Recent developments

Emergency medicine

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Most people believe that the emergency department is always available to help provide non-elective acute hospital care. Daniel Fatovich explains why this is not necessarily so

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Emergency medicine is a field of practice based on the knowledge and skills required for the prevention, diagnosis, and management of the acute and urgent aspects of illness and injury affecting patients of all age groups with a full spectrum of undifferentiated physical and behavioural disorders.¹ It is a specialty in which time is critical. Anyone who has been to an emergency department will appreciate that it is a complex and often turbulent environment. The emergency department is like the fire brigade—you hope you won't need it, but if you do, you expect a timely response.

Emergency medicine is a fairly new specialty. Resuscitation, toxicology, and clinical criteria for imaging represent some of the core topics of the practice of emergency medicine. This review focuses on these key areas and underlines the major problem that the specialty faces—namely, overcrowding.

Methods

Many advances have been made in emergency medicine recently. I surveyed colleagues both locally and internationally to nominate suitable topics. The topics I have chosen were considered to be clinically useful and educational. They reflect subjects of change or advancement. Once the topics were chosen, I performed a directed review of leading relevant journals, mostly from publications in 2000–1. Because

Summary points

Overcrowding is the most serious issue confronting emergency departments in the developed world, with quality and timeliness of emergency care being compromised

Amiodarone is the antiarrhythmic drug of choice for cardiac arrest due to shock refractory ventricular fibrillation and ventricular tachycardia

For calcium channel blocker toxicity, the induction of hyperinsulinaemia and euglycaemia has striking benefits

Octreotide prevents the rebound hypoglycaemia of sulphonylurea overdose

Validated clinical criteria for requesting imaging have been developed for cervical spine injury and are being developed for minor head injury

of space restrictions, this article cannot be a comprehensive review of all recent advances.

Overcrowding in the emergency department

Overcrowding in the emergency department is the biggest impediment to the delivery of timely and adequate emergency care. It is an international problem, and it is getting worse.² It is often manifest as diversion of ambulances—an emergency department instructs the ambulance service to divert ambulances elsewhere because it is unsafe for more patients to attend.

Overcrowding in the emergency department is caused by a complex web of inter-related issues; these have been reported previously and are summarised in boxes 1 and 2.² Figure 1 outlines basic processes of patient flow in the emergency department. In simple terms, if inflow is greater than outflow the result is overcrowding. This has been called “exit block” in the

Fig 1 Flow of patients in an emergency department

Box 1: Causes of overcrowding in the emergency department (adapted from Derlet and Richards²)

Increased complexity and acuity of patients presenting to the emergency department
 Overall increase in numbers of patients
 Lack of beds for patients admitted to hospital
 Avoiding admission of patients to hospital by intensive assessment and treatment in the emergency department
 Delays in service provided by radiology, laboratory, and ancillary services
 Shortage of nursing staff
 Lack of available specialty consultants
 Shortage of administrative and clerical support
 Shortage of physical space in the emergency department
 Problems with language and cultural barriers
 Documentation requirements for medical records
 Difficulty in arranging follow up care

Box 2: Effects of overcrowding in the emergency department (adapted from Derlet and Richards²)

Public safety at risk through compromised clinical care
 Prolonged pain and suffering
 Staff may leave because of the demands placed on them
 Long waits and dissatisfaction of patients
 Diversion of ambulances
 Decreased clinical productivity and effectiveness
 Violence
 Negative effect on teaching and research
 Miscommunication because of increased volume
 Medicolegal consequences
 Inability to evacuate in an emergency, such as fire

past, but it is now referred to as “access block,” as the patient is denied access to ongoing inpatient care.

