Sorbitol 2.5% mannitol 0.54% irrigation solution for hysteroscopic endometrial ablation surgery

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Purpose: To determine if systemic absorption of sorbitol 2.5%/mannitol 0.54% irrigation solution (165 mosm·L⁻¹) during hysteroscopic endometrial ablation with diathermy is associated with hyponatraemia and hypoosmolality.

Methods: In 35 day surgery patients in a university hospital we measured baseline preoperative variables: serum sodium and creatinine concentrations and osmolality, haematocrit, haemoglobin, urine osmolality and sodium concentration, and weight. Fractional excretion of sodium (FE_{Na}) was calculated. The same observations were obtained postoperatively before discharge (one hour post resection). Volumes of intraoperative fluid irrigation intravasation and perioperative intravenous fluid absorption (lactated Ringer's solution) were estimated clinically (volumetric).

Results: The mean (± SD) serum sodium concentration preoperatively was 140.3 ± 2.4 mmol·L⁻¹; and postoperatively, 139.7 ± 2.2 mmol·L⁻¹ (P=NS). The serum osmolality decreased from 285.4 ± 4.5 to 282.6 ± 4.1 mmol·kg⁻¹ (P<0.001). The mean volume of intravasated irrigation fluid was 26.4 ml (range 0–300). During the same time, the FE_{Na} increased from 0.57% to 0.79% (P<0.001).

Conclusion: In these patients, closely and continuously observed for imbalance between infused and collected irrigation fluid, there was no clinical evidence for hyponatraemic hypoosmolality. However, there was a small 1% ± 1.5% (mean ± SD; range -3.4 to 3.6%) decrease in plasma osmolality despite adequate blood volumes as shown by urinary sodium indices.

Objectif : Déterminer si l'absorption systémique d'une solution d'irrigation de sorbitol 2,5% avec mannitol 0,54% (164 mosm·L⁻¹) pendant l'ablation endoscopique de l'endomètre par diathermie est associée à de l'hyponatrémie et à de l'hypoosmolalité.

Méthodes : Sur une période de trente-cinq jours, nous avons mesuré dans un hôpital universitaire les variables préopératoires de base de la natrémie et de la créatininémie, et l'osmolalité, l'hématocrite, l'hémoglobine, l'osmolalité et la concentration du sodium urinaires ainsi que le poids. L'excrétion fractionnée du sodium (FE_{Na}) a été calculée. Les mêmes variables ont été notées après l'intervention au moment du congé (accordé une heure après la résection). Le volume de l'absorption vasculaire peropératoire du liquide d'irrigation et le volume de liquide intraveineux administré pendant la période périopératoire (solution de lactate de Ringer) ont été évalués par volumétrie.

Résultats : La natrémie moyenne (±ET) préopératoire était 140,3 ± 2,4 mosm·L⁻¹, et postopératoire de 138 ± 2,2 mosm·L⁻¹ (P = NS). L'osmolalité sérique a diminué de 285,4 ± 4,5 à 282,6 ± 4,1 mosm·L⁻¹ (P<0,001). Le volume moyen du liquide d'irrigation absorbé était de 26,4 ml (écart de 0 à 300). Pendant la même période, la FE_{Na} augmentait de 0,57% à 0,79% (P<0,01).

Conclusion : Chez ces patientes qui sont sous surveillance continue pour un déséquilibre entre le liquide perfusé et collecté, l'hypoosmolalité hyponatrémique n'a pas été cliniquement démontrée. Cependant, on a noté une petite diminution de 1% ± 1,5% (moyenne ± ET; écart de 3,4 à 3,6%) de l'osmolalité plasmatique malgré une volumie adéquate comme l'ont démontré les indices du sodium urinaire.

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ENDOMETRIAL ablation was approved by the FDA in the United States in 1988 as a less invasive and expensive alternative to hysterectomy for menorrhagia. Dysfunctional uterine bleeding accounts for about 20 percent of hysterectomies (100,000 annually) performed in the United States. The long-term efficacy of endometrial ablation to control menorrhagia remains to be established.¹ Diagnostic uncertainty in excluding cancer by pathological analysis of resected tissue postoperatively may also be a problem, especially with laser ablations. Of particular concern is the report of one death (autopsy-confirmed cerebral oedema and tonsillar herniation; serum sodium $121 \text{ mmol}\cdot\text{L}^{-1}$) and three other symptomatic hyponatraemic episodes (mean serum sodium $107 \text{ mmol}\cdot\text{L}^{-1}$, range 93–121) following this procedure.^{2,3} Hypotonic solutions are required during electrocautery resections (as opposed to laser resections where isotonic saline solution may be substituted) to diminish current dispersion, which limits cutting ability. Sterile water irrigation has been used,⁴ but is probably too prone to well-established complications for routine use.⁵

