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Military Medicine

Combat radiology: Challenges and opportunities



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ABSTRACT

Radiology services in a combat situation are essentially centred on assisting the battle field physicians/surgeons to save/salvage life and limb. Timely and accurate detection of type and mapping of extent of injury can aid in making imaging based triage which can be of immense help to the treating physicians/trauma surgeons. With the availability of rapid assessment (clinical as well as imaging based) and quick transport facility, the focus has gradually been shifting from merely limb-saving to life-saving strategies. Providing the right imaging modality at the right time for the right patient at the right place is the need of the hour and will dictate the success of combat casualty care. Although there are limitations in terms of terrain and hostility in a combat scenario, newer developments in the field of Radiodiagnosis and imaging can be optimally utilized for better casualty care services. Point of care Digital/Computed Radiography and basic Ultrasonography for trauma complemented by usage of multidetector computed tomography will go a long way in helping timely and accurate management of victims of blast and ballistic injury in a combat scenario. Following a rigid, easy to understand yet comprehensive protocol and radiology reporting system will be invaluable in the combat scenario despite various limitations.

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Introduction

Combat radiology is considered as old as radiology itself and possibly dates back to 1897.¹ Although technically, combat radiology may not be very different from peace time radiology, there are many environmental (climate/terrain

related), situational, administrative, logistic and operational differences between the two which make combat radiology very unique and highly demanding. Keeping pace with the unparalleled advancement of radiologic technology and changing combat dynamics, combat radiology has assumed even greater role in the assessment, triage and management of combat casualties. Modification, innovation and creativity

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in a hostile environment with limited resources remain the cornerstone of successful casualty management in a combat scenario. Speed, clarity, adequacy and accuracy coupled with immediate remote transmission of data/results are the essence of present day combat radiology.

Radiology services in a combat situation are essentially centred on assisting the battle field physicians/surgeons to save/salvage life and limb. Timely and accurate detection of type and mapping of extent of injury can aid in making imaging based triage which can be of immense help to the treating physicians/trauma surgeons. With the availability of rapid assessment (clinical as well as imaging based) and quick transport facility, the focus has gradually been shifting from merely limb-saving to life-saving strategies. Providing the right imaging modality at the right time for the right patient at the right place is the need of the hour and will dictate the success of combat casualty care.²⁻⁶ The following paragraphs dwell upon various issues pertinent to combat radiology.

The requirement

- 1) Basic radiology facility (Radiography) is required at the Forward Surgical Centre (FSC) where surgical and critical care specialists are available and initial life and limb saving treatment is done. Facility for computed radiography at a peripheral point of care location would be ideal. Ultrasonography (USG) facility should be available at the FSC level. A Computed Tomography (CT) scan machine should preferably be available with trained technologists and radiologist at the nearest border static hospital.
- 2) All components of combat radiology setup are required to be functional 24 × 7 with trained technical manpower like any other emergency radiology department.
- 3) Facility for image transfer and cross consultation among radiologists and other concerned specialists at a remote location must be available, possibly on the same information networks that serve the combat personnel as this will ensure a robust information-sharing platform that is secure and reliable.

Challenges

- 1) Setting up the radiology facility in the combat zone in temporary shelters amidst hostility and adverse terrain/climatic conditions is always a challenge. Non-availability of adequate space for proper functioning of X-ray machines is always a major constraint. X-ray equipment require relatively high voltage electricity supply for smooth functioning. In the absence of a dedicated source of constant electricity supply with stable voltage, optimum functioning of the radiographic equipment cannot be guaranteed. Voltage fluctuations in the electrical supply are a major risk factor for breakdown of radiological equipment including ultrasonography machines. Temperature and dust control is another daunting task.
- 2) Construction of light proof, dark room facility for handling of radiographic films is often difficult. Non-availability of automatic film processors may be another constraint. Manual processing of films is not often practically feasible

in extremes of temperature in field conditions. Similarly, storage of radiographic films in optimum temperature becomes increasingly difficult in such situations.

- 3) Transportation of sophisticated electro-medical equipment (like X-ray machines) to field/combat location may be difficult because of unfavourable terrain and climate. Radiography for deep seated structures like abdomen, lumbo-sacral spine etc. is often suboptimal with the low mA portable machines commonly transported in field locations. Most of the radiology equipment being sophisticated, field repairs for minor breakdown can be difficult in the absence of technical expertise in combat location.
- 4) Ensuring radiation protection measures is often difficult in field conditions.
- 5) Availability of functioning USG machines with requisite probes and trained manpower for operating such machines optimally often remains a challenge. Availability of multi-detector CT scan machine at the nearest static hospital, though ideal, may not always be possible.

Discussion

Success of combat casualty care, to a large extent, will depend on the success of combat radiology services, which in turn will depend mainly on three factors: (a) *speed*: rapidity of diagnosis, (b) *accuracy*, and (c) *reach*: how forward the diagnostic facility can be advanced. Most injuries in combat scenario are likely to be ballistic and/or blast injuries often resulting in poly-trauma. Familiarity of imaging appearances of poly-trauma due to ballistic/blast injuries is of paramount importance for timely and appropriate management of such cases. Familiarity with wound ballistics and wound cavity and even number guide can prove very useful.²⁻⁴

Staffing

In an ideal situation, a radiology technologist needs to be placed at the FSC where the surgical team consisting of surgeons and anaesthetists would be available round the clock. A portable USG machine is ideally located at the FSC level. The surgeon as well as anaesthetist should be familiar with carrying out Focussed Assessment with Sonography for Trauma (FAST) and preferably Extended Focussed Assessment with Sonography in Trauma (EFAST). High end radiology equipment like MDCT should ideally be available at the nearest static hospital where facility for definitive treatment will be available. A radiologist is preferably stationed at the CT scan centre for augmenting the radiology services.

Radiography

Radiography plays an important role in the initial screening and evaluation of combat casualty particularly for the skeletal injuries. Portable, low mA machines are often limited by technically suboptimal radiography particularly for abdomen and thicker body parts. Also, the issue of conventional

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