

Inadvertent sodium loading in critically ill patients — plus some pedantry

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TO THE EDITOR: Congratulations to the Flinders intensive care unit team for their clinically useful and interesting paper on inadvertent sodium loading in critically ill patients¹ — and for the comprehensive list of occult pharmaceutical sources of inadvertent sodium administration, of which most of us would probably not have been aware. Many would be taken aback to note the high sodium content of, for instance, moxifloxacin, ticarcillin–clavulanate or metronidazole. The researchers were very thorough in tracking down sodium content. In identifying the additive effect of all sources, including, for example, a median 17.4% of total sodium input from repeated flushes, they provide valuable data that indicate the need for reassessment to optimise practice. Other sources contribute concomitant to their required use (eg, transfusions).

Ever since the retirement in 1983 of our unit's pioneering director, the Department of Critical Care Medicine at Auckland Hospital has used a sodium-free 5% glucose maintenance fluid (278 mOsm/kg), so this does not add to sodium input as happens with the 0.18% saline and 4% dextrose solution used by Flinders ICU.

The statement in the Abstract that "Sodium administration is rarely separated from fluid administration in critically ill patients" does not take account of the therapeutic use of 4 mol/L saline to help treat intracranial hypertension in traumatic brain injury (which was not a clinical factor in the Flinders study). Incidentally, when we used it in the past, Upjohn's dexamethasone did contribute a minimal 1 mEq of sodium per 30 mg (Figure 1).

But still, please allow me to point out — purely to give a historical perspective — that during what one can perhaps dignify as the Bronze Age (Early or Late?) of Intensive Care Medicine, this sodium problem was not

Figure 1. Sodium balance chart used by Auckland Hospital Department of Critical Care in the 1970's*

| AUCKLAND HOSPITAL | | Fix label here or fill in | | | | | | | | | | | | | | | |
|-----------------------------|---------------------|----------------------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------|------|-------------------|----|-------|----|-------|-----------|
| DEPARTMENT OF CRITICAL CARE | | FAMILY NAME (SURNAME) | | | | | | | | Sex | Ward | Hospital no. | | | | | |
| Sodium Balance | | Given (or Christian) names | | | | | | | | | | Date of birth/age | | | | | |
| Admission Day Number | 0 | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | | |
| Month | JULY | Date | | 18-19 | | 19-20 | | 20-21 | | 21-22 | | 22-23 | | 23-24 | | 24-25 | |
| Sodium source | mEq/100ml | mEq | ml | mEq | ml | mEq | ml | mEq | ml | mEq | ml | mEq | ml | mEq | ml | mEq | mEq Total |
| Saline 0.18% | 3.0 | 510 | 15 | 230 | 7 | 200 | 6 | | | 135 | 4 | 140 | 4 | | | | |
| Saline 0.45% | 7.5 | | | | | | | | | | | | | | | | |
| Saline 0.9% | 15.0 | 90 | | | | | | | | | | | | | | | |
| Saline 1.8% | 30.0 | | | | | | | | | | | | | | | | |
| 2 M Saline | 200 | | | | | | | | | | | | | | | | |
| 1 M Bicarbonate | 100 | | | 50 | 50 | | | | | | | | | | | | |
| Plasma | 13.5 | 800 | 108 | 200 | 297 | | | | | | | | | | | | |
| Albumen | 11 | | | | | | | | | | | | | 100 | 11 | | |
| Packed cells | 5 | | | | | | | | | 500 | 25 | | | | | | |
| Whole Blood | 10 | | | | | | | | | | | | | | | | |
| Platelet Plasma | 13.5 | | | | | | | | | | | | | | | | |
| Haemacel | 14.5 | | | | | | | | | | | | | | | | |
| Glucose-electrolyte | 2.4 | | | | | | | | | | | | | 250 | 6 | | |
| Milk | 2.5 | | | 500 | 13 | 800 | 20 | 800 | 20 | 625 | 16 | 560 | 14 | 650 | 16 | | |
| Sustagen | 6.3 | | | | | | | | | | | | | | | | |
| Vivonex | 5.6 | | | | | | | | | | | | | | | | |
| Flexical | 1.5 | | | | | | | | | 700 | 11 | 800 | 12 | 450 | 7 | | |
| Casilan | 2.1 | | | | | | | | | | | | | | | | |
| Hycal | 0.6 | | | | | | | | | 175 | 1 | 200 | 1 | 50 | 0 | | |
| (All) Aminofusins | 3.5 | | | | | | | | | | | | | | | | |
| Lignocaine 1% | 12.0 | | | | | | | | | | | | | | | | |
| Sodium source | mEq/G | mEq | G | mEq | G | mEq | G | mEq | G | mEq | G | mEq | G | mEq | G | mEq | mEq Total |
| Penbritin | 2.9 | | 3 | 9 | 4 | 12 | 8 | 23 | 8 | 23 | 8 | 23 | 8 | 23 | 8 | 23 | |
| Orbenin | 2.2 | | 3 | 6 | 4 | 8 | 4 | 8 | 4 | 8 | 4 | 8 | 5 | 10 | 9 | 18 | |
| Celbenin | 2.4 | | | | | | | | | | | | | | | | |
| Crystapen | 2.8 | | | | | | | | | | | | | | | | |
| Pyopen | 5.4 | | | | | | | | | | | | | | | | |
| Ef-cortelan | 3.0 | | | | | | | | | | | | | | | | |
| Decadron (30mg/1mEqNa) | mEq | | | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | - | - | - | - | - | | |
| Valium (16mg/1mEqNa) | mEq | 3 | 6.5 | - | - | 2 | 4 | 4 | 4 | 5 | 10 | 9 | 4 | | | | |
| Total Sodium Input | | 93 | 155 | 388 | 59 | 55 | 92 | 69 | 85 | | | | | | | | |
| SODIUM OUTPUT | Urine | - | 28 | 83 | 273 | 192 | 212 | 136 | 106 | | | | | | | | |
| SOURCE | Gastric Aspirate | | | | | | | | | | | | | | | | |
| | Blood, chest drains | | | | | | | | | | | | | | | | |
| | Total Output | - | 28 | 83 | 273 | 192 | 212 | 136 | 106 | | | | | | | | |
| Daily balance | | +93 | +132 | +305 | -218 | -137 | -120 | -67 | -21 | | | | | | | | |
| Cumulative balance | | +93 | +225 | +530 | +312 | +175 | +55 | -12 | -33 | | | | | | | | |