Other perioperative complications reported anecdotally during endometrial ablation include possible anaphylactic or chemical reaction to hypertonic dextran when used for irrigation solution,⁶ pulmonary oedema from fluid overload,⁷ and venous air embolism with cardiac arrest.⁸ As with transurethral resection of the prostate (TURP), because of positioning, the operative site can be above the level of the heart. The possibility of air entrainment may be underappreciated.^{9–10} Dextran is now less frequently used, and the hazards of continuous gas cooling of laser heads has been recognized. With increasing experience,^{11–12} proponents of the procedure appear to be achieving its potential as a less invasive, less costly and, possibly, safer alternative to hysterectomy for selected cases of menorrhagia or uterine myomata.

We designed a prospective study in a single practice to test the hypothesis that hysteroscopic endometrial ablation using sorbitol 2.5% and mannitol 0.54% irrigation solution (Cystosol™) might be associated with hyponatraemic hypoosmolality despite maintaining irrigation fluid balance as close to zero as possible.

Materials and methods

After institutional review board approval and written informed consent were obtained, 35 ASA I or II patients undergoing outpatient endometrial ablation completed this study between September, 1994 and November, 1995. Patients who did not consent or had a history of uncontrolled diabetes mellitus (dextrostix $>6 \text{ mmol}\cdot\text{L}^{-1}$ on the morning of surgery) or renal disease were excluded from the investigation. No

one met these exclusion criteria and were not entered except for refusers, discontinuers, or subjects with lost or incomplete data.

One patient received sublingual lorazepam for premedication. The majority of patients not undergoing simultaneous laparoscopy were awake, receiving paracervical block anaesthesia with lidocaine 2% and bupivacaine 0.25%, midazolam and/or fentanyl sedation, and short periods of hypnosis with propofol as needed. These awake patients were assessed for clinical signs of hyponatraemic encephalopathy.¹³ General anaesthesia (four patients) consisted of precurarization, thiopentone or propofol, fentanyl, and succinylcholine followed by tracheal intubation and controlled ventilation with nitrous oxide 70% and isoflurane 0.5%–1.5%. Intraoperative monitoring included ECG, automated oscillotonometry, pulse oximetry, and capnography (during general anaesthesia). All patients received an infusion of lactated Ringer's solution in the operating and recovery rooms, and these volumes were recorded.

The subjects were fasted overnight (earlier cases) or for four hours preoperatively (later cases). After admission to the day surgery unit, usually in the early morning, they were weighed on a balanced beam scale in standard hospital attire after voiding a first study specimen. The urine specimen was sent for measurement of osmolality, sodium, and creatinine concentrations. In addition to the surgeon's usual orders, blood was sent for sodium, creatinine, haemoglobin, haematocrit, and osmolality determination. Plasma samples were examined grossly for lactescence (not seen in any subject), and the osmolalities were determined by freezing point depression. Sodium concentrations were determined with a Hitachi analyzer [Hitachi Instruments, Inc., San Jose, CA]. Laboratory analyses were done without knowledge of the clinical data or time of collection.

Three litre bags, or two bags in tandem by a Y-connector, of the irrigation solution were infused by gravity flow from a height of 70 cm to one meter. A two-channel, 26-French gauge irrigating hysteroscope was used. One gynaecologist or his supervised trainees performed the endometrial ablations with both roller-ball and wire-loop electrocautery devices. The volume of irrigation used (visually estimated), and duration of resection and procedure were recorded. Collection of irrigation fluid was by passive drainage into a closed plastic drape, and then by wall suction (first 17 cases) or by gravity (last 18 cases) to calibrated containers. No hypotensive episodes occurred with either general or regional anaesthesia. There were no surgical complications. Blood loss was felt to be minimal in all cases. We recognized no clinical evidence of hypoosmolality or fluid overload. In the recovery room, patients were monitored for signs of

hypoosmolality and their intravenous fluid absorptions were tallied in the usual manner. After returning to the day surgery unit, approximately one hour after the end of the resection, blood and urine specimens were sent for the same determinations as above. The urine determinations were repeated approximately two hours postresection. There were no unscheduled hospital admissions.

