The role of computed tomography in the primary survey of polytrauma patients

Mortality in polytrauma patients has substantially decreased in the last 30 years (Regel et al, 1993), but major trauma is still one of the leading causes of death among young adults in the industrial world; it has a severe socioeconomic impact and can result in devastating morbidity especially among the working population (Hessmann et al, 2006).

Specific problems associated with initial assessment of polytrauma victims in the emergency department include patients being confused, unconscious or under the influence of drugs and/or alcohol. It is often very difficult to get an accurate clinical history, and life- or limb-threatening injuries are not always apparent (Mahoney et al, 2003). Accurate interpretation of the available clinical signs and mechanism of injury are key to avoiding missing potential life-threatening injuries.

Most emergency departments in the UK work with an agreed round the clock multidisciplinary trauma team that is available to review any major trauma patient within a few minutes of presentation. The hospital is usually alerted by the pre-hospital team attending the patient at the site of accident. This allows time for the hospital trauma team to assemble and resuscitate patients in an organized manner following advanced trauma life support guidelines.

A multidisciplinary trauma team led by the emergency department consultant manages polytrauma patients based on the 'golden hour in shock' principle. This involves focused and effective detection of life- and limb-threatening injuries.

The role of imaging

Radiological assessment is an essential part of this strategy. The primary radiological survey is undertaken within minutes of a patient's arrival in the emergency department. This includes an anteroposterior view of the pelvis, a postero-anterior view of the chest and a single adequate lateral view of the cervical spine including C7. These images can help with early diagnosis of possible life-threatening injuries like severe bleeding or unstable fractures that might cause permanent disability in a trauma patient.

Focused assessment with sonography for trauma (FAST) scans are used in the emergency department to help detect major abdominal or pelvic organ damage. Results of these investigations have a direct impact on the further diagnostic and therapeutic strategy such as transfusion, immediate surgery or urgent transfer to a specialist trauma centre.

Conventional computed tomography investigations have been used in the secondary survey in the past to assess brain, thoracic, abdominal visceral and pelvic ring injuries in haemodynamically stable patients. Practical limitations include the risk of transferring intubated patients from the emergency department to the computed tomography suite. Furthermore, it was often perceived as a waste of time when such patients warranted emergency surgery (Hessmann et al, 2005).

The introduction of spiral computed tomography, and particularly multidetector or multislice computed tomography, has changed this because the increased speed of image acquisition reduces the scanning time (Becker and Poletti, 2005). Multiple body parts can be examined at high resolution, multiplanar reconstructions can be obtained and immediate on- and off-line interpretation of images is possible at separate workstations.

The main advantage of multislice computed tomography is the significant reduction in time required to undertake scans. The main limitations are availability of a trained radiologist and radiographer round the clock which has cost implications, the need for the computed tomography suite to be adequately equipped so that the patient can be resuscitated simultaneously while having the scan and the fact that multislice computed tomography exposes the patient to a substantial radiation dose compared to conventional radiology (Hui et al, 2009).

Computed tomography in the primary survey

The importance of using computed tomography scans in the primary survey of polytrauma patients is not new (Leidner et al, 1998). Whole-body contrast-enhanced multislice computed tomography is the imaging procedure of choice for multiply injured patients in many trauma centres in central Europe, and is a predictor of survival compared to conventional computed tomography imaging (Huber-Wagner et al, 2009).

The decision to allow the trauma patient to undergo computed tomography is taken by the trauma team leader in consultation with the surgical, orthopaedic and surgical teams. Computed tomography should not delay or replace a thorough clinical examination. Information on the haemodynamic status of the patient, the mechanism of injury and possible body parts involved determines if the patient can undergo a spiral computed tomography scan.

If the patient is critical and needs urgent resuscitation, diagnostic evaluation should be undertaken in the emergency department. Conventional radiographs are performed parallel to the primary survey and initial resuscitation.

In cases of less critical trauma, immediate computed tomography is performed under continuous monitoring. Since resuscitation can be undertaken in the computed tomography suite, haemodynamic instability should not be a contraindication to multislice computed tomography (Hessmann et al, 2006). Body parts commonly scanned include brain, cervical spine, chest, abdomen and pelvis including the hips. Any gross abnormality of the limbs can be incorporated in the computed tomography scan at this stage on request from the orthopaedic team.

The findings are assessed immediately in a separate workstation by a trained radiologist and a preliminary report is produced for the trauma team (Linsenmaier et al, 2002). This allows the surgeon and/or orthopaedic surgeon to plan surgical intervention. Furthermore, the computed tomography findings can be correlated with intraoperative findings. This is important for centres practising damage control surgery as the decision to manage severe limb injuries can be based on these images. A decision is taken to transfer the patient to theatre, intensive care unit or a major trauma centre soon after the patient comes out of the computed tomography suite. Further imaging can be planned at this stage. The radiologist performs further surveys of the computed tomography findings and three-dimensional reconstructions are processed. Since this is more time consuming, relevant secondary computed tomography findings are reported by telephone to the trauma team involved in the further management.

The patient is removed from the hard board but the cervical spine remains triple immobilised until he/she is transferred to the operating table or an intensive care unit bed. All patients are log rolled until imaging excludes any unstable spinal injury. The hard collar does not interfere with the procurement or quality of computed tomography images. There is growing evidence to support the use of multislice computed tomography in the primary survey of polytrauma patients (Sierink et al, 2012a).

Computed tomography scans are increasingly used for initial assessment in some level 1 trauma centres in the UK (Gallagher, 2012). A systematic review of whole body computed tomography scans in multiple injured patients found no improvement in mortality compared to conventional imaging with supplemented computed tomography during the secondary survey (Sierink et al, 2012a). However, this result has to be taken with caution as one study had a large sample size compared to the other three and in each study only the most severely injured patients had multislice computed tomography. The authors acknowledged this limitation and advised future randomized controlled trials in patients with comparable injuries – at least one such trial is currently underway (Sierink et al, 2012b).

Conclusions

Immediate computed tomography scan can be a useful adjunct to the primary survey in polytrauma patients. Most of the data to support this come from central Europe. The main limitation of multislice computed tomography is cost. It is not always financially viable to relocate existing computed tomography suites or built new ones near the emergency departments, especially in small district general hospitals. However, it is recommended that all newly built computed tomography suites should be near the emergency department ensuring quick and easy transfer of patients.

At present multislice computed tomography is recommended in tertiary centres dealing with regular polytrauma where necessary arrangements are in place to obtain imaging without compromising initial resuscitation. However, the trauma team leader takes this decision on clinical grounds. BJHM

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KEY POINTS

- Polytrauma patients require immediate focussed resuscitation following established guidelines.
- There can be difficulties in detecting all life- and limb-threatening injuries during the primary survey.
- Multislice computed tomography has emerged as an useful adjunct in detecting injuries with extreme accuracy in patients with multiple injuries.
- Use of whole body computed tomography can be undertaken as part of the primary survey and saves time before the patient is referred to appropriate specialist teams.
- There is no evidence at present indicating any reduction in mortality by using computed tomography scans in the primary survey for polytrauma patients.
- Using computed tomography scans for the primary survey is expensive and exposes patients to higher radiation compared to a conventional computed tomography scan.