The main cause of access block is a lack of beds for acute inpatients. Some emergency departments are, however, experiencing “entry block” or entry overload—overwhelming numbers of patients presenting to the emergency department in a short time (fig 2). This results in impaired access to emergency care.³

Health systems in the United States, United Kingdom, Australia and New Zealand, and Canada are having similar difficulties, which implies that a profound change has occurred in the delivery of Western medicine. Health care in Western societies has been through a period of severe economic rationalisation, resulting in the closure of thousands of beds in the acute hospital system. In the United States, the number of medical and surgical beds declined by 18% in 1994-9. From 1990 to 1999, attendances at emergency departments increased by 15%.⁴ Many beds for elderly people have been closed or changed to community based facilities.

After a decade of hospitals downsizing and reducing operating costs, local healthcare systems have been left with little slack to accommodate unforeseen trends in the number of patients.⁴ Stopgap measures (box 3) provide only some temporary relief.

Longer term measures are required to deal with all the causes of overcrowding in emergency departments. Governments at all levels need to recognise and acknowledge the problem, which requires a system-wide approach. The government of the Australian state of Victoria has published a paper on how to manage emergency demand, which reports that the equivalent of another major suburban hospital is required.⁵ Opening additional beds in 1999-2000 led to a reduction of 24% in the number of patients waiting in emergency departments for admission for longer than 12 hours, and the episodes of ambulance diversion fell by 30%. In July, August, and September 2000, however, access block and ambulance diversions increased again, showing that the hospital system was operating at capacity and was unable to absorb further pressure.⁵

Emergency departments are the main point of entry into inpatient settings for people requiring non-elective acute hospital care. If all else fails in the health system, the emergency department is always available to help. That basic tenet is now being challenged, and the general public may no longer be able to rely on emergency departments for emergency care that is timely and of high quality.²

Resuscitation in cardiac arrest

As a result of an international conference in 2000, revised guidelines and algorithms on cardiopulmonary resuscitation and emergency cardiovascular care have been published (fig 3). Drugs such as adrenaline, antiarrhythmics, and buffer agents have been relegated to a secondary role. Systematic reviews show that no evidence exists to confirm a benefit resulting from these agents.⁶

Two new drugs have been recommended, vasopressin and amiodarone. Vasopressin is included as an option in the algorithm for ventricular fibrillation and ventricular tachycardia (level of evidence: acceptable, not harmful, supported by fair evidence).⁶ Vasopressin, a natural antidiuretic hormone, becomes a powerful vasoconstrictor when used at much higher doses than are normally present in the body. The drug has positive effects that duplicate the positive effects of adrenaline,

Fig 2 A typical scene of overcrowding in an emergency department. Situations such as these lead to loss of clinical productivity and effectiveness and place the safety of patients at risk

Fig 3 International algorithm for advanced cardiac life support (adapted from Resuscitation Council UK website, www.resus.org.uk/pages/alsalgo.pdf). (BLS=basic life support, VF/VT=ventricular fibrillation/ventricular tachycardia, CPR=cardiopulmonary resuscitation, ACS=acute coronary syndrome)

but it does not replicate the adverse effects of adrenaline.⁶

Vasopressin is recommended as a single dose of 40 units. Its half life is 10-20 minutes, compared with the 3-5 minute half life of adrenaline. It can be given as an alternative to adrenaline, but a recent trial indicates the outcome is the same as with adrenaline.⁷ Adrenaline at high dosage (0.1 mg/kg) is not recommended for routine use but can be considered if doses of 1 mg fail.⁶

Amiodarone has a similar level of evidence as vasopressin and is supported by a better evidence base than any other antiarrhythmic drug.⁶ It should be the first choice antiarrhythmic drug for ventricular fibrillation and ventricular tachycardia that do not respond to defibrillation. The recommended dose for patients with cardiac arrest is 300 mg given intravenously as a bolus. If ventricular fibrillation or pulseless ventricular

tachycardia recurs, a second dose of 150 mg should be considered. Lignocaine has an indeterminate level of recommendation.⁶

