as ophthalmic and neurosurgery.

The PCRF can arrive in theatre fully configured and operational, whereas a field hospital has a significant set-up time, may have to advance as the frontline moves, and then expand as the operation matures. The large flight deck of RFA ARGUS allows multiple rotary wing aircraft of all types to deliver casualties; indeed the ship's secondary role is as an aviation training platform. The design of the facility is 'front-end heavy', with easy access to the complex from the flight deck and an enhanced ED capacity.

The PCRF underwent full external validation in 2014 on Exercise JOINT WARRIOR 14 using the latest

healthcare assurance tools available, applied by an expert multidisciplinary team, and remains the United Kingdom's (UK) most versatile advanced military medical facility in this new era of contingency operations. A specific review of airway equipment also took place during this exercise and is discussed in this paper.

Difficult airway management principles

For the purposes of this article, there are two different types of difficult airway management for the deployed anaesthesia team to consider in all patients:

- The unanticipated difficult airway
- The anticipated difficult airway

In view of the potential 'holding period' on the PCRF depending on the position of the ship in the world, it may be necessary for patients with anticipated or known difficult airways who are not at risk of a full stomach to return to theatre for secondary surgical procedures.

Unanticipated difficult airway

The Difficult Airway Society (DAS) Guidelines should be followed in the case of the unanticipated difficult airway (2). The decision to 'wake up' the patient is often not an option in the trauma setting and though this must be considered, an emergency surgical airway in the form of a cricothyroidotomy may be required. A surgical cricothyroidotomy was favoured to a needle cricothyroidotomy in the recent National Audit Project 4 by the Royal College of Anaesthetists (3).

Intubation of a casualty in the trauma bay

Experience from recent conflicts in Afghanistan and Iraq (4) has determined that in UK-Defence Anaesthesia, the default position for securing the airway in the majority of trauma patients is:

- Rapid sequence induction using a Macintosh size-4 laryngoscope blade.
- Gum-elastic bougie (to be available).
- Two suction devices (to be available).
- No more than three attempts at intubation (with re-oxygenation between each).
- Clear communication of failed intubation with immediate progression to a surgical cricothyroidotomy.
- Successful airway control to be communicated after confirmation of a capnograph trace.

This is based on a review of the collective experience of anaesthetists in the Defence Medical Services, information from the Joint Theatre Trauma Registry and a literature review (5). The decision as to who will perform the surgical airway is made prior to the patient arriving on the PCRF amongst trauma team members. There is also support amongst the anaesthetic cadre for the availability of a supraglottic device (such as a laryngeal airway) when faced with a failed intubation; this is currently included in the Difficult Airway Society guidelines (2).

Assessment of a casualty who has arrived from another facility

If a patient is admitted from the pre-hospital environment or a Role 2 unit and the trachea has already been intubated, care must be taken to ensure that the endotracheal tube has not become dislodged during the transfer. It is important that there is clear communication to the trauma team leader regarding:

- The presence of a regular capnograph trace
- The position of the endotracheal tube at the patient's lips.
- Subsequent confirmation of the endotracheal tube position on the trauma chest x-ray when reported by the consultant radiologist.

Anticipated difficult airway

Anticipated difficult airway in casualties arriving from point of wounding is uncommon. This was determined by a recent analysis of the UK-Joint Theatre Trauma Register, which revealed that there were only 375 cases of face and neck injuries during the period 2003–08 (6). Of these cases, there were only 28 penetrating vascular injuries and 13 penetrating laryngo-tracheal injuries. This means that discussions between the members of the trauma team prior to the patient arriving are very important, and such discussions are practiced during pre-deployment training on courses such as the Military Operational Surgical Training (MOST) course (7). Non-trauma reasons for anticipated difficult airway, including anatomical and pathological causes (e.g. trismus), should be managed carefully as part of a multi-disciplinary team.

Airway equipment on the PCRF

An audit of current equipment at the start of Exercise JOINT WARRIOR 14 in March 2014 revealed an assortment of equipment accrued over many years, and therefore a need to simplify and rationalise the equipment available on board. A selection of the equipment found onboard is shown in Figure 1.

Figure 1. Equipment originally available on the PCRF for the management of difficult airway.

In accordance with the National Guidelines and current Defence Medical Services (DMS) Experience outlined above, the authors reviewed the type and quantity of airway equipment that would be required in the Role 3 anaesthetic module (Module 317) for the PCRF to function safely in its current configuration. In all a total of 20 lines were removed from the anaesthetic modules with considerable over- and under-stocking noted.

Rationale for airway equipment additions and subtractions

It is important that the team is familiar with all available equipment prior to deploying (8). Variation in equipment available nationally can create duplicate lines and excess equipment – there are ten different facemasks, fifteen different supraglottic airway devices, thirty different laryngoscope blades and fifteen different videolaryngoscope models, with at least six different blades and twenty different tracheal tubes available in all sizes, and eight different stylets or bougies.

The process involved a subject matter expert led line-by-line review of all airway equipment, cross-referenced with the Role 2 modules, Clinical Guidelines for Operations (CGOs) (9) and DAS guidelines (2). The outcome and rationale for these decisions is outlined below.

Sterilisation of equipment provides a logistical challenge in the deployed environment. The aim has been to move to single use items where possible. Paediatric airway equipment is held separately, and so not mentioned in this article.

Airway adjuncts and facemasks

The available airway adjuncts were rationalised as follows:

- Nasopharyngeal airways - Only one size is required for adults. Size 7 to remain and Size 6 to be removed.
- Oropharyngeal airways - Sizes 2-4 are standard UK clinical practice and so were kept.
- Bag-Valve-Mask (BVM) resuscitator - Essential requirement.
- Oronasal facemasks - These were added to module list as absent.

