Fluid and Electrolyte Balance in Open Heart Surgery

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RAPID ADVANCES in the field of cardiac surgery over the past two decades have brought with it, the need for accurate patient assessment during the post-operative phase. A precise awareness of the haemodynamic status and a careful control of fluid and electrolyte balance will make all the difference between success or failure of an operation. This is especially true when one ventures into the field of open heart surgery. While uncomplicated congenital abnormalities like a straight forward atrial septal defect or ventricular septal defect may not pose much of a problem in fluid and electrolyte balance the majority of acquired cardiac diseases coming for surgery are quite another matter indeed.

The technique of fluid and electrolyte replacement would certainly vary from patient to patient, unit to unit and when one considers the influence of climate, from Country to Country, but the basic principles however, tend to run along similar lines. This article is based on the method followed by the cardio-thoracic unit of C.M.C. Hospital and also the Schedule adopted by the Mayo clinic.

The estimation and replacement of electrolytes and fluids must of a necessity be carried out at three distinct stages of management namely the pre-operative, the intra-operative, and the postoperative phases.

Pre-operative phase : Patients who have been on long-term digitalis and diuretic therapy are particularly prone to potassium depletion. This K^+ deficit should be corrected as far as possible before the patient undergoes surgery. Serum K^+ levels are not always a true reflection of the state of potassium balance in the system as the sampling may occur during the phase of K^+ shift from the intra cellular to the extra cellular compartment. Perhaps a more accurate method would be estimation of 24 hour K loss in the urine. This method is, however, cumbersome and time consuming. Rapid estimation and equally rapid replacements are of prime importance in cardiac surgery and hence for want of a better system. Flame photometric estimation of serum K continues to be used. The content is 140 m Eq/litre while extra cellular content is 5 m Eq/litre. Maintenance of intracellular K content is of extreme physiological importance. A deficit in the serum K level is reflected in the intra cellular content. In the pre-operative phase total deficit in the whole body water is calculated. For example if serum K is reported as 3·5 mEq/litre, it would mean a deficit of 1·5 m Eq/litre in both the extra cellular and the intracellular compartment. Therefore, the following formula namely: $\frac{1.5 \times 3/4}{13.6}$ Body wt. in Kg will give the approximate to deficit in gms. Every attempt is made to correct this deficit, either by oral replacement or if time does not permit, by the parenteral route before surgery. A similar method of calculation is used for rational replacement of K^+ during the intra-operative and the post-operative phase also.

Sodium : Since Na restriction is part of medical management, correction of any deficit finds a place if at all only during the post-operative phase and will be referred to, later.

Intra-operative management : Cardio pulmonary bypass, has become a safe and routine procedure today, however, the period the patient is on the pump constitutes a formidable physiological insult and the management of problems which arise there from, are not within the scope of this paper. Maintenance of K^+ levels of intra and extra cellular fluids at near normal levels is of prime importance in the prevention of cardiac arrhythmias. During CP bypass, there is considerable losses of potassium in the urine amounting to approximately 10 m Eq/100 ml. The calculated pre-operative deficit and this urine loss is made up during the operation by addition of Kcl to the priming fluid of the pump oxygenator.

Post-operative phase : Seventy per cent of body weight is water and of this 50% is in the intra-cellular and 20% in the extra-cellular compartments. Fig. 1 shows the water and electrolyte content of Man and Woman :

FIGURE 1

	Man	Woman
Weight Kg	70	57
Surface area (m2)	1.73	1.6
Total water (l)	43	29
Extracellular (l)	11	8
Plasma (l)	2.8	2.4
Sodium (m Eq)	2950	2250
Potassium (m Eq)	3200	2300

Post perfusion water loss has been calculated by workers at the Mayo clinic after averaging a large number of open heart surgery cases. Water intake in the post-operative phase, should balance this loss. Electrolytes are concomittantly replaced. Fig. 2 shows post-perfusion water loss.

(*Contd. on p. 344*)

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