



## Nursing the head trauma patient (part II)

**In part II of this article Louise O'Dwyer MBA BSc (Hons) VTS (anaesthesia and emergency and critical care) DipAVN (medical and surgical) RVN, focuses on the initial diagnostic, monitoring, treatment and patient care in the head trauma patient**

Patients with head trauma can deteriorate quickly, so should be closely monitored.

### INITIAL DIAGNOSTICS

After the initial assessment, an intravenous (IV) catheter should be placed and blood drawn for an extended database (venous and arterial blood gas values, complete blood count [CBC] and biochemistry). Collection of blood from the jugular vein is contraindicated because occlusion of the vein decreases venous outflow from the brain, therefore, increasing intracranial pressure (ICP; [Fletcher, 2012]). The packed cell volume (PCV) and total solids (TS) value are used to check for haemorrhage. The blood glucose level is monitored to ensure that the patient is not hypoglycaemic and is supplemented only until the level is normal.

Hyperglycaemia (iatrogenic or related to brain trauma) is associated with severe head injuries in animals (Terry, 2010). To avoid hyperglycaemia, the blood glucose level should be maintained in the normal range. Blood gas analysis is used to check ventilation, oxygenation, perfusion, and acid-base status. The carbon dioxide (CO<sub>2</sub>) level should be monitored

because an increase in it can induce cerebral vasodilation and increase blood flow to the brain, thereby increasing ICP and possibly causing ICH (Terry, 2010). The CO<sub>2</sub> levels should be maintained in the low normal range – 40-45mmHg (venous); 35-40mmHg (arterial). Hypercapnia can increase ICP, which may necessitate mechanical ventilation of the patient. Hypercapnia should also be avoided because it can cause cerebral vasoconstriction, which can lead to cerebral ischaemia (Terry, 2010).

Serial monitoring of the following is recommended: mucous membranes, capillary refill time, heart rate, respiratory rate and effort, pulse rate and quality, lung sounds, temperature, the heart's electrical activity, oxygenation (by pulse oximetry or arterial blood gas measurement) and blood pressure. By closely monitoring these parameters, veterinary nurses can detect changes in a patient's status and notify the veterinary surgeon before they become life-threatening.

Based on extensive research on head trauma and hypotension, blood pressure should be maintained at 100-150mmHg and MAP at 80-110mmHg (Fletcher, 2007). Hypotensive patients have decreased cerebral perfusion, which may lead to brain ischaemia.

In the past, it was thought that the administration of intravenous (IV) fluids would increase ICP, causing more brain trauma. Research has found that early and rapid establishment of euvoemia and avoidance of overhydration, are essential. There has been much discussion about whether crystalloid or colloid fluid therapy is better for rehydrating head trauma patients. Either therapy can be used as long as hypovolaemia is treated and blood pressure is maintained in the normal range (Terry, 2010).

## MONITORING

The duration and frequency of episodes of hypoperfusion have been associated with poorer outcomes in people with traumatic brain injury (TBI); (Fletcher, 2010). Serial monitoring of perfusion is essential for successful management. Frequent qualitative assessment of tissue perfusion via mucous membrane colour, capillary refill time, heart rate and pulse quality, as well as quantitative assessment of blood pressure, oxygenation, and ventilation, are crucial (Terry, 2010). A minimal MAP of 80mmHg should be targeted to decrease the risk of inadequate CPP. If the Doppler technique is used for monitoring, a minimum of 100mmHg should be a target, as it most closely reflects systolic pressure in small animals (Fletcher, 2012). Continuous electrocardiography (ECG) monitoring should also be employed if possible; if episodes of sinus bradycardia are noted, blood pressure should be assessed for evidence of the Cushing's reflex, which warrants aggressive therapy directed at lowering ICP (Fletcher, 2010). When the ICP is dangerously high, it can trigger the Cushing reflex, in which the patient's blood pressure increased and heart rate decrease (bradycardia). The Cushing reflex is life threatening, so immediate identification and treatment are important. Affected patients should be monitored by continuous electrocardiography and regular BP monitoring (Terry, 2010).

## TREATMENT

There are two main hyperosmolar treatments for an increase in ICP: mannitol or hypertonic saline therapy. Mannitol is an effective therapy for patients with increased ICP, and has been shown to reduce cerebral oedema, increase cerebral perfusion pressure (CPP) and CBF, and improve neurological outcome in TBI. It has a rapid onset of action, with clinical improvement occurring within minutes of administration, and these effects can last as long as 1.5 to six hours. Mannitol boluses of 0.5-1.5g/kg have been recommended for treatment of increased ICP in dogs and cats. The diuretic effect of mannitol can be profound and can cause severe volume depletion; therefore, treatment must be followed with isotonic crystalloid solutions and/or colloids to maintain intravascular volume. Mannitol crystallises easily at room temperature, so it should be warmed before administration through a 0.22µm filter. Hypertonic saline may be used as an alternative to mannitol in patients with TBI. Hypertonic Saline has similar osmotic effects to mannitol, and can also improve hemodynamic

status via volume expansion and positive inotropic effects, as well as beneficial vasoregulatory and immunomodulatory effects (Fletcher, 2012). In euvoemic patients with evidence of intracranial hypertension, both mannitol and hypertonic saline can have beneficial effects. If an individual patient is not responding to one drug, the other may yield a beneficial response (Fletcher, 2010).

