operating lists, which took up only extra seconds of administrative time.

The only major change that running the system has required so far as junior staff are concerned is that the houseman now needs to fill in the proforma. This takes about three minutes for each patient. Once this has been done, however, the essential work of organising a discharge summary is already completed. Housemen who used the old and new systems in parallel found that using the proforma helped them to keep organised, and happily transferred to the new system. It is also important that the houseman contacts the secretary daily. We were able to perform a full audit of the working of the consultant unit without collecting any additional data. Details of this important aspect of computerisation will be reported separately.

Although neither of us had had any training in computer programming, we developed the software ourselves. Difficulties arose in obtaining secretarial help mainly because, in our hospital, a secretarial pool is used to type discharge summaries. If all the secretarial work on the unit had been organised in one office the introduction of the system would have been easier.

The capital costs include the purchase of a suitable micro-computer, which must include a hard disc (cost about £2000); a good printer is also necessary (cost about £1200). The software costs included the database (Rescue, about £450) and a word processing program (Wordstar, about £250). It is possible to run the system for the whole general surgical department (six consultants and their junior staff) using one secretary full time.

Conclusions

A useful and effective computer system can be developed by clinicians to produce discharge documents and provide data for audit. The system results in an improved service to the general practitioner, with more essential information getting to him early. The secretarial time required to run the system is less than that needed to produce conventional discharge summaries, which thus offers potential savings. Although the initial development of the system was time consuming, it is now running smoothly and providing useful data. We have found advantages in having a system that the user can modify easily to suit local circumstances.

We are grateful to many of our house staff and especially to Dr B Squire, Dr J Tanqueray, and Dr V Lees for their help in making the system operational. We also thank Mrs Ros Britton for typing the manuscript and Mrs A Osborne and Miss E Tabor for voluntarily entering the early data.

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Lesson of the Week

Hypomagnesaemic tetany associated with prolonged treatment with aminoglycosides

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Magnesium is essential for normal calcium metabolism, and hypomagnesaemia may lead to hypocalcaemia and tetany. Despite occasional case reports it is not widely known that hypomagnesaemia may occur after treatment with aminoglycosides.¹⁻³ We report on a patient with hypomagnesaemia, hypocalcaemia, and tetany due to a renal tubular leak of magnesium after prolonged treatment with tobramycin.

Case report

A 25 year old woman with sickle cell anaemia was admitted with a painful vaso-occlusive crisis and a fever of 38°C. She was treated with intravenous

Hypomagnesaemia should be suspected in patients with hypocalcaemia, especially after prolonged treatment with aminoglycosides

fluids and parenteral analgesia, but the pains in both thighs, back, and abdomen were slow to settle and her temperature remained raised. Twenty three days after admission she developed a tense swelling of the right thigh and clinical septicaemia. Cultures of blood, sputum, and urine showed no growth, but intravenous tobramycin and mezlocillin were started. Peak and trough concentrations of tobramycin were monitored regularly and remained within the therapeutic range during the next 31 days. She remained feverish, and on the 43rd day after her admission the swelling was incised and 1200 ml pus drained. Cultures grew *Bacteroides fragilis* sensitive to metronidazole, which was then added to the antibiotic regimen. Her condition gradually improved.

On the 50th day she developed carpopedal spasm. Serum calcium concentration was 1.19 mmol/l (4.8 mg/100 ml) (normal range 2.20-2.65 mmol/l (8.8-10.3 mg/100 ml)), serum albumin 17 g/l, serum potassium 2.2 mmol(mEq)/l, and serum creatinine 42 µmol/l (0.5 mg/100 ml). Despite treatment with bolus intravenous calcium gluconate (2.25 mmol (90 mg) calcium every six hours) intermittent tetany persisted and the serum calcium concentration remained low (figure). On the 58th day the serum magnesium

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concentration was found to be 0.16 mmol/l (0.4 mg/100 ml) (normal range 0.7-0.9 mmol/l (1.7-2.2 mg/100 ml)). Retrospective analysis of stored serum showed that the hypomagnesaemia had developed during antibiotic treatment (figure). Calcium gluconate, mezlocillin, and tobramycin were stopped, and a six hourly infusion of 20 mmol (480 mg) magnesium sulphate in 500 ml of 5% dextrose was given daily.

Serial changes in serum calcium and magnesium concentrations in relation to treatment. Shaded bands represent normal ranges. ○=Retrospective measurements.

Conversion: SI to traditional units—Calcium: 1 mmol/l ≈ 4 mg/100 ml. Magnesium: 1 mmol/l ≈ 2.4 mg/100 ml.