* Reported in Eur J Intensive Care Med 1975; 1: 93-7, and later featured in Int Anesthesiol Clin 1979; 17: 299.

unrecognised. For some of the 1970s, an attempt was made not just to track sodium input but to try to gain an idea of sodium “balance”, constructed by trying to determine sodium input and its content in all fluid outputs that could be measured. The accompanying diagram (Figure 1) is from one of a series of charts I had designed for our unit’s record keeping, which I then included in my poster display at the First World Congress on Intensive Care, London, 1974. For the years of the chart’s usage it was applied to all critically ill patients at Auckland Hospital’s Department of Critical Care in the mid 1970s, until the necessary lessons from it had been well absorbed. There was an accompanying 24 hours fluid balance record of course.

Now, writing as a nomenclature pedant, may I make three pinpricks please?

First, I do note with appreciation the authors’ use of the descriptive term “medicines” instead of “drugs” — except for once — although I no longer wonder whether doctors should keep calling medicines “drugs”:² the firm answer is “No!”

Second, what is the authors’ so-called 0.9% normal saline (or “0.18% normal saline” mentioned in the same table)? Those writing for an academic journal — in fact, all of us — should be aware that normal saline is not 0.9% saline but 5.85% saline (with 6.5 times the amount of sodium),³ so to say “normal” saline clinically is careless (and, however unintended, misleading, even if the excuse is that it is lower case “n” so everybody knows that “Normal 5.85%” is not meant). So let’s be accurate. If one insists on being descriptive and not mathematical,

why not say “isotonic saline” in place of 0.9% saline or 0.9% NaCl?

Lastly, as “dextrose” is an American not a British term, it is probably better not to use it in place of “glucose”, whatever it says on the outside of the bag of fluid. In Australia and New Zealand,⁴ when so labelled, 5% dextrose is a 5% glucose (anhydrous) solution with 5 g/100 mL. Curiously, the United States Pharmacopeia (and possibly it alone) provides the formula for its glucose, which is that of the monohydrate.⁵ So in the US, while 5 g/100 mL of the anhydrous glucose would make a 5% solution, 5 g of the monohydrate glucose could make only a 4.5% solution.^{3,5} (Please correct me if I am wrong.) Should a manufacturer supply sufficient glucose monohydrate for the solution to contain 5 g of [anhydrous] glucose?

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References

- 1 Bihari S, Ou J, Holt AW, Bersten AD. Inadvertent sodium loading in critically ill patients. *Crit Care Resusc* 2012; 14: 33-7.
- 2 Trubuhovich RV. Should doctors keep calling medicines “drugs”? *Crit Care Resusc* 2007; 9: 374-6.
- 3 Trubuhovich RV. Nomenclature for two intravenous solutions. *Crit Care Resusc* 2007; 9: 104-5.
- 4 Baxter Healthcare Ltd (NZ). Clinical Information Sheet 88-19-01-123.
- 5 US Pharmacopeia. Dextrose. http://www.pharmacopeia.cn/v29240/usp29nf24s0_m24230.html (accessed May 2012). □

Correction

Incorrect competing interests statement: In “Statistical analysis plan for the Crystalloid Versus Hydroxyethyl Starch Trial (CHEST)” in the March 2012 issue of the Journal (*Crit Care Resusc* 2012; 14: 44-52), it was incorrectly stated that Professor John Myburgh and Professor Simon Finfer (a CHEST Management Committee member) received speaker and travel expenses from Fresenius Kabi. Neither Professor Finfer nor anyone else on his behalf has received speaker fees from Fresenius Kabi. The George Institute for Global

Health received reimbursement from Fresenius Kabi for travel expenses they incurred in sending Professor Myburgh and Professor Finfer to Germany during the planning stage of the CHEST study. Professor Finfer has not personally received any remuneration or reimbursement from Fresenius Kabi. Professor Myburgh received a speaker’s fee from Fresenius Kabi for an unrelated presentation at a sponsored meeting in April 2008 that preceded the development of the CHEST study.