Intravenous Fluid Administration in Cockatoos

Mancy Lau[1] and Lucio J Filippich[2]

Fluid therapy has long been an important procedure in critical care. There are four parenteral routes for fluid therapy; intravenous, intraosseous, intraperitoneal and subcutaneous. Both subcutaneous and intraperitoneal administrations can be impractical in the avian patients. In mammals, subcutaneous administration is unsuitable in hypothermic patients because of peripheral vasoconstriction. Incorrect technique of intraperitoneal injections can be dangerous in the avian patients because of the presence of air sacs.

The intraosseous route is especially useful when the intravenous route cannot be accessed (Ritchie 1990). The efficacy and fluid dynamics of Ringer's lactated solution given intraosseously had been studied in pigeons (Lamberski and Daniel 1991 and 1992), and in some raptors (Agullar et al 1993). The risks associated with intraosseous cannulation included joint damage, and alkaline drugs can irritate the medullary bones, and thus should not be given intraosseously. The maximum rate of fluid administration that can be given intraosseously still needs to be investigated. Also, the effects of the fluid on the patient have been inadequately studied.

There is little literature on intravenous fluid administration in birds, nor the effect of the fluids on the avian patients. This route is often avoided in birds because of haematoma formation, intolerance of the conscious animal to bandages and catheters, and the requirement for frequent restraint of the animal for bolus injections. However, intravenous administration is most effective in the dehydrated patients. This route allows immediate expansion of the intravascular volume and administration of drugs and parenteral nutrition.

Materials and methods-

Eight sulphur-crested cockatoos (*Cacatua galerita*) were used in this study. These birds were maintained normothermically under isoflurane anaesthesia for two hours (Lau and Filippich 1996). Intravenous fluid[3] was administered at the rate of 100ml/kg/hr in the first hour. The study was divided into four parts. Two fluids, Hartmann's solution[4], and 5% dextrose, were each administered at two temperatures, room temperature (20^{o}C) and 35^{o}C.

1 Department of Companion Animal Clinical Studies, Veterinary School, The University of Queensland, Q 4072.

2 Department of Companion Animal Clinical Studies, Veterinary School, The University of Queensland, Q 4172.

3 The fluids were administered using an IMED 960 intravenous pump.

4 Lactated Ringer's solution.

A 22 gauge intravenous cathether[5] was inserted into the right jugular vein and was sealed with an injection site[6]. The catheter was secured by a butterfly bandage and sutured to the skin. The catheter was the site for both fluid infusion, and blood collection. The birds were weighed every hour. Blood was taken (after flushing blood through the catheter several times) for biochemistry, blood gas and acid-base analysis at zero, one and two hours (before, immediately after and an hour after fluid therapy). The fluids were warmed to the desired temperature by coiling the drip line around a heating coil[7]. Heart rate[8], blood pressure[9], respiratory rate, respiratory minute volume and cloacal temperature[10] were measured every fifteen minutes during the study. The birds' cloacal contents were expressed during the study and before weighing.

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5 Terumo intravenous catheters, Terumo Corporation, Japan.

6 Injection Site, Tuta Laboratories Australia, Lane Cove, NSW Australia

7 This heating coil was made in the Department of Companion Animal Clinical Studies, Veterinary School, The University of Queensland.

8 Heart rate was recorded by electrocardiogram (ECG).

9 Blood pressure was measured indirectly using an Ultrasonic Doppler Flow Detector, Bosco Medical, Wynnum, Qld. The cuff was placed about 2cm below the stifle joint. The crystal was placed over the tibial artery. The mean of several readings was used.

10 A mercury clinical thermometer and a thermistor probe were used simultaneously. The thermistor probe was calibrated with a clinical thermometer.

Results

Table: Packed cell volume (PCV), plasma biochemistries and various parameters measured in eight anaesthetised sulphur-crested cockatoos before and after intravenous fluid administration.

