The CHALICE rule

The CHALICE rule: ready for prime time?

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Perspective on the paper by Dunning *et al* (see page 885)

The paper by Dunning *et al*¹ in this issue discusses a classic medical screening problem. Particularly during the long, light summer evenings, every accident and emergency department in the country sees large numbers of children who have sustained traumatic head injuries, most of which seem trivial; but among such children, there are a small number who are at avoidable risk of severe disability or death. How can they be identified most effectively? In the reported series of around 20 000 children, 95% had not even a brief loss of consciousness and 97% had a Glasgow Coma Scale of 15, but at the tip of the severity pyramid were 281 (1.2%) children with abnormal computed tomograms, 137 (0.6%) of whom required a neurosurgical procedure, and 15 deaths (although the paper does comment on how many of these deaths were deemed potentially preventable).

The authors point out the weakness of the evidence base (and thus the current National Institute of Clinical Evidence guidelines) in this area, particularly in relation to children, and are to be commended for the largest prospective paediatric study of this problem to date. Their paper derives a clinical decision rule that identifies high-risk children warranting computed tomography, and they have deliberately prioritised sensitivity over specificity.

The traditional approach to this problem (which might be described as "observation-first") relied on a combination of skull x rays (SXR) and admission for clinical observation, with computed tomography reserved for high-risk patients. The deficiencies of this approach have been recognised for some time. The sensitivity of SXR for major intracranial abnormality is inadequate, and National Institute of Clinical Evidence and other recent guidelines have convincingly argued that for all clinical management purposes, computed tomography should be used, with SXR having a role only in the forensic evaluation of suspected non-accidental head injury. The Children's Head Injury Algorithm for the prediction of Important Clinical Events (CHALICE) data support this view.

Another deficiency of the traditional approach has been less emphasised but is equally important, and is again well illustrated by the CHALICE data, which largely reflects traditional observation-first practice. More children were admitted for observation than were scanned. However, only 27 of 1461 (1.8%) children admitted to the ward for observation without a prior scan deteriorated (24 requiring neurosurgery). Clinical skills of neurological assessment and observation are hard earned. With shortened clinical training, fewer adverse events are seen, and it is the experience of most junior doctors that these children "do OK", leading to complacency. "Watch and wait" becomes "wait".

At the heart of the data in this paper are the 10 children who were sent home from the accident and emergency department without a scan and the two other children who were actually admitted and sent home without a scan, who later returned with positive scans. Of these 12 patients, seven required neurosurgery. Two of these children returned to a hospital other than where they were first seen, again reinforcing the complacency of those who originally sent them home.

The advocates of the "computed tomography first" strategy have two arguments. Clinical features are just too non-specific to form the basis of robust triage rules: most children, even those who are symptomatic, will do well. Secondly, the admission only of children with known computed tomography abnormalities for careful neurological observation focuses minds and can be centralised to units with the appropriate expertise.

The counter-argument is predominantly one of unintended consequences. The CHALICE rule has intentionally been developed as a high-sensitivity rule at the expense of specificity. The main value of the CHALICE rule is its negative predictive value. In the absence of any of the CHALICE features, a child can be discharged without examination. Although most clinicians presume this many times a day already, we now know we can be 99.9% confident that such a child will come to no harm (owing to the design of

the study, we cannot assume that rule-negative children had normal computed tomograms, just that they do not return to medical attention). The rule, however, failed in four (arguably three) cases, two of which were due to human error, where important signs were missed.

But what should we do with a child meeting one or more CHALICE criteria? Application of the rule would result in a 14% predicted computed tomography rate (versus an observed admission rate of 6.4% and a computed tomography rate of 3.3% in this study), of which approximately 92% are expected to be normal. Again, the main value is in a negative computed tomography scan, enabling large numbers of these children to be discharged home with confidence. The number of children showing unexpected computed tomography abnormalities will be low. The study population did not exclude obviously moderately and severely injured children: this increases the prevalence of abnormal computed tomograms and inflates the positive predictive value of the rule. Any positive screening test is of most use where least needed, performing best in populations with a high prior probability of pathology. The number of (normal) scans needed to identify each unexpectedly abnormal scan will be greatest precisely in the population that clinicians currently hesitate over. Although the paper offers some data on the performance of the rule in less severely injured children (Glasgow Coma Scale 13–15, where its positive predictive value is, as expected, lower), a more exacting analysis is required of its positive predictive value in truly borderline cases (eg, the children who vomited a few times but never lost consciousness and are now fine).

Any paediatrician who has seen the devastating, avoidable disability (and lifelong care costs) that can arise after delayed recognition of an expanding extradural haemorrhage will be sympathetic to the argument that the economic costs of increased computed tomography rates are justified (and are also countered by reduced bed occupancy). But such cases are rare. The cost-benefit and risk-benefit analyses will need to be more sophisticated to include, for example, the borderline child who vomited three times and presents late at night to a smaller unit that does not currently have a paediatric out-of-hours computed tomography capacity. Should such a child be transferred to a larger centre in the middle of the night? How likely is it, even if an abnormality is shown on computed tomography, that clinical management will be altered if the child is well? Would a combined clinical-radiological rule

(eg, admitting the child and taking a scan in the morning if symptoms have persisted for a threshold period after injury) improve the positive predictive value sufficiently to overcome economic and radiation-exposure concerns?

The authors correctly state that their study has established a rule that now needs prospective validation in further studies. Previous studies of the implementation of the Royal College of Surgeons head injury guidelines found

that they were not being fully followed: recommended numbers of SXR, computed tomograms and admissions were not occurring because clinicians believed them to be inappropriately aggressive. A robust validation of CHALICE discussing these more complex cost- and risk-benefit analyses will be required to reassure clinicians and ensure that history does not repeat itself.

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Training

Paediatricians subspecialising in cardiology: clinical governance, maintenance of expertise, and training

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Perspective on the paper by Pushparajah *et al* (see page 892)

The inability of the limited workforce of paediatric cardiologists to cope with an ever increasing workload and the need for more paediatricians with some expertise in cardiology to address this problem has been highlighted in this issue by Pushparajah and colleagues.¹ Paediatricians undertaking such a role, whether in district general hospitals or teaching hospitals are likely to be undertaking most of their cardiology practice on their own, potentially placing themselves in a vulnerable position. There is a need to establish clearly the potential roles of these posts for the protection of both doctors and patients. Level of expertise will inevitably vary according to the training and aspirations of individual consultants, but this should not prevent all those involved adhering to certain common standards. The British Congenital Cardiac Association (BCCA) and the Royal College of Paediatrics and Child Health (RCPCH) have recently endorsed a brief guide (see *ADC* website: www.archdischild.com/supplemental) to practice for paediatricians with a special interest in cardiology, initially introduced for governance purposes in the Yorkshire, Humberside and Northern Trent paediatric cardiac network after local consultation with doctors and patients. The guide was heavily influenced by the Department of Health Paediatric and Congenital Cardiac Services Review

(PCCSR, published in response to the Bristol Inquiry Report).² Other than generic recommendations for local audit and joint practice with cardiologists from a tertiary centre, the guide recommends that any child deemed to have a cardiac abnormality should see a cardiologist on at least one occasion, and that each child should have a clear plan for follow up, jointly agreed by cardiologist and paediatrician. While paediatricians more experienced in cardiology may view such a recommendation as unnecessarily restrictive (particularly for simple anomalies such as small muscular ventricular septal defects), it is hard to argue against the PCCSR's recommendation (guided by the Children's Heart Federation) that any child with a cardiac abnormality should have access to a specialist opinion. This simple approach has the added value of minimising potential for iatrogenic cardiac disease.

In Pushparajah's practice every echocardiogram performed is reviewed at a later date by a cardiologist, which appears to work well for the individuals concerned. The BCCA/RCPCH guide does not see that as essential, but does make firm recommendations for documented audit on an ongoing basis to ensure that quality is maintained, and that appropriate measures for CPD and maintenance of expertise (usually by regular periods of secondment to a

tertiary cardiac centre) are in place. These measures demand a formal approach, agreed within job plans and with managerial and financial support from NHS Trusts.

It is important to recognise the major role played by cardiac technical staff in supporting "outreach" cardiology. The BCCA, in liaison with the British Society for Echocardiography (BSE) are currently working together to develop guidelines for practice for technical staff, including a mechanism for formal BSE accreditation in paediatric echocardiography for those working outside tertiary congenital heart disease centres. These guidelines, to be piloted later this year in several UK centres, will be based on the current BCCA/RCPCH recommendations for paediatricians practising cardiology but will include modern methods of assessment of competence such as direct observation of practical skills (DOPS), recently introduced for physicians in higher specialist training.

Training opportunities for paediatricians wishing to subspecialise in cardiology as consultants are, happily, expanding. NHS Trusts and their funding bodies are beginning to appreciate the benefits of such skills and there are now specifically designated training posts in most UK cities. These posts are open to trainees already in established general paediatric training posts, are advertised nationally, and are appointed in open competition. The posts are for one year, are administered by the tertiary cardiac centre's Postgraduate Deanery, and are specifically funded, the trainee returning to their original training scheme at the end of the year. If current progress with funding training can be matched by funding of consultant posts for paediatricians with cardiology as their subspecialty, quality of local care for children with suspected or confirmed heart disease will be hugely improved.

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