Supraglottic airway devices

There were numerous supraglottic airway devices available. We decided to rationalise and remove any 'reusable' items to ensure sterility. This included reinforced and reusable laryngeal masks (LMAs) as they were not indicated on deployed operations. The 'intubating LMA' (iLMA) was also removed as the Aintree catheter™ (Cook Medical, Bloomington, IN) was preferred and would allow intubation under direct vision. We decided to have one supraglottic device available, the iGel sizes 3 and 4. A patient can also be easily intubated via a supraglottic device with an Aintree Catheter (10).

Laryngoscopes

There has been considerable change in recent years around the type of laryngoscopes used in clinical practice. This stemmed from the worry of contracting Variant Creutzfeldt-Jakob disease (vCJD) with a subsequent move towards disposable devices. Clinical Guidelines for Operations (9) state that in a standard adult patient there should be a maximum of three attempts at intubation with a Macintosh (Mac) 4 Blade. It was decided to include Mac 3 and Mac 4 blades but to remove the McCoy blade, as its capability was not required with indirect laryngoscope availability (Mac 3 blades may be required for smaller patients). Re-useable handle with disposable fibre-optic metal blades (e.g. ProAct Green system duo, ProAct Hydra, or Timesco Optima Xenon Callisto) would conform to best practice and the handles are wipe-clean also. This would allow an optimum reliable light source and reduce cost and stock holdings. The handles would also be effective for paediatric blades.

Stylets and bougies

The Gum Elastic Bougie (GEB) is no longer available and so was removed from the module. Clinical Guidelines for Operations (9) requires a bougie to be available for all rapid sequence inductions, as do the Difficult Airway Society guidelines (1). The Frova™ (Cook Medical, Bloomington, IN) intubating bougie, 14FrG, 70cm was the preferred alternative to the GEB, but experience in the pre-hospital environment has led to the Sunmed coude tip bougie (Sunmed, Mitchigan, US) being preferred in this environment and therefore selected as the bougie of choice across the modules.

The Aintree Catheter (10) is an advanced item of airway equipment and can be used as part of the CGO (9)/DAS (2) unanticipated difficult airway algorithm. It can be used with a fibreoptic scope, allows safe exchange of supraglottic airways and endotracheal tubes and is widely familiar in NHS anaesthetic and Critical Care practice. This was added to the module list.

Endotracheal tubes

The following endotracheal tubes (ETT) were reviewed (ID=Internal diameter)

- Malinckrodt high volume, low pressure ETT (ID 7.0 & 8.0) maintained.
- The Gliderite is no longer available therefore removed from module.
- Reinforced ETT, 7.0 & 8.0 ID - To be used where tube position important.
- Ring-Adair-Elwyn (RAE) ETT was removed as the capability is covered by reinforced ETT
- Double lumen endobronchial tubes - All sizes were removed except 37Fr Left & 39Fr Left to maintain capability, as there is a very limited requirement in trauma.

Video/indirect laryngoscopes
The Airtraq™ (Teleflex Medical, Morrisville, North Carolina) size 2 (green) & 3 (blue) were maintained as a first line low technology indirect laryngoscope. Most anaesthetists are familiar with this inexpensive, disposable equipment and it is covered on the MOST course. The airway guidelines in CGOs do not have a requirement for an indirect laryngoscope in the acute setting (9).

The Glidescope Ranger™ (Verathon, Bothell, WA) provides an LCD screen with large (size 3-4) and small (size 1-2) batons, and single use blades (size 2 & 3). There has been significant investment in this equipment and so it will be maintained within capability and reviewed on a regular basis. Size 1 and 4 blades were removed from the module list as superfluous.

Fibre-optic bronchoscope
A fibre-optic bronchoscope was not in any module list, though it was kept on board PCRF. Bronchoscopic washout is a key requirement for ITU and has been going through the procurement process to generate a permanent operational capability. A bronchoscope can also be used for an 'awake-fibre-optic intubation' (AFOI) or to facilitate intubation with an Aintree Catheter (10). As stated, there are operational implications for equipment that requires sterilisation. Subsequent to the review, Ambuscope A3™ (Ambu, St Ives, Cambs) disposable bronchoscope has been added to the Role 3 modules. New generation target-controlled infusion enabled pumps will also permit the use of Remifentanil for awake fibre-optic intubation (11) should a patient with, for example, a dental abscess be transferred to the PCRF.

Emergency airway devices
The military pattern cricothyroidotomy set with dilator, scalpel and 6.0mm minitrach tube (NSN 6515-99-929-7765) was chosen to be the emergency surgical airway device of choice. This is referred to in CGOs (9) and is also taught in the Battlefield Advanced Trauma Life Support Course and on the MOST course. The Portex Minitrach and Melker cricothyroidotomy set were removed, as guide-wire techniques are not included in GOs (9).

Summary
Using national guidelines, evidence from recent military experience, and the Clinical Guidelines for Operations, we have reviewed and rationalised the airway equipment that is available to anaesthetists working on the PCRF when configured as a Role 3 Facility. The case mix could include complex trauma, critically ill patients returning to theatre several times, as well as non-battle injury procedures. The review has focused on simplification of airway equipment whilst maintaining capability in a deployed setting. This revised airway equipment list has been ratified by the Anaesthetic Equipment Special Interest Group and has been put forward as a template for airway equipment across all anaesthesia medical modules.

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