It has been shown in many publications that hyperglycemia can cause increased cerebral injury when the brain is ischemic, increased propensity for wound infection, increased propensity for renal dysfunction post-operatively, and other complications. Many units don't routinely monitor blood sugar levels (BSL) during CPB and many more only on known diabetic patients.

METHODS

We retrospectively analyzed 2095 consecutive CPB cases performed during 2003–4. We reviewed at gender, age, diabetic status, requirement for insulin, highest, lowest and mean BSL recorded at four time points (post-heparin pre-CPB, 5′, 30′ and 60′ into CPB), and percentage of cases with a BSL > 8.0 mmol/l.

RESULTS

In over 8000 tests, no patient recorded a BSL < 3.0 mmol/l, i.e., hypoglycemia. The lowest BSL recorded was 3.9 mmol/l.

Pre-CPB 19% of non-diabetic patients recorded a BSL > 8.0 mmol/l. Twenty-seven percent of diabetic patients had a BSL > 8.0 mmol/l at this point.

At CPB+5′ this fell to 17% and 24% respectively, most likely due to dilution with the pump prime. All age group's BSL either fell or remained at pre-CPB levels except the <50 year-old group where the BSL almost doubled from 21% to 39% and 25%–40% respectively.

At CPB+30′ 45% of all non-diabetic patients recorded a BSL > 8.0 mmol/l (48% for diabetics).

At CPB+60′ 72% of all non-diabetic patients recorded a BSL > 8.0 mmol/l, the percentages were higher for the diabetic patients (82%). This was despite insulin treatment in many of these patients.

Further, this rise in BSL was seen across all age groups and both genders. Interestingly the highest rise in BSL was seen in the under 50 years of age group at all time points and in both diabetics and non-diabetics.

CONCLUSION

This retrospective audit has demonstrated the difficulty in effective control of blood glucose and the need to monitor BSL carefully in all patients during CPB.

Review on the Usage of Mannitol During Cardiopulmonary Bypass

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INTRODUCTION

Mannitol is an inert, undissociated six-carbon polyhydric alcohol .It is an osmotic diuretic. Mannitol is used during cardiac surgery as it improves renal blood flow, minimizes extra vascular fluid shifts and reduces positive fluid balance.

METHODS

A retrospective analysis was performed on the usage of mannitol during cardiopulmonary bypass. Mannitol was not used as a constituent of the prime, however was administered during cardiopulmonary bypass, at the discretion of the perfusionist, to augment diuresis and to minimize fluid movement to the extra vascular space. Data was collected from sixty-five consecutive patients who underwent routine cardiopulmonary bypass procedures. The patients were divided into two groups. Group A did not receive any mannitol during the surgery; Group B received 0.25 g/kg body weight mannitol during surgery. The parameters analyzed were age, pre operative hemoglobin, weight, renal function, intra operative hemoglobin, bypass time, urine output, volume added during bypass and the fluid balance. Statistical analysis was performed with SPSS for windows V 13.

RESULTS

32 patients (group A) did not receive any mannitol. 33 patients (group B) received mannitol.The demographics show that the two groups were similar in all respects except for the bypass time ($p < 0.05$), which was significantly longer in group B (88.1 vs. 109.8 mins).

	Group A (no Mann)	Group B (Mann)	p Value
Age	64.9 (±12.5)	69.4 (±12)	0.14
Hb (pre-op)	134 (±18.4)	137.8 (±17.4)	0.40
Weight	79.5 (±14.4)	78.6 (±14.6)	0.79
Urea	7.23 (±2.9)	9.2 (±12.1)	0.36
Creatinine	89.4 (±31.8)	91.8 (±28.8)	0.76
Fluid balance	3131.3 (±840.0)	3341.9 (±1064.4)	0.38
Bypass time	88.09 (±23.2)	109.8 (±41.9)	0.01
Urine output	725 (±467.3)	806.7 (±516)	0.51
Hb (bypass)	76.1 (±15.3)	77.7 (±12.1)	0.63

CONCLUSION

The results of the review showed no significant difference in fluid balance and urine out put with the addition of mannitol. There was a trend for increased urine output in patients with prolonged bypass time. A prospective randomized control trial with larger patient group and addition of mannitol either in the prime or at a discrete time during bypass to reduce the variability between the groups is recommended.

What Blood Pressure is Appropriate for Cardiopulmonary Bypass and How To Get It

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In 1995, Gold et al. published the results of a randomized clinical trial of elective coronary artery bypass grafting in 248 patients randomized to two groups (1). In one group, mean arterial pressure was maintained between 50 and 60 mmHg during cardiopulmonary bypass and in the other it was maintained between 80 and 100 mmHg. The incidence of combined cardiac and neurological complications was significantly lower in the high pressure group (4.8%) than in the low pressure group (12.9%: $p = 0.026$). Six months postoperatively, the mortality rates were 1.6% and 4%, stroke rates 2.4% and 7.2%, and cardiac complication rates 2.4% and 4.8%. Cognitive and functional status outcomes did not differ between the groups. This study precipitated a change in practice in our unit, more in response to casual discussion than in any formalised way. The use of vasoconstrictors to maintain higher mean arterial pressures has become the norm.

Gold's study was cirticised when published on a number of grounds, notably the unjustifiable technique of selectively pooling data to achieve statistical significance. Other criticisms included the lack of data on the prevalence of post bypass and postoperative hypotension or hypertension.

WHAT IS THE TRUTH OF THE MATTER?

The primary reason for worrying about blood pressure on CPB is the potential for injury to the brain. Adverse cerebral outcomes after cardiac surgery are associated with higher in-hospital mortality, longer hospitalisation, and a higher rate of discharge to other facilities for further care (2). Factors which have the potential to affect neurocognitive outcomes after cardiac surgery include:

1. hypoperfusion (3,4,5)
2. cerebral embolic load (6)
3. hypoglycaemia (6)
4. hypertension (7)
5. atheromatous disease (8)
6. therapeutic agents (9)
7. temperature (10)

Studies of pressure during CPB need to take each of these into account. This has not always been the case. Stockard established the concept of tm^{50} (the integral of perfusion pressure $\leq$50 mmHg over time) (11). We have the opportunity to study this in our own patients.

Cerebral perfusion pressure is the difference between mean arterial pressure and central venous pressure. The argument around perfusion pressure and cerebral blood flow is complicated. Low flow may be associated with hypoperfusion. High flow may increase embolic load. Brown has demonstrated a relationship between embolic load and bypass time (12) which links to other work showing poorer neurological outcomes with increased bypass times. Schmidt has demonstrated that cardiopulmonary bypass is associated with a significantly higher rate of cerebral injury in patients who were hypertensive preoperatively (7). Technical matters are also important (13)—including the design of equipment used during CPB (14,15). Putting the patient head down at critical moments in the procedure may reduce embolisation to the brain (16). Reducing the haematocrit may improve flow but the lowest haematocrit during CPB is an independent risk factor for mortality (risk is increased if the haematocrit $\leq$ 14%) (17). Transient hypertension during cardiac surgery has been associated with stroke. High perfusion pressure may be associated with more damage to blood elements and thereby exacerbate the inflammatory response to CPB. It may also compromise the surgical field.

Table 1. Some factors which affect cerebral blood flow.

	Item
1	$PaCO_2$
2	PaO_2
3	Blood viscosity
4	Intercranial pressure
5	Mean arterial pressures
6	Central venous pressure
7	Drugs