Plasma Vasopressin Response to Contrast Medium during Cardiac Catheterization in Infants and Children

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Fifteen infants and children (M=7, F=8), aged from 0 to 13 years, who underwent cardiac catheterization and cardioangiography under ketamine-diazepam anesthesia were the subjects of this study. The effect of a contrast medium, isolamate sodium (66.8%) on the plasma somolality and vasopressin concentration was studied. The plasma osmolality was significantly elevated after contrast medium administration (289 ± 3 vs. 303 ± 8 mosmol·kg^{-1}) as well as plasma vasopressin (from 2.1 ± 0.9 vs. 4.7 ± 2.0 micro-unit·ml^{-1}).

It is concluded that the administration of contrast medium for cardioangiography causes elevation of plasma osmolality, which leads to the elevation of plasma vasopressin concentration. (Key words: vasopressin, contrast medium, pediatric anesthesia)

(Yamashita M, Horigome H, Kudo T, et al.: Plasma vasopressin response to contrast medium during cardiac catheterization in infants and children. J Anesth 5: 203–204, 1991)

Contrast medium used in angiography is hyperosmolar and its administration results in an increase in plasma osmolality[1]. However, the response of plasma vasopressin to the changes of plasma osmolality induced by contrast medium has not been elucidated. The plasma vasopressin concentration as well as plasma osmolality were measured before and after the administration of angiographic contrast medium in infants and children.

Methods

Fifteen infants and children (M=7, F=8), aged from 0 to 13 years (mean age of 3.2 ± 3.8, M ± SD), weighing 14.3 ± 9.7 kg who underwent cardiac catheterization and cardioangiography were the subjects of this study. Informed consent was obtained from their parents. The infants and children were anesthetized with intravenous ketamine (1–2 mg·kg^{-1}) and diazepam (0.2–0.3 mg·kg^{-1}). Balanced salt solution of 4 ml·kg^{-1}·hr^{-1} for the first 10 kg, 2 ml·kg^{-1}·hr^{-1} for the second 10 kg, and 1 ml·kg^{-1}·hr^{-1} to the third 10 kg of the body weight was administered intravenously.

Contrast medium, isolamate sodium (66.8%), was administered 2.8 ± 0.6 ml (mean ± SD) for cardioangiography. Osmolality of the isolamate sodium is eight times higher than that of normal saline.

Blood samples were taken from the catheter introducer at the beginning and the end of the procedure. Plasma vasopressin was measured by radioimmunoassay[2] and plasma osmolality by the freezing point depression method. The data in the report are expressed as mean ± SD. Student's paired t-test was utilized for statistical analysis, and

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$P < 0.01$ was regarded as significant.

Results

Hemodynamic parameters remained stable during the procedure, and blood loss was minimal in all patients.

Both serum osmolality and plasma vasopressin increased ($P < 0.01$) after the procedure, to 303 ± 8 from 289 ± 3 mosmol·kg^{-1} and to 4.7 ± 2.0 (M ± SD) from 2.1 ± 0.9 micro-unit·ml^{-1}, respectively. Good correlation was observed between the increase in plasma vasopressin concentration (Y) and that in plasma osmolality ($Y = 0.3X - 0.4$, $r = 0.79$).

Serum electrolyte values were not measured in this study.

Discussion

Plasma vasopressin increased in response to the increase of serum osmolality after contrast medium injection in infants and children. We could confirm a linear relationship between the changes of plasma vasopressin and that of serum osmolality in children.

Plasma vasopressin concentrations in children older than one year are essentially the same as those in adults[3]. The osmotic threshold for vasopressin release is reported to be 285 mosmol·kg^{-1} in serum osmolality in children[3]. The serum osmolality after the administration of contrast medium in this study was well above this value (303 ± 8 mosmol·kg^{-1}).

The response of vasopressin to osmotic stimuli was maintained in our children under ketamine-diazepam anesthesia. However, fentanyl anesthesia is reported to abolish the plasma vasopressin response to osmotic stimulus[4]. Thus, there seems to be some differences among the anesthetics in regards to the modifying effect of the vasopressin response to osmotic stimuli.

In addition to hypertonicity, intravascular volume loss with hypotension, and nociceptive stimuli are also reported to induce vasopressin release. In children undergoing cardiac surgery, plasma vasopressin increased to 7 micro-unit·ml^{-1} in response to surgical stress and to 40 micro-unit·ml^{-1} during cardiopulmonary bypass[5]. However, the cardiac catheterization and angiography do not affect the plasma vasopressin concentration to that extent as does the open cardiac surgery.

In summary, a linear relationship was observed between serum osmolality changes induced by contrast medium for cardioangiography and plasma vasopressin levels in children under ketamine-diazepam anesthesia.

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References

1. Iseri L, Kaplan MA, Evans MJ, Nickel ED: Effects of concentrated contrast media during angiography on plasma volume and plasma osmolality. Am Heart J 69:154–158, 1965
2. Kudo T, Kudo M, Oyama T: Radioimmunoassay of vasopressin. Clin Endocr (Tokyo) 24:1311–1315, 1976
3. Rascher W, Rauh W, Brandeis WE, Huber K-H, Schåerer K: Determinants of plasma arginine-vasopressin in children. Acta Paediatr Scand 75:111–117, 1986
4. Ecoffey C, Simon D, Samii K, Diraison PM, Poggi J, Noviant Y, Ardaillou R: Antidiuretic hormone response to osmotic stimulus under fentanyl anaesthesia. Acta Anaesthesiol Scand 28:245–248, 1984
5. Yamashita M, Ishihara H, Kudo M, Matsuki A, Oyama T: Plasma vasopressin response to extracorporeal circulation in children. Acta Anaesthesiol Scand 28:331–333, 1984