		5% Dextrose Solution		**Hartmann's Solution**	
Parameter	Time	20°C	35°C	20°C	35°C
PCV	0	44±8.3	40±1.9	42±4.2	40±4.4
(%)	1	43±9.8	33±6.5	37±5.5	31±6.0
	2	46±4.1	45±4.5	39±9.7	35±4.7
Total protein	0	33±3.5	33±3.1	32±3.4	33±3.5
(g/L)	1	30±4.4	27±5.2	25±4.8	30±4.4
	2	37±4.4	36±4.3	26±3.4	26±2.7
Albumin	0	14±1.3	14±1.2	13±1.3	14±1.3
(g/L)	1	12±1.4	11±2.2	10±1.7	13±1.5
	2	15±1.9	15±1.6	11±1.3	11±1.2
Sodium	0	144±4.7	146±5.7	147±2.8	143±5.9
(mmol/L)	1	115±8.0	118±10.7	152±1.6	150±3.9
	2	127±9.1	134±7.4	152±3.7	151±4.5
Chloride	0	111±4.6	113±6.9	114±3.0	110±5.9
(mmol/L)	1	84± 6.4	89±9.4	118±3.6	114±4.9
	2	92±6.6	98±7.5	117±5.2	114±5.2
Potassium	0	3.73±0.57	3.81±0.34	3.53±0.34	3.90±0.42
(mmol/L)	1	3.92±0.39	4.02±0.47	3.96±0.41	4.03±0.49
	2	3.97±0.74	3.87±0.38	4.07±0.29	4.05±0.30
Glucose	0	17±1.1	16±1.6	17±0.83	17±1.46
(mmol/L)	1	46±9.7	41±2.9	13±0.29	14±0.63
	2	26±9.4	24±9.9	14±0.52	14±0.27
pH	0	7.39±0.07	7.36±0.07	7.40±0.07	7.43±0.04
(pH units)	1	7.34±0.07	7.38±0.07	7.40±0.07	7.44±0.05
	2	7.33±0.11	7.38±0.07	7.38±0.05	7.39±0.06
Temperature	0	40.8±0.4	41.1±0.6	40.6±0.5	40.9±0.4
(°C)	1	37.5±0.9	39.4±0.7	38.6±0.3	39.4±0.8
	2	38.7±1.5	39.0±0.9	38.5±0.3	38.7±0.6
Blood pressure	0	139±27	137±30	130±23	137±15
(mmHg)	1	177±15	176±18	168±12	160±22
	2	130±39	122±39	150±14	150±23
Body weight	0	777±60	758±60	777±82	745±66
(g)	1	799±70	795±64	840±64	790±68
	2	793±63	776±58	802±85	769±73

N.B. Time is expressed in hours after anaesthetic induction; all values are expressed as mean±standard deviation, n=8 in all cases. PCV denotes packed cell volume.

Discussion

Hartmann's fluid most closely resembles mammalian plasma in its electrolyte composition, but its effects on electrolytes and other parameters have not been studied in avian species. Oral dextrose solution has been suggested to be useful in hypovolaemic birds but intravenous use has not been investigated.

It is not uncommon for intravenous fluids to be given at room temperature (approx. 20^{o}C). All the birds lost body heat during the infusions, but the greatest decrease was seen in the first hour of the 20^{o}C infusions. The birds which were infused with the 20^{o}C fluids lost on average 2.65^{o}C body heat. Administering fluids at 35^{o}C decreased the body temperature loss to 1.6^{o}C. Although such changes may not be significant in healthy birds, they may be detrimental in an ill bird. It should also be noted that in the 20^{o}C dextrose experiment, the birds regained some of the lost body heat whilst under general anaesthesia in the hour after the infusion.

The administration of 5% Dextrose caused a significant decrease in the plasma electrolytes such as sodium and chloride. Sodium, being the "osmotic skeleton", was diluted by the infusion of dextrose. In contrast, the Hartmann's solution increased plasma sodium, chloride and potassium concentrations. Plasma potassium (K) increased in all cases. Some of the changes were great (e.g. 0.54 mmol/l increase with the infusion of Hartmann's at 20^{o}C). Hyperkalaemia occurs in acidosis in mammals (Senior, 1989). With the Hartmann's infusion, potassium concentration increased towards the potassium level in the administered fluid, in the absence of blood pH changes. With the 20^{o}C dextrose infusion, the birds became slightly acidotic, and potassium concentration increased.

The administration of 5% dextrose intravenously caused haemodilution (decreased PCV, TP, Alb, increased BP), followed by haemoconcentration post- infusion. One hour after the infusion was completed PCV, TP and Alb were elevated above initial values and BP dropped below the original values, although the birds retained an average of 17ml of fluid. This suggests that fluid had moved into an extravascular compartment. This can be explained in terms of the renin-angiotensin system. Blood pressure increased due to the intravascular fluid load but the absence of sodium in the infusion caused diuresis with sodium conservation. Osmotic diuresis may also have occurred as the urine tested positive for glucose. It should be noted that two birds in the 20^{o}C dextrose and one bird in the 35^{o}C dextrose infusion experiments showed blood pressure decreases to 60 mmHg (two birds) and 80 mmHg (one bird) at one hour after the infusion.

Hartmann's solution caused a slight increase in the major electrolytes. During the infusion, Hartmann's solution caused an increase in the electrolytes, and a dilution of PCV, TP and Alb. One hour after the infusion, PCV, TP and Alb were still decreased but were returning towards the initial values. With the infusion, BP was increased from 133mmHg to 164mmHg. An hour after the completion of the infusion, the BP was still maintained at 150mmHg. Diuresis was noted in these birds but they retained on average 24ml fluid. The retention of fluid in the intravascular space supported the blood pressure.

Overall, Hartmann's solution has a more sustained effect in expanding the plasma volume and increasing the blood pressure than 5% dextrose. Warming infused fluids should be encouraged to minimise clinically important changes in body temperature. The importance of body temperature on acid-base, electrolyte and cardiorespiratory function has been demonstrated previously (Lau and Filippich 1996, Verkest and Filippich 1995, Verkest 1995).

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