Frusemide, a diuretic, has been used to help manage cerebral oedema. However, frusemide can deplete intravascular fluid volume, resulting in systemic hypotension and a decrease in cerebral perfusion pressure, leading to cerebral ischemia. Because frusemide can adversely affect the patient outcome, it is one of the least used diuretics for treating an increase in ICP (Terry, 2010). Frusemide can be used alone or with mannitol, but it is normally given once, whereas mannitol can be given several times.

The use of corticosteroids is not recommended for treating head trauma patients. Research in humans has found that the use of corticosteroids is detrimental to recovery. In a clinical study involving more than 10,000 people, who sustained head injuries, corticosteroid therapy was associated with worse outcomes (Fletcher and Syring, 2009). The Human Brain Trauma Foundation recommends that corticosteroids not be given to patients with traumatic brain injuries. Veterinary medicine has followed this recommendation.

Sedatives and analgesia is recommended if a patient is anxious, may worsen through its injury through self-trauma, or seems painful. The sedative or analgesic which is used ideally should be reversible with flumazenil (a benzodiazepine antagonist) or naloxone (an opiate antagonist). Buprenorphine is ideal for treating pain because it does not depress the respiratory system or central nervous system as much as fentanyl. Seizures are a common complication of head trauma. If a patient has seizures, traditional anticonvulsants (eg. diazepam, midazolam) should be administered (Terry, 2012). If the seizures are not controlled with these medications, administration of propofol is recommended. Propofol, which includes anaesthesia, can be given as a one-off bolus (to see if the seizures stop) or a constant rate infusion (CRI). If propofol is needed for long periods of time, the patient should be intubated and given supplemental oxygen. The respiratory rate and effort, and heart rate, should be monitored closely while the patient is under anaesthesia. An arterial blood gas reading should be obtained to ensure adequate ventilation until the patient is awake. Monitoring the end-tidal CO<sub>2</sub> level is helpful if the clinic is not able to check the blood gas values.

## RECENT TREATMENT DEVELOPMENTS

Polyethylene glycol is an inorganic hydrophilic polymer that has a white matter sparing effect after induced traumatic central nervous system (CNS) injury when injected intravenously. It also been shown to have antioxidant effects and to decrease free radical production. In experimental studies of TBI, it reduced cellular damage and compromise of the BBB, and improved behavioral recovery in rats when

administered within two to four hours after brain injury (Fletcher, 2012). This drug shows promise as a therapeutic agent for the treatment of TBI.

Controlled hypothermia and induction of coma reduce the metabolic rate and have been reported in human head trauma patients, and recently in veterinary patients. Hypothermia can be achieved by cooling a patient to a rectal temperature of 32-35°C, which reduces cerebral metabolic rate and oxygen consumption and leads to a decreased CBF and ICP (Platt, 2012). This technique is not without its problems as it may result in the development of cardiac arrhythmias, coagulopathies, electrolyte disturbances, hypovolaemia and insulin resistance (Platt, 2012).

### PATIENT CARE

Patient care is an important part of what veterinary nurses can do for a head trauma patient, who are usually recumbent. It is very important to turn these patients at least every four hours. Patients should be maintained on a clean, dry, padded area to prevent decubital ulcers. While the patient is recumbent, it is very important to elevate the cranial end of the body to 30° to 40° to decrease the ICP and thereby help prevent ICH. Elevating the head alone may restrict the jugular veins, decreasing blood flow from the brain and thereby increasing the ICP (Terry, 2010). Because patients may not be able to blink, their eyes should be flushed with ocular wash and lubricated with artificial tears at least every four hours to prevent dry eyes and formation of ulcers. Obtunded or comatose patients may have difficulty swallowing, causing saliva and debris to accumulate in their mouths; therefore, the mouth should be wiped out every four to six hours, as needed, to remove secretions and keep it moist (Terry, 2010). An oral cleaning

spray or solution can be used to clean the mouth, and diluted glycerine can be used to keep the mouth moist. Rarely, the mouth and oral pharynx may require suctioning to remove a large amount of secretions.

If the patient cannot walk or stand or use a litter tray, the bladder should be expressed at least every three to six hours or an indwelling urinary catheter and closed system should be placed to keep the patient clean and dry and to avoid development of an atonic bladder (Terry, 2010).

Recovery time can be prolonged and nutrition is an important part of recovery. If the patient can eat it should be helped into sternal and encouraged to eat every four to six hours. If the patient is obtunded or comatose, a feeding tube, eg. oesophageal or gastrostomy tube, should be placed or the patient be given parenteral nutrition. Naso-oesophageal tubes are generally contraindicated as they may stimulate sneezing, which can cause a transient increase in ICP (Platt, 2012)

Muscle wasting can occur in non-ambulatory patients; therefore, passive range of motion exercises (PROM) may be indicated for all the limbs every six to eight hours. PROM should be performed with caution, or not at all, in patients that also have a spinal injury or a broken limb (Terry, 2010). Consult the veterinary surgeon before starting PROM.

### CONCLUSION

While head trauma patients can be difficult to manage, these patients are highly rewarding and allow the nursing team to develop their nursing skills. These successful outcomes for these patients is very much dependent on close monitoring, attention to detail and focusing on changes in the patient clinical signs, which may detect early deterioration and allow changes to be made to the treatment plan.

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