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When was the last time you had a physical examination (PE) by your human medical doctor? Because of advanced diagnostic testing and the practice of defensive medicine, human medicine has gone beyond the scope of the stethoscope and palpation. Fortunately, veterinary medicine has not lost this imperative, vital use for PE, and as a result, we are able to fine tune our physical diagnostic skills.

Most of you might think the PE is the most boring, least exciting part of this conference. Lo, take back those words! The PE is one of the most underrated, under-appreciated, but most important tools in emergency medicine and critical care. The combination of the animal’s signalment, history, and PE often reveals the diagnosis within minutes of presentation. The PE is the #1 tool you should perform, as it can be fine-tuned to yield you an efficient, easily repeatable, and inexpensive primary diagnostic test. While we all perform physical exams several times a day, this talk will review the importance of our PE, discuss the correlation with monitoring, reiterate the need for serial exams, and review exam in the emergent or critically patient.

Primary survey is defined as initial stabilization of the ABCDs: airway, breathing, circulation, and disability. Secondary survey is more complete physical evaluation of the patient.

With the improvement in veterinary critical care, veterinarians and technical staff are better able to provide state of the art care through the use of quantitative and qualitative monitoring. Quantitative monitoring includes monitoring heart rate (HR), respiratory rate (RR), body weight, temperature (T), blood pressure (BP), central venous pressure (CVP), acid-base status, PCV/TS, colloid osmotic pressure (COP), urine output (UOP), urine specific gravity, and pulse oximetry. Qualitative monitoring parameters include the assessment of mucous membranes (mm), capillary refill time (CRT), pulse quality or strength, the presence of jugular pulses, mental status, respiratory quality, and other miscellaneous tests such as the use of radiography and electrocardiography. With the use of both quantitative and qualitative monitoring parameters, patient assessment through serial PE is the key factor to adequately evaluate emergency critical care patients.

Physical examination
In the emergent patient, a thorough head to tail PE should be performed once the patient has been triaged, stabilized, and the life-threatening problems have been addressed. The first priority is to evaluate the primary survey; once these ABCDs have been assessed and the patient has been stabilized, a more thorough PE (secondary survey) should be done.

Primary survey
The following parameters should be assessed:

Airway
Evaluate the patient for the presence of a large, upper airway obstruction by listening for the presence of stertor (e.g., low frequency, snoring sounds) or stridor (e.g., high frequency, squeaking sounds) briefly. Next, evaluate the animal’s work of breathing and ability to inspire or expire. Exaggerated chest excursions that do not result in air movement indicate total airway obstruction whereas the lack of

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excursions supports respiratory arrest. One should provide supplemental oxygen in all cases of dyspnea, tachypnea, or obstruction, as it may provide some benefit and pose little risk to the patient. Remember to use the least stressful means of oxygen delivery (e.g., oxygen cage, flow-by oxygen). If the airway is uncontrolled or if the patient is severely dyspneic, peri-arrest, has total airway obstruction, or is about to respiratory fatigue, consider sedation, intubation, and positive pressure ventilation if indicated.

**Breathing**

Note the respiratory rate (RR) and effort (RE) by observing the patient from a distance. Normal respiratory effort is characterized as perceptible but not exagerrated movement and should be at an appropriate rate (e.g., 20-30 breaths per minute). The nares should be evaluated for patency and the presence of nasal discharge. Mucous membrane color should be assessed for the presence of cyanosis, which is an indication of severe hypoxemia (PaO2 < 40-50 mmHg, normal: 80-100 mmHg). However, keep in mind that just because the mucous membranes are pink, it doesn’t rule out hypoxemia.

The patient should then be ausculted for the presence of abnormal respiratory sounds crackles, wheezes, or increased bronchovesicular sounds (BVS). Auscult or percuss for the absence of breath sounds, which is consistent with gas/air, tissue, pus, fluid, or blood in the pleural space or alveoli. The presence of dull lung sounds dorsally is consistent with pneumothorax, while the presence of dull lung sounds ventrally is often consistent with severe pulmonary parenchymal disease (e.g., aspiration pneumonia), pleural effusion, or presence of abnormal tissue (e.g., diaphragmatic hernia, neoplasic). Thoracocentesis may be necessary and life-saving, depending on the underlying etiology. Increased lung sounds (e.g., BVS, crackles, or wheezes) may be suggestive for underlying respiratory disease such as pulmonary contusions, aspiration pneumonia, pulmonary edema, asthma, bronchiolar disease, or pleural space disease.