Preoperative and postoperative weights and laboratory measurements except haematocrit and haemoglobin (insufficient numbers) were compared using paired *t* tests. A sample size of 30 patients was calculated to provide a power of at least 0.8, assuming the need to detect a mean change in serum sodium concentration of 10 mmol·L⁻¹, and assuming the standard deviation of serum sodium concentration in normal outpatients is about 2 mmol·L⁻¹.¹⁴

Results

Most patients were perimenopausal. Four patients were undergoing endometrial ablation for the second time. Simultaneous submucous fibroid resection was performed hysteroscopically in two patients. Laparoscopy was done in three patients, for diagnostic purposes in one, tubal ligation in one, and endometriosis diathermy in one. Dysmenorrhoea was the primary indication for endometrial ablation in one patient (Table I).

Data from the 35 study patients are summarized in Table II. We found that over resection times (mean

±SD) of 27.9 ± 14.5 min (range 10–68) using 6421 ± 4075 ml (range 2400–18,600) of irrigation fluid, plasma sodium concentration decreased from 140.5 ± 2.4 to 139.7 ± 2.2 mmol·L⁻¹ (*P*=NS) and measured plasma osmolality from 285.4 ± 4.5 to 282.6 ± 4.1 mosm·kg⁻¹ (*P*<0.001). During the same time, urinary osmolality declined from 598.3 ± 251.5 to 523.6 ± 189.5 mosm·kg⁻¹ (*P*= NS), returning to 540.8 ± 194.5 before hospital discharge. The FE_{Na} increased from 0.57% to 0.79% (*P*<0.001). The mean (±SD) weight gain was 0.43 ± 0.6 Kg (*P*<0.001), and the mean (±SD) volume of lactated Ringer's solution given was 681 ± 243 ml. Haematocrit decreased (mean ±SD) from 41 ± 3.2% to 38.1 ± 3.0%, and serum haemoglobin concentration from 138.6 to 128.3 g·L⁻¹ (insufficient number for statistical analysis). The expected haematocrit after the observed intravenous absorption of Ringers lactate solution would have been 39.8%.

Six patients showed decreases of 7, 7, 7, 8, 8, and 10 mmol·kg⁻¹ in measured osmolality, but only the last of these demonstrated any noteworthy decrease in serum sodium concentration (5 mmol·L⁻¹). In retrospect, this patient and one of those who showed an 8 mosm·kg⁻¹ osmolality decrease also experienced tremulousness in the recovery room, but no other sign of possible hyponatraemic encephalopathy, such as nausea, headache, etc. The mean (± SD) decrease in sodium concentration was 0.7 ± 2.0 mmol·L⁻¹ (range -5 to +3). The mean volume of intravasated irrigation fluid, estimated clinically, was 26.4 ml (range 0–300).

TABLE I Patient Characteristics

Characteristic	Value
Age, yr (mean ±SD, range)	41.2 ± 6.1, 26–65
Nulliparous, n(%)	2(6)
Laminaria, n(%)	18(53)
Endometrial preparation	
None, n(%)	5(14)
Danazol, n(%)	26(74)
GnRH* analogue, n(%)	3(9)
Birth control pill, n(%)	1(3)

*Gonadotropin-releasing hormone

Discussion

Operations such as TURP and hysteroscopy for endometrial ablation, excision of uterine fibroids, or metroplasty employ electrical resectoscopes and require continuous irrigating fluid to flush out blood/tissue debris and distend the operative field. Optically, the perfect irrigating fluid is distilled water, but its use in TURP was eliminated decades ago because of systemic absorption of water, causing haemolysis, fluid overload, and water intoxication.⁵ Electrolyte solutions tend to disperse electrical current enough to inhibit the cutting

TABLE II Summary of Laboratory Values in 35 Women Undergoing Endometrial Ablation

	Mean SD, Range			
	Preoperative	1 Hour Postoperative	Change	<i>P</i>
Serum sodium (mmol·L ⁻¹)	140.3 ± 2.4, 136–147	139.7 ± 2.2, 135–145	-0.7 ± 2, -5 to 3	0.057
Serum osmolality (mosm·kg ⁻¹)	285.4 ± 4.5, 277–297	282.6 ± 4.1, 276–291	-2.7 ± 4.2, -10 to 10	<0.001
Serum creatinine (μmol·L ⁻¹)	83.5 ± 14.9, 54–112	74.9 ± 14.6, 44–103	-8.5 ± 7.4, -26 to 9	<0.001
Fe _{Na} (%)	0.6 ± 0.3, 0.1001–1.384	0.8 ± 0.4, 0.2223–2.248	0.2 ± 0.3, -0.4542 to 1.116	<0.001

function of resectoscopes. Hypotonic or nearly isotonic solutions of glycine 1.5%, sorbitol 2.5–5%, mannitol, or combinations of sorbitol and mannitol are in clinical use as flushing solutions. Dilutional problems have been identified,¹⁵ and intravasation of glycine (inhibitory neurotransmitter), its intermediary metabolites (e.g., ammonia, serine), and hepatic breakdown products of sorbitol (lactate) have been cited as actual or potential toxins from intravascular absorption.^{16,17} Recently, several marker studies have been performed to identify intravasation of irrigation fluid continuously (ethanol tagged irrigation fluid and monitoring ethanol concentration in the expired breath),¹⁸ and to determine serum concentrations of administered compounds and breakdown products. A glycine 1.5%/ethanol 1% irrigation solution is commercially available.¹⁹

The osmolal effects of the intravascular absorption of sorbitol 2.5%/mannitol 0.54% irrigation solution are multifactorial. These include: intrauterine pressure, surgical factors such as the degree of cervical dilatation, the predominantly hepatic disposition of sorbitol (metabolism to fructose, glucose, pyruvate and lactate [$T_{1/2} = 30$ min] with saturation kinetics and some renal elimination at high plasma concentration), the action of mannitol, and probably many other factors such as perioperative blood pressure fluctuations (pressure natriuresis), stress or hypotension-related ADH secretion, pain, etc. The plasma glucose concentration does not rise as a result of a moderate amount of sorbitol intravasation. Thus, it may provide little protection for the effective osmolality of plasma, or against cytotoxic cerebral edema, caused by excess free water.

In our 35 patients, closely and continuously observed for an imbalance between infused and collected irrigation fluid, we did not diagnose hyponatraemic hypoosmolality during and immediately after hysteroscopic endometrial ablation using sorbitol 2.5%/mannitol 0.54% (165 mmol·L⁻¹) irrigation solution. However, plasma osmolality decreased by (mean $\pm$ SD) $1 \pm 1.5\%$ (range -3.4 to 3.6%) at one hour postoperatively, associated with a non-significant decrease in plasma sodium concentration. The predicted serum osmolality, based solely on the intravenous absorption of 680 ml lactated Ringer's solution, would have been 285.0 mosm·kg⁻¹. The measured mean serum osmolality was 282.6 mosm·L⁻¹. During this time, urinary osmolality decreased from 598.3 to 523.6 mosm·kg⁻¹, before returning to 540 mosm·kg⁻¹ prior to hospital discharge. This small increase in urinary dilution appeared to compensate for the change in plasma osmolality. The levels of FE_{Na} increased during the time course of the surgical

procedure. That is, there is no evidence that a hypovolaemic stimulus to ADH release was present.

Chiu *et al.* studied systemic absorption of glycine 1.5% solution during endometrial ablation in 20 patients.²¹ Elevations in plasma glycine concentrations correlated with intraoperative plasma sodium decreases of ≥ 3 mmol·L⁻¹; there was a trend in the same direction with decreases in postoperative plasma sodium values. Serum osmolality did not change, which may be due to the osmotic action of glycine itself until it is metabolized. The clinically estimated irrigation fluid deficit (median = 0.25 L; range = 0–1.0 L) was a poor predictor of the increase in plasma glycine concentration, as was central venous pressure measurement. The single best predictor of hyperglycinaemia was an intraoperative decrease in plasma sodium of ≥ 7 mmol·L⁻¹. The volume of irrigation fluid used (median 10.5 L; range 4.0–29.0 L) was larger than in the current study.

Studying glycine 1.5% irrigation solution during endometrial ablation, McSwiney *et al.* found plasma sodium decreases of ≥ 3 mmol·L⁻¹ in 14 of 21 patients, with low irrigation volumes (6.9 ± 2.9 L) and irrigation deficits (1.1 ± 0.7 L). However, plasma osmolality changes or peak glycine concentrations were not reported.²²

Although sorbitol 2.5%/mannitol 0.54% and glycine 1.5% are equally hypotonic, the former may have some advantages, firstly by avoiding the potential toxicity of glycine *per se*.^{23,24} Also, mannitol remains extracellular, induces an osmotic water diuresis, and has a long half-life. Thus, it may help maintain effective osmolality.

In a patient undergoing hysteroscopic metroplasty and showing a dilutional toxicity postoperatively, D'Agosto *et al.* used 8 L of sterile water over the course of two hours.⁴

In 25 patients undergoing laser endometrial ablation with saline 0.9% irrigation fluid, Osborne *et al.* measured fluid uptake by equating fluid uptake in litres with the difference between preoperative and postoperative weights in kilograms.²⁵ Mean ($\pm$ SD) fluid uptake, as defined, was 1.5 ± 1.6 L with a range of 0 to 5.1 L. Procedure duration (mean 1.78, SD 0.47, range 0.7–2.5 hr) and volume of irrigation infused (mean 9.1, SD 5.0, range 4–24 L) did not correlate with fluid uptake (weight gain).

Distending the endometrial cavity for visualization during hysteroscopy requires a fairly high pressure ($>$ uterine venous pressure) because of the stiffness of the uterine walls. Hasham *et al.* showed that the intrauterine pressure (IUP) attained during endometrial laser ablation (isotonic saline irrigation solution) influenced the

amount of fluid absorbed as assessed by volumetric irrigation fluid deficit and hysterosalpingography.²⁶ Using a pressure-limited rotary pump to administer irrigation fluid, they found no fluid absorption in a group of 11 women if the mean maximum IUP was 70 mm Hg (pressure just sufficient to maintain visibility and to prevent bleeding from disrupted vessels). Besides intravenous absorption, hypotonic fluid may also enter the peritoneal cavity through the fallopian tubes or through inadvertent uterine perforation.

In treating childhood diabetic ketoacidosis, a hyperosmolar state with perhaps limited comparability because of the generation of organic osmolytes, it has been reported that cerebral oedema may occur if calculated effective osmolality declines at a rate of ≥ 6.5 mmol·kg⁻¹·hr⁻¹.^{27,28} In our study the reduction in osmolality was 2.8 ± 4.3 mmol·kg⁻¹ at one hour. Six patients experienced a postoperative decrease in osmolality of ≥ 7 mosm·kg⁻¹ (maximum 10 mosm·kg⁻¹), and two of these exhibited tremulousness in recovery room but no other sign of possible hyponatraemic encephalopathy.

Though feasible for this investigation, the study design was observational and uncontrolled. During operative hysteroscopy procedures employing hypotonic irrigating solutions, practitioners should estimate fluid absorption at regular intervals and terminate the procedure if large deficits (e.g., >2000 ml) are identified.^{11,12,19,29} They should monitor for clinical signs of hyponatraemic encephalopathy, and be prepared to treat it. However, therapy for hyponatraemia is controversial. Although seizures or respiratory arrest may supervene, overtreatment of hyponatraemia may itself cause neurological injury.

In summary, in 35 outpatients undergoing endometrial ablation sorbitol 2.5%/mannitol 0.54% irrigation solution (165 mmol·L⁻¹) caused no clinical or biochemical evidence of hyponatraemic hypoosmolality. A decrease in serum osmolality was found, but no hyponatraemia was seen. Future observational studies might resolve this discrepancy. Given widespread knowledge of the complications of each of the commonly used irrigation solutions, there may be no need for comparative trials.

