Monitoring Parameters – Part 2

The Ins and Outs of Urine Output

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Pathophysiology

The main function of the kidneys is to excrete metabolic wastes and reabsorb vital electrolytes and water. The volume and contents of the urine produced is a result of the function of the population of nephrons, made up of the glomerulus and renal tubules. The volume of urine produced is dependent upon the glomerular filtration rate (GFR) and ability of the renal tubules to reabsorb sodium and water. The factors governing the GFR are the size of the glomerular capillary bed, the permeability of the capillaries, and the hydrostatic and oncotic pressure gradients across the capillary walls. The factors governing the function of the tubular cells include: oxygen utilization, glucose availability, and integrity of the cellular enzyme systems. Variations in these factors have predictable results. For example, should the mean arterial blood pressure falls below 60 mmHg, the hydrostatic pressure gradient declines across the glomerular capillary beds and glomerular filtration almost stops (oliguria). Severe prolonged hypoxia can cause the dysfunction or death of the glomerular and tubular cells, leading to inadequate urine production. In addition, interruption of the tubular cell ability to reabsorb sodium results in high urine sodium and an increased urine production.

Procedure

Accurate and frequent measurement of urine output requires bladder catheterization. A sterile soft red rubber or polyurethane feeding tube is used in the male dog and a Foley catheter in the female. Open-ended tom cat catheters or 3.5 French soft red rubber feeding tubes are used in cats. Aseptic technique, utilizing sterile gloves, minimizes iatrogenic urinary tract infections. The catheter is lubricated and advanced slowly through the urethra into the neck of the urinary bladder and sutured to the vulva or prepuce. A closed urinary collection system utilizing a sterile collection bag and IV line is attached with the bag maintained off the floor and below the level of the catheter. The bladder is immediately emptied and the time recorded as the 0 time (start of collection). The frequency of measuring UO is determined by the rate of onset and the severity of the disease. In general, UO is measured every 2 hours. Daily examination of urine sediment is performed to monitor for infection. Urinary catheters should be flushed with sterile saline and inspected for kinks and clots in the line at least every 8 hours or if there is a sudden decline in urine collected.

An indirect method of estimating UO is to place diaper sheets (under-pads or chucks) in the patient's cage to collect the urine. The weight of a dry diaper is subtracted from the weight of a urine soaked diaper. Each1mg increase in weight equals 1ml of urine. An alternate method is to place the animal on a grate elevated off the cage floor. Urine is then collected and measured.

Fluid input and UO are recorded, including any fluids administered by enteral or parental routes. Quantities of fluid lost through vomiting and diarrhea are estimated and recorded.

Assessment

Normal UO is 1-2 ml/kg/hour. Oliguria is defined as UO <0.27 ml/kg/hr and anuria is <0.08 ml/kg/hr. However, as urine falls below 1 ml/kg/hr, oliguria is anticipated. Oliguria can be from prerenal, renal, or postrenal causes. Prerenal conditions such as hypovolemia, cardiac failure, hypotension, excessive vasoconstriction or hypercalcemia can lead to reduced GFR. Dehydration and hypotension will decrease UO (prerenal) until adequate intravascular volume has been restored. Renal changes affect the glomeruli and/or tubular cell function, with sepsis, trauma, toxins (such as aminoglycosides, amphotericin), radiocontrast agents, infections (polynephritis) as potential etiologies. Postrenal problems cause interruption of the flow of urine through the ureters, bladder or urethra and include renal calculi, blood clots, neoplasia or trauma.

True oliguria in an animal receiving IV fluid will result in a decreased PCV/TS due to hemodilution. The CVP will increase and harsh or wet lung sounds may develop. The body weight will increase rapidly as fluid accumulates. Increasing blood levels of urea nitrogen, creatinine and potassium suggests renal failure or postrenal obstruction and warrants immediate veterinary attention.

Excessive urine production is called polyuria and can be due to IV fluid overload or impaired renal tubular absorption of sodium and water. Other conditions such as medullary wash out, post obstructive diuresis and sepsis can causes polyuria and require large amounts of IV fluids.

Intervention

The technician must evaluate the UO in relation to the hematocrit, total solids, central venous pressure (CVP), blood pressure, heart rate, and body weight. Any decrease in UO in an adequately hydrated and perfused animal warrants immediate notification of the veterinarian. The IV fluid rate is reduced and the urinary collection system examined for postrenal causes of urine outflow obstruction. If the origen of the condition is determined to be renal the veterinarian will administer either mannitol or furosemide and dopamine to stimulate urine production.

A polyuric animal will require a greater quantity of intravenous fluids for maintenance of normal hydration. Medullary washout often occurs and requires a slow tapering from IV fluids onto oral fluids to avoid significant dehydration. Potassium is commonly low in these animals and required aggressive supplementation.