**Circulation**

Effective circulation is determined by several factors, including adequate cardiac output (CO) (e.g., stroke volume and heart rate), adequate arterial oxygen content (e.g., hemoglobin, oxygen saturation, PaO2), blood volume (e.g., Hg, PCV), cardiac pump function (e.g., preload, afterload, and contractility), and arterial blood pressure (e.g., systemic vascular resistance). One can adequately assess effective circulation with PE by evaluating the following parameters: mntion, mucous membrane color, CRT, heart rate, the presence of jugular pulses, vascular tone, pulse quality and pressure, and extremity temperature. All of these parameters allow us to adequately assess the cardiovascular system and perfusion.

Evaluation of mntion starts from afar. Observe the attitude of the patient without stimulation. Examine the patient’s response to sound, touch, and noxious stimuli. Changes in mental state can result from inadequate perfusion, hypoxia, hypoglycemia, direct brain injury, primary neurologic disease, head trauma, cerebral edema, or sedation. Patients should be treated appropriately for their underlying disease and assessed frequently to make sure signs of cerebral edema or possible herniation are not imminent. After appropriate therapy (e.g., fluid resuscitation, oxygen therapy, dextrose administration), one may observe a noticeable improvement in mentation. If not, aggressive therapeutics and re-evaluation should be considered.

Next, evaluate the mucous membranes (after ensuring it is safe to do so) by examining the color of the gums. Alternatively, examine the conjunctiva, penis or vagina in fractious animals or patients with pigmented or inflamed gums. The normal pink hue of mm is due to the presence of oxygenated hemoglobin in red blood cells in the capillary bed. A lack of cells in the capillary bed (e.g., due to anemia or local (pre-capillary) vasoconstriction) results in a pale, grey, or white mm color. Blue-tinged mm indicate the presence of deoxygenated hemoglobin and severe hypoxia; this severity is dependent on the PCV of the patient, however. Mucous membrane color may be more difficult to assess if the patient is icteric or has pigmented mm. Keep in mind that acutely deceased dogs often still have pink mm (for several minutes), so evaluate mm color with other parameters accordingly!

Evaluate the CRT by applying digital pressure to the surface to the mucous membrane; this forces the blood from the capillary bed. Avoid areas of inflammation (e.g., gingivitis), as local vasodilatation may be present. Use the buccal side of the mucous membrane to help prevent this. Carefully observe the return of color. Normally, blood will refill the capillary bed in 1-2 seconds as indicated by a return of color (oxygenated hemoglobin). A slow return to color (> 2 seconds) supports vasoconstriction of the pre-capillary arterioles while a quick (< ½ second) return to color supports vasodilatation. Too slow of a return to color (e.g., pale mm, CRT = 2.5 seconds) is consistent with poor perfusion, anemia, or hypervolemia. Too rapid of a CRT in a brick, red, injected mucous membrane is consistent with a hyperdynamic state (e.g., sepsis, exercise, etc.).

Determine the heart rate from cardiac auscultation, palpation of the apex beat, or from the pulse rate if it is synchronous with the heart rate. Increased heart rates (>160 beats/minute (bpm) in the dog, 220 bpm in the cat) should raise the index of suspicion for underlying diseases such as hypovolemic shock or pain. Keep in mind that, like respiratory rates, there are other stimuli for tachycardia in the trauma patient including hypotension, shock, sepsis, fear, cardiac disease, hypoxia, or excitement. With hypotension, HR should increase as compensation for decreased stroke volume (SV); this is an attempt to maintain cardiac output (CO), as HR X SV = CO.

In tachycardiac patients, first rule out primary heart disease; if there is no evidence of a heart murmur, arrhythmia, dyspnea, coughing, poor pulse quality, etc., then hypovolemic shock or pain are often your two primary differentials. Once cardiogenic shock has been ruled out, one can rule in appropriately with fluid therapy followed by analgesic therapy, as appropriate. For example, if you evaluate a HBC dog that is tachycardiac and has poor femoral pulse quality (e.g., HR of 180 bpm with poor synchronous pulses), a 20 ml/kg crystalloid fluid bolus (IV, over 15-20 minutes) should be considered. After 20 minutes, another serial focused PE (e.g., HR, RR, CRT, pulse quality) should be performed. If the dog is still tachycardiac but its pulse quality has improved, a second crystalloid bolus can be considered followed by conservative pain therapy. Cats, on the other hand, rarely show signs of hypovolemic shock by tachycardia, and a normal HR is no guarantee of cardiovascular stability.

Bradycardia is defined as a HR < 60 bpm in the dog and < 140 bpm in the cat. Ruleouts include myocardial failure (e.g., cardiomyopathy, late septic shock), increased vagal tone (e.g., ileus, gastrointestinal stimulation or dilation), electrolyte abnormalities affecting electrical conductance (e.g., hyperkalemia, hypomagnesema), drug effects (e.g., opioids), and primary bradyarythmias (e.g., A-V block). Septic cats often present bradycardic, so much so, that the presence of bