

EFFECT OF VESICAL FEEDBACK ON RATE OF URINE FORMATION DEMONSTRATED BY INFUSING HYPOTONIC AND HYPERTONIC SALINE INTO THE URINARY BLADDER OF DOGS

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Abstract : The present study was undertaken to investigate the effect of the presence of solutions of different osmolality (hypertonic 3%, 4% and 5% hypotonic 0.1%, 0.2% and 0.3% in the urinary bladder on renal urine formation. The study was conducted on 36 dogs of either sex. 100 ml normal saline was used for distending the bladder. Various hypertonic and hypotonic solutions were infused inside the bladder and rate of urine formation was recorded. Presence of hypertonic fluid increased the rate of urine formation and hypotonic fluid decreased it.

Key words : hypertonic fluid hypotonic fluid kidney urine formation

INTRODUCTION

There are various mechanisms affecting urine formation by kidneys. One such mechanism is the tubulo-glomerular feed back mechanism (1), which helps in maintaining salt and water balance. Another mechanism which affects the urine formation is negative feed back signals from the urinary bladder to the kidneys (2). The present study was carried out to explore the feed back effect of osmotic pressure on urine formation by kidneys.

METHODS

The present study was carried out in dogs of either sex weighing 8-12 kg, under Pentothal sodium (25 mg/kg) administered intravenously. Tracheotomy was performed to ensure respiratory function.

Ureters were exposed through a midline incision in the lower abdomen. Polythene catheters were introduced into the ureters upto the pelvis of kidney. Both catheters were lead to a glass funnel from where the urine fell on to a magnetic drop recorder, the electrical signals of which were recorded kymographically.

The other two catheters were introduced inside the bladder. One of them was connected to a mercury monometer to record bladder pressure while the other catheter was used for infusion of various fluids.

A simultaneous record of carotid blood pressure was taken to indicate the changes in arterial blood pressure. A timer marked the time signal on the record.

Continuous saline infusion at the rate of 20-25 drops per minute was carried out to ensure regular urine formation. The effect of infusion of fluids of various tonicity inside the bladder on the rate of urine formation was observed.

RESULTS

Table I shows that infusion of 100 ml of 3%, 4% and 5% hypertonic fluid in the urinary bladder resulted in increase in urine formation by 114.8%, 57.7% and 76.47% respectively after a latency of 20-30 seconds. Prior to infusion of various hypertonic fluid, 100 ml of normal saline was infused and rate of urine formation was recorded. On infusion of xylocain (4%) inside the bladder prior to infusion of

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hypertonic fluid, it was observed that the effect of previous hypertonic fluid did not persist. Six dogs were used in each group. The increase in rate of urine formation induced by the 3% solution was found statistically significant ($P < 0.05$) whereas with 4% or 5%, it was statistically non-significant ($P > 0.05$).

TABLE I : Effect of intravesical hypertonic fluid on rate of urine formation.

Tonicity of fluid	Average rate of urine formation after 100 ml normal saline (drops/min)	Average rate of urine formation after 100 ml hypertonic fluid (drops/min)	% Increase
3%	3.5±3.57	7.5±3.48	114.28*
4%	4.5±2.95	7.1±3.97	57.77
5%	5.1±2.48	9.0±4.60	76.47

All values are Mean ± SD; * $P < 0.05$

There was a decrease in urine formation by 37.70%, 34.88% and 44.44% with 0.1%, 0.2% and 0.3% hypotonic fluids respectively. 100 ml of normal saline was infused and rate of urine formation was recorded before the infusion of hypotonic fluid. The decrease in urine formation with 0.1% hypotonic fluid was found to be statistically significant ($P < 0.05$) whereas it was statistically non-significant with 0.2% and 0.3% fluid ($P > 0.05$) as shown in Table II.

TABLE II : Effect of intravesical hypotonic fluid on rate of urine formation.

Tonicity of fluid	Average rate of urine formation after 100 ml normal saline (drops/min)	Average rate of urine formation after 100 ml hypertonic fluid (drops/min)	% Increase
0.1%	6.1±1.47	3.8±1.60	37.70*
0.2%	4.3±2.07	2.8±1.72	34.88
0.3%	4.5±2.88	2.5±1.74	44.44

All values are Mean ± SD; * $P < 0.05$

DISCUSSION

The present study was undertaken to examine the vesico-renal feedback mechanism and its effect on urine formation. The experiments performed by

infusing fluids of varying tonicity inside the bladder indicate a physiological feed back relationship between urinary bladder and kidney on the rate of urine formation. The increase in rate of urine formation with hypertonic fluid 3% inside urinary bladder was significant, whereas with 4% and 5% the increase was non-significant. Similarly the decrease in rate of urine formation with 0.1% was significant, whereas with 0.2% and 0.3% it was non-significant. Since the control value is the lowest in case of 3% infusion, the percentage change is the highest; hence it is significant. In other cases (4% and 5%) there is less scope for increase as the control values are higher, and that may be the reason for the insignificant increase. Similar reasons apply also for the non-significant decrease in rate of urine formation with 0.2% and 0.3% fluid infusion. If the number of dogs would have been more in each group, or the control values of urine formation were similar for all, the conclusions might have been more definitive.

The osmo-receptors in the wall of urinary bladder are sensitive towards the tonicity of fluid (2). Hypothalamic osmoreceptors maintain osmolarity of extracellular fluid (3). Decrease in osmolarity of extracellular fluid forms hypotonic urine and concentrated extracellular fluid forms hypertonic urine restoring back normal osmotic pressure. This hypothalamic regulatory process appears to be antagonised by vesical osmoreceptors since presence of hypotonic urine in bladder inhibits further diuresis whereas hypertonic urine increases urine formation by vesicorenal reflex. Both the above effects have been reported to be mediated through vesical osmoreceptors (4,5). The exact location of osmoreceptors in the bladder has not been located. Beside osmoreceptors in bladder wall, volume sensitive stretch receptors are present in the wall of urinary bladder which are stimulated by distension (6). This mechanism for change in urine formation with change in osmolarity of fluid protects bladder epithelium from being exposed to highly concentrated or dilute urine and further helps to minimise concentration gradient between bladder contents and extracellular fluid across vesical epithelium.

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