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References

- 1 Carlson KJ, Nichols DH, Schiff I. Indications for hysterectomy. *N Engl J Med* 1993; 328: 856–60.
- 2 Arieff AI, Ayus JC. Endometrial ablation complicated by fatal hyponatremic encephalopathy. *JAMA* 1993; 270: 1230–2.
- 3 Lyon RP, Mangar D, O'Connor TM, *et al.* Hyponatremic encephalopathy after endometrial ablation (Letters). *JAMA* 1994; 271: 343–5.
- 4 D'Agosto J, Ali NMK, Maier D. Absorption of irrigating solution during hysteroscopic metroplasty. *Anesthesiology* 1990; 72: 379–80.
- 5 Creevy CD. The importance of hemolysis during transurethral prostatic resection; a clinical investigation. *J Urol* 1948; 59: 1217–32.
- 6 Witz CA, Schenken RS, Silverberg KM, Olive DL, Burns WN. Complications associated with the absorption of hysteroscopic fluid media. *Fertil Steril* 1993; 60: 745–56.
- 7 Vercellini P, Rossi R, Pagnoni B, Fedele L. Hypervolemic pulmonary edema and severe coagulopathy after intrauterine dextran instillation. *Obstet Gynecol* 1992; 79: 838–9.
- 8 Eugster D. Cardiac arrest during endometrial ablation (Letter). *Anaesth Intensive Care* 1993; 2: 891–2.
- 9 Vacanti CA, Lodhia KL. Fatal massive air embolism during transurethral resection of the prostate. *Anesthesiology* 1991; 74: 186–7.
- 10 Tur Kaspas I. Hyperbaric oxygen therapy for air embolism complicating operative hysteroscopy (Letter). *Am J Obstet Gynecol* 1990; 163: 680–1.
- 11 Hulka JF, Peterson HB, Phillips JM, Surrey MW. Operative hysteroscopy. American Association of Gynecologic Laparoscopists 1991 Membership Survey. *Reprod Med* 1993; 38: 572–3.
- 12 O'Connor H, Magos A. Endometrial resection for the treatment of menorrhagia. *N Engl J Med* 1996; 335: 151–6.
- 13 Davidman M. The management of hypo-osmolar states. *Annals RCPSC* 1994; 27: 90–2.
- 14 Glantz SA. *Primer of Biostatistics*, 3rd ed. New York: McGraw-Hill, 1992: 174.
- 15 Hurlbert BJ, Wingard DW. Water intoxication after 15 minutes of transurethral resection of the prostate. *Anesthesiology* 1979; 50: 355–6.
- 16 Shepard RL, Kraus SE, Babayan RK, Siroky MB. The role of ammonia toxicity in the post transurethral prostatectomy syndrome. *Br J Urol* 1987; 60: 349–51.
- 17 Dimberg M, Allgen L-G, Norlen H. Absence of lactate accumulation on transurethral resection of the prostate using 2.5% sorbitol solution as an irrigating fluid. *Scand J UrolNephrol* 1988; 22: 119–24.
- 18 Stalberg HP, Hahn RG, Jones AW. Ethanol monitoring of transurethral prostatic resection during inhaled anesthesia. *Anesth Analg* 1992; 75: 983–8.

- 19 *Williamson KM, Mushambi MC.* Complications of hysteroscopic treatments of menorrhagia (Editorial). *Br J Anaesth* 1996; 77: 305-7.
- 20 *Dimberg M, Norlen H, Allgen L-G, Allgen T, Wallin M.* A comparison between two hypotonic irrigating solutions used in transurethral resections of the prostate: sorbitol (2%)-mannitol (1%) and 1.5% glycine solutions. *Scand J Urol Nephrol* 1992; 26: 241-7.
- 21 *Chui PT, Short TG, Leung AKL, Tan PE, Oh TE.* Systemic absorption of glycine irrigation solution during endometrial ablation by transcervical endometrial resection. *Med J Aust* 1992; 157: 667-9.
- 22 *McSwiney M, Myatt J, Hargreaves M.* Transcervical endometrial resection syndrome. *Anaesthesia* 1995; 50: 254-8.
- 23 *Roesch RP, Stoelting RK, Lingeman JE, Kahmoski RJ, Backes DJ, Gephardt SA.* Ammonia toxicity resulting from glycine absorption during a transurethral resection of the prostate. *Anesthesiology* 1983; 58: 577-9.
- 24 *Wang JM, Wong KC, Creel DJ, Clark WM, Shahangian S.* Effects of glycine on hemodynamic responses and visual evoked potentials in the dog. *Anesth Analg* 1985; 64: 1071-7.
- 25 *Osborne GA, Rudkin GE, Moran P.* Fluid intake in laser endometrial ablation. *Anaesth Intensive Care* 1991; 19: 217-9.
- 26 *Hasham F, Garry R, Kokri MS, Mooney P.* Fluid absorption during laser ablation of the endometrium in the treatment of menorrhagia. *Br J Anaesth* 1992; 68: 151-4.
- 27 *Bello FA, Sotos JF.* Cerebral oedema in diabetic ketoacidosis in children (Letter). *Lancet* 1990; 336: 64.
- 28 *Rother KI, Schwenk WF II.* Effect of rehydration fluid with 75 mmol/L of sodium on serum sodium concentration and serum osmolality in young patients with diabetic ketoacidosis. *MayoClin Proc* 1994; 69: 1149-53.
- 29 *Lewis BV.* Guidelines for endometrial ablation. *Br J Obstet Gynaecol* 1994; 101: 470-3.