above. Ease of operation of the system would allow doctors to undertake self-assessment on an open access basis.

Computer-assisted self-assessment was well received both by those who were self-selected and by those who were not (table II). Most users enjoyed the programs and comments were volunteered such as "very enjoyable and helpful," "a salutary experience," and "not intimidating," although a few considered it to be "of uncertain benefit" and "of limited value." The programs were designed to simulate real clinical problems which the participants had to consider and evaluate before replying so that they became actively engaged in the self-assessment/teaching process. The scores for each question from each user could be rapidly retrieved and analysed, unlike printed programmed texts.

The method now requires a more extensive trial to determine how effectively it can be used throughout the country. The programs, however, have been sent by post to several other centres where they were used without direct guidance from us and the responses from such centres have been equally favourable.

Of the two scoring systems used, the simpler 1-3 scale was more popular, but the 1-5 scale may permit more discrimination when dealing with situations demanding clinical judgments, and there is no absolute correct answer.

In conclusion, computer-assisted self-assessment combines the function of continuing postgraduate education and quality assurance. It would appear to be able to differentiate between varying levels of knowledge. It was acceptable to most of the anaesthetists who took part, and information may be obtained and analysed readily. It may offer a possible solution to the requirements for a method of quality assurance in anaesthesia and in other specialties. The quality of the assessment programs is of major importance in determining this aspect of quality

assurance, and the mechanism for achieving acceptable standards of programs would be a matter for debate within the specialties concerned.

This work is supported by Department of Health and Social Security Grant No J/R125/1930CS(A)4. We are grateful to the dean and Board of Faculty of Anaesthetists of the Royal College of Surgeons of England for additional financial assistance and the opportunity to participate at the meeting of faculty tutors. We also thank all those who participated in the trials and Miss E H Polley and Miss D E McCorkindale for their secretarial help.

Requests for reprints should be addressed to Dr C Schmulian.

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(Accepted 1 December 1981)

Lesson of the Week

Bladder calcification after umbilical catheterisation

D F M THOMAS, G DU MONT, P G RANSLEY

We report on an infant with calcification of the bladder associated with the administration of sodium bicarbonate and calcium chloride through a misplaced umbilical catheter.

Case report

An infant boy sustained profound intrapartum asphyxia during a complicated vaginal delivery at term. He had persistent bradycardia despite intubation, ventilation, and cardiac massage, so an umbilical catheter was introduced without difficulty into the apparent lumen of the umbilical vein. Although blood

Infusion of sodium carbonate and calcium chloride through an umbilical catheter may cause calcification of the bladder

could not be withdrawn from the catheter, sodium bicarbonate (2.5 ml of a 1 mmol/ml solution), calcium chloride (1 ml of a 1 mmol/ml solution), and adrenaline (0.5 ml of a 1 : 1000 solution) were injected through the catheter as a life-saving measure. The heart rate gradually increased, and after 23 minutes he was extubated and the umbilical catheter removed. Apart from transient cerebral irritability, there were no obvious neurological sequelae when he was discharged on the 12th day.

He was readmitted at 25 days of age with a two-day history of vomiting and reluctance to feed. The results of physical examination were normal, but the plasma and urinary electrolyte concentrations showed that he was losing salt. Shortly after admission urine began to drain from his umbilicus and the urethral output was reduced to a dribble. A plain abdominal x-ray examination showed a ring of calcification corresponding

Department of Paediatric Urology, Hospital for Sick Children, London WC1N 3JH

D F M THOMAS, MRCP, FRCS, senior registrar
P G RANSLEY, FRCS, consultant urologist

Paediatric Unit, St Thomas's Hospital Medical School, London SE1
G DU MONT, MRCP, DCH, lecturer

FIG 1—(a) Plain lateral abdominal x-ray showing ring of calcification. (b) Intravenous urogram 20 minutes after injection of contrast, showing the peripheral location of bladder calcification and dilatation of the upper renal tract.

FIG 2—The test tube on the right shows the result of mixing equal volumes of sodium bicarbonate (1 mmol/ml) and calcium chloride (1 mmol/ml). The tube on the left contains only sodium bicarbonate.

to the outline of the bladder, and examination by intravenous urography confirmed peripheral calcification of the bladder and moderate dilatation of both ureters and pelvicaliceal systems (fig 1a and b). The umbilical urinary fistula closed promptly after an indwelling urethral catheter was inserted, but when a cystogram was attempted contrast and urine leaked into the peritoneum through a weakness in the posterior vesical wall. Laparotomy, performed to drain the perforation, showed that the bladder was covered by extensive rigid plaques of calcification. His recovery was uneventful, and after the catheter was removed the bladder continued to drain freely by constant dribbling rather than intermittent voiding. Despite dilatation of the upper urinary tract, seen on intravenous urography and ultrasound examination, a gamma camera scan showed prompt transit of isotope to the bladder, indicating that the course of the ureters was not constricted because of calcification. Persisting hyponatraemia was attributed to a combination of medullary necrosis and postobstructive tubular damage. Treatment with oral sodium supplements was continued when he left hospital at 2 months of age.

A month later the calcification was not visible on a plain x-ray film and when he was 6 months of age ultrasound examination showed normal bladder contractility and a few abnormal echoes corresponding to sites of earlier calcification. The child was now thriving, and his mother had noted intermittent bladder emptying with a good urinary stream. Plasma creatinine, urea, and electrolyte concentrations were normal, and the sodium supplements were therefore reduced.

Comment

We have found no reports of calcification of the urinary bladder in an otherwise normal infant. The history of this

patient pointed strongly to an iatrogenic cause from receiving sodium bicarbonate and calcium chloride through an umbilical catheter. When these two solutions are mixed in vitro in the concentrations used a brisk chemical reaction causes carbon dioxide and a precipitate of calcium carbonate to form (fig 2). A similar reaction may occur in vivo if the solutions were injected together into an avascular plane or poorly perfused viscus. The early appearance in this infant of peripheral plaques of calcification favours this rather than ischaemic necrosis (related to the use of adrenaline) as the precursor of calcium deposition. THAM (trihydroxymethylaminomethane) has been reported¹ to cause bladder necrosis when injected into an umbilical artery, but in those cases the lesion was discrete and unilateral. The peripheral distribution of calcification and the occurrence of an urachal fistula in our patient suggest to us that the umbilical catheter was inadvertently passed alongside the urachus rather than into an umbilical artery, which would have led to full thickness damage of the bladder wall. Because of the fast resorption of the calcium and return of contractility the prognosis for normal bladder function is encouraging, but he may have residual upper urinary tract damage.

The location of the umbilical catheter should be checked by successful draining back of blood before injection, and the catheter should be flushed with saline when sodium bicarbonate and calcium chloride are to be given in quick succession.

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(Accepted 21 October 1981)