Biphasic defibrillators are now commonplace. They deliver current that flows in a positive direction for a specified duration. The current then reverses and flows in a negative direction for the remaining milliseconds of the electrical discharge. Biphasic waveforms have proved superior to monophasic waveforms for defibrillation by implantable defibrillators.⁶ Further research indicates that repetitive biphasic waveform shocks at lower energy (repeated shocks at <200 J) have equivalent or higher success for eventual termination of ventricular fibrillation than defibrillators that increase the current with successive escalating shocks (200 J, 300 J, 360 J). The energy level of the biphasic first shock yielding the highest termination rate of fibrillation is unknown.⁶

A more recent development in resuscitation of patients with cardiac arrest is the role of thrombolysis. Initial results show that thrombolysis in cardiac arrest may represent an important advance.^{8,9}

Toxicology update

Up to 5% of patients presenting to an emergency department have taken an overdose. The drugs taken most often include benzodiazepines, paracetamol, alcohol, antidepressants, antipsychotics, anti-convulsants, and non-therapeutic substances. Many ingestions involve multiple drugs.

As new drugs are developed and released, inevitably patients take overdoses of them. This section briefly reviews some of these drugs that are now seen in overdose, or some of the newer treatment options. One such drug is bupropion, which has been licensed to help people stop smoking. Large quantities of bupropion have been prescribed over a short time. Bupropion is a unique monocyclic antidepressant that has structural similarities to amphetamines. Seizures have been a major concern with therapeutic use of bupropion, at a rate of around 0.4%. One study found a seizure rate of 21% in patients who had taken an overdose. Most convulsions either stopped spontaneously or were controlled with benzodiazepine. The time to onset of the first seizure ranged from 1 hour to 8 hours (mean 3.7 hours). Other toxicity affecting the central nervous system included lethargy, tremors, confusion, lightheadedness, hallucinations, and paresthesias. Sinus tachycardia is the most common cardiovascular effect.^{10,11} Treatment is supportive.

Another recent development is the use of atypical antipsychotic agents (respiridone, clozapine, quetiapine, olanzapine, ziprasidone, sertindole), which have largely replaced traditional agents as first line drugs for the treatment of schizophrenia. Most patients who take an overdose of atypical antipsychotic drugs will remain asymptomatic or develop only mild to moderate toxicity. Death is rare. Toxic effects begin within 1-2 hours after ingestion and peak by 4-6 hours. Toxicity is variably characterised by depression of the central nervous and respiratory systems, meiosis or mydriasis, hypertension or orthostatic hypotension, sinus tachycardia, agitation, delirium, anticholinergic stigmata, and, uncommonly, seizures and arrhythmias. Treatment is primarily supportive.¹²

Box 3: Some measures to address overcrowding in emergency departments

Short term

Diversion of ambulances
Postponing elective surgery

Longer term

Increasing capacity of emergency departments, with both human and physical resources
Reopening inpatient beds

Box 4: NEXUS cervical spine criteria¹⁸

N—Neurological examination: any focal deficit?
S—Spine examination: any tenderness posterior midline of the cervical spine?
A—Alertness: any alteration?
I—Intoxication: any evidence?
D—Distracting injury: any painful injury that might distract the patient from the pain of a cervical spine injury?

Patients who do not have any of the five criteria have a very low probability of clinically significant injury to the cervical spine. If any of these criteria is present, radiography is needed.

A new treatment has been reported for poisoning with calcium channel blockers.¹³ Conventional treatment includes intravenous fluids, calcium, dopamine, dobutamine, noradrenaline, and glucagon. Inducing hyperinsulinaemia and euglycaemia as adjunctive treatment has resulted in striking benefits (dosage 0.5 units insulin/kg body weight/h, 10% dextrose 100 ml/h). The exact mechanism is poorly defined.

Overdose of sulphonyl urea is potentially life threatening. Traditional treatment includes intravenous dextrose and frequent monitoring of blood glucose concentrations. A dose of dextrose is a potent stimulus for additional release of insulin and often results in rebound hypoglycaemia that can be recurrent and prolonged. Octreotide acetate, a synthetic octapeptide analogue of the endogenous human hormone somatostatin, directly inhibits the secretion of insulin from the pancreas and prevents rebound hypoglycaemia. In one review, the dosing of octreotide ranged from a single subcutaneous dose of 40 µg to an intravenous infusion of 125 µg/hour.¹⁴

For people who take overdoses to harm themselves deliberately emergency departments need to address the psychiatric aspects of attempted suicide. Recent guidelines for the management of deliberate self harm in young people represent a consensus overview on the reasonable management of deliberate self harm in young people.¹⁵

Finally, with the new risks of bioterrorism, emergency physicians need to lead in the early diagnosis of illnesses such as anthrax, smallpox, plague, tularaemia, and botulism. Clinical vigilance for unusual or unexplained clusters of illness is the key to early detection and reporting.¹⁶

Improved clinical criteria for imaging**Injury to the cervical spine**

Unrecognised injury to the cervical spine can produce catastrophic neurological disability. Fear of failing to diagnose such injuries has led to the liberal use of radiography of the cervical spine. This practice exposes many patients to radiography, at considerable expense, but detects injury only in a few.¹⁷

The National Emergency X-Radiography Utilisation Study (NEXUS) was a prospective, multicentre, observational study of patients with blunt trauma for which cervical spine imaging was ordered.¹⁸ NEXUS was organised to evaluate previously derived clinical criteria (box 4) and determine whether they can reliably identify patients who have no risk of cervical spine injury.

The decision instrument was tested in 34 069 patients and the sensitivity of the criteria approached 100% for clinically important injuries. Only 2.4% of patients had a radiographically documented injury to the cervical spine. The overall rate of missed injury was less than one in 4000 patients, which was estimated to represent once in every 125 years of clinical practice.¹⁷

Computed tomography for minor head injury

Computed tomography is widely used to screen patients with minor head injury, which is defined as witnessed loss of consciousness, definite amnesia, or witnessed disorientation in a patient with a Glasgow coma score of 13–15. The controversy about the use of computed tomography is considerable, and guidelines are conflicting. Until recently, the evidence base of who should receive a scan for minor head injury has been limited.

In 2000, Haydel et al derived and validated a set of clinical criteria that could be used to identify patients with minor head injury in whom computed tomography could be forgone.¹⁹ They found that one or more of seven findings (headache; vomiting; age > 60; drug or alcohol intoxication; defects in short term memory; physical evidence of trauma above the clavicle; seizure) had a sensitivity of 100% for identifying patients with positive results on scans, and the absence of all seven findings had a negative predictive value of 100%.

In 2001, Stiell et al's study on the use of computed tomography in minor head injury showed five high risk factors that were 100% sensitive for predicting the need for neurosurgical intervention and would require only 32% of patients to undergo computed tomography (box 5).²⁰ The group intends to validate the rule prospectively and explicitly in multiple sites in a further study.

Drug or alcohol intoxication is not a feature of these criteria: clinical examination in patients with suspected intoxication was neither reliable nor discriminating, and serum concentrations of alcohol were not correlated with important brain injury. Patients with intoxication who present with a Glasgow coma score of 13 or 14 therefore do not automatically require immediate computed tomography, but should be scanned if they do not improve to a Glasgow coma score of 15 within two hours of the injury.²⁰

Competing interests: None declared.

Box 5: Canadian computed tomography head rule (adapted from Stiell et al²⁰)

Computed tomography is required only for patients with minor head injuries with one of the following criteria

High risk for surgical intervention

Glasgow coma score < 15 at 2 hours after injury
 Suspected open or depressed skull fracture
 Any sign of basal skull fracture (haemotympanum, "racoon" eyes, cerebrospinal fluid otorrhoea or rhinorrhoea, Battle's sign)
 Two or more episodes of vomiting
 Age ≥ 65 years

Medium risk (brain injury will show on computed tomography)

Amnesia before impact > 30 min
 Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height > 1 m or down five stairs)

Additional educational resources

EMedHome (www.emedhome.com)

Contains useful reviews, clinical cases, kernels of information that may not be widely known but are extremely useful in clinical practice, a database of protocols, and links to helpful sites
 Rehoboth McKinley Christian Hospital Emergency Department (www.rmch.org/erlinks.htm)
 Contains a huge number of links and educational material, including emergency medicine and trauma related sites, radiology sites, medical and surgical specialties, paediatrics and family medicine, and advanced cardiac life support guidemaps.
 National Center for Emergency Medicine Informatics (www.ncemi.org)

Contains many useful algorithms and educational material, including weekly electrocardiograms, x ray films, and photographs, as well as clinical decision rules, diagrams, and scoring systems.

Best Evidence Topics (www.bestbets.org)

Provides rapid evidence-based answers to real life clinical questions (accessed 28 Mar 2002)

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A case of mistaken muscles

Oxford Clinical School recently piloted a scheme in which final year students serve as mentors to first-year clinical students. The assumption is that these near qualified students are not too far advanced to have forgotten those first anxious steps on the wards and can therefore provide a type of support that qualified doctors could not. Equally important, they have sufficient experience to teach the basic clinical skills of history taking and physical examination.

During a teaching session given by HUA (a finalist) to SA (a first year student) on the dreaded neurological examination, we both gained valuable lessons beyond those simply related to the intricacies of the nervous system. While HA confidently presented the innervation and actions of the various extraocular muscles, SA patiently listened. After HA had finished, SA shook her head and proclaimed, "But that's wrong." Having recently left the confines of the dissection room, SA recalled that the superior oblique and inferior oblique muscles did not adduct (medially rotate) the eye, as HA had explained. These two muscles, as well as depressing and elevating the eye, abducted (laterally rotated) it. The superior rectus and inferior rectus muscles served to adduct. Having acquired a certain degree of arrogance during his two years of clinical experience, HA was having none of this. His clinical examination textbook, recommended and used by countless students around the country, was on his side. However, SA quickly produced an equally respected anatomy textbook supporting her viewpoint.

Which book was right? With HA soon to sit finals and SA having just embarked on her clinical career, it was understandable that paranoia should set in: after all, such flaws in knowledge could be fatal in clinical exams. So, armed with a determined intellectual curiosity (and fear of failure), we scrutinised a selection of popular and respectable anatomy and clinical textbooks to discover the truth.

The result was odd. All four clinical textbooks we surveyed supported the view that the superior oblique and inferior oblique muscles adduct the eye, while the superior rectus and inferior rectus muscles abduct the eye. In all five anatomy textbooks we consulted the reverse was demonstrated. Could the meticulous anatomists be wrong? Had the clinicians inadvertently embroiled themselves in an institutionalised error, passed down from one generation of doctor to the next? Such was the reputation of the books in the two opposing camps, that we had no choice but to (reluctantly) perform a first in our medical studies—we opened *Gray's Anatomy*. The answer, though revealing, was hardly surprising—the clinicians were wrong. *Gray's Anatomy* supported its less voluminous siblings.

What lessons did we learn from this brief investigation of muscular minutiae? Firstly, clinicians do forget their anatomy, whether they are students or great professors of medicine. Secondly, if you are to teach, make sure you have learnt the subject correctly. At the very least, do not be arrogant and inflexible; prepare to be proved wrong, and hence enlightened. Thirdly, regardless of how authoritative your books and superiors in medicine seem to be, if in doubt be brave and challenge. If we are to reach the truth many of today's supposed facts must be made tomorrow's errors.

And most important of all, the superior oblique and inferior oblique muscles abduct the eye, while the superior rectus and inferior rectus muscles adduct it.

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