The tetany responded immediately, and studies of the renal handling of magnesium 12 hours after intravenous administration of magnesium showed a pronounced renal tubular leak of magnesium, with fasting urinary magnesium excretion of 0.0173 mmol/l of glomerular filtrate (0.4 mg/l) at a serum magnesium concentration of 0.35 mmol/l (0.9 mg/100 ml). This inappropriately high value indicates greatly reduced reabsorption of magnesium.⁴ Although the serum magnesium concentration increased slowly over the 14 days of treatment with intravenous magnesium, serum calcium concentration increased immediately and, allowing for hypoalbuminaemia, was normal within 10 days. The hypokalaemia, which had persisted despite potassium supplementation, also improved after magnesium was started, at a rate similar to that of the hypocalcaemia.

After serum and calcium concentrations had returned to normal magnesium repletion (oral magnesium hydroxide; 11 mmol (267 mg) magnesium twice daily) was continued for a further 58 days. Renal tubular reabsorption did not return to normal after tobramycin was stopped (fasting magnesium excretion 0.018 mmol/l glomerular filtrate (0.4 mg/l) at a serum magnesium concentration of 0.75 mmol/l (1.8 mg/100 ml)) for three months.

Discussion

Magnesium homeostasis depends mainly on the renal tubular reabsorption of magnesium; if the filtered load of magnesium falls the normal kidney is able to reduce urinary magnesium to very low values.⁵ When renal tubular reabsorption of magnesium is impaired hypomagnesaemia ensues because, unlike with calcium, there is no mechanism by which magnesium can be selectively mobilised from soft tissue and bone.

Aminoglycosides may induce a renal tubular leak of magnesium, which can occur in the absence of other evidence of renal impairment. Such cases have occurred after prolonged administration of gentamicin,^{1,2} amikacin,³ sisomicin, and, in two previous cases, tobramycin,⁶ a drug that is claimed to be less toxic than gentamicin. Renal biopsy has shown structural alterations in the proximal tubules of patients treated with gentamicin.⁷ Although in

man the serum half life of aminoglycosides is only 30 minutes, animal studies have shown a half life of roughly 100 hours for renal tissue.⁸ High concentrations of aminoglycosides may gradually accumulate within the kidney, accounting for the delayed onset of the renal tubular leak of magnesium. Our patient received a total of 8640 mg tobramycin over 31 days, and the renal tubular leak of magnesium persisted for three months after the aminoglycoside was stopped.

Magnesium deficiency impairs secretion of parathyroid hormone⁹ and may render bone and kidney resistant to the effect of the hormone.¹⁰ The hypocalcaemia can be reversed by administration of magnesium.¹¹

We subsequently studied 10 patients with sickle cell anaemia who were not in crisis; fasting serum magnesium concentrations and their relation to urine magnesium excretion were normal. It is thus unlikely that sickle cell anaemia contributed to the hypomagnesaemia.

Reports of aminoglycosides inducing hypomagnesaemia are rare, possibly because of the length of treatment required to induce a renal leak of magnesium. Our observations in five patients with acute leukaemia who developed infections requiring treatment with tobramycin indicated that aminoglycosides have to be given for more than two weeks before hypomagnesaemia occurs. Two of the patients, who received under two weeks' treatment with tobramycin, showed no change in serum magnesium concentrations. The remaining three patients, however, received three to six weeks' treatment and all developed hypomagnesaemia. Previous workers have reported hypomagnesaemia and hypocalcaemia in patients with acute leukaemia or cancer receiving intensive chemotherapy and aminoglycosides.^{6,12} The prolonged courses of aminoglycosides given to such patients may cause their hypomagnesaemia.

The syndrome may occur despite serum aminoglycoside concentrations being within the therapeutic limits, and regular monitoring of serum magnesium concentration is therefore recommended for patients at risk.

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WORDS

SCISSORS. There is nothing especially noteworthy about the derivation of "scissors," but as you have read this far we may as well continue. The word stems from *L cisoria*, plural of *cisorium*, a cutting instrument, and the plural usage presumably stems from the two blades. The ultimate root is *caesum*, past participle of *caedere*, to cut. But what interests me is the plural usage for single objects having a paired structure, and for which there is no current singular. This is manifest in the names of nether garments (trousers, pants, drawers, knickers, bloomers, jeans); spectacles; and instruments (scissors, pliers, tweezers, shears). There is no such thing as a pant, a trouser, or a scissor in the same sense as the plural form. Singular forms do exist for some of these terms, but they have other meanings.—B J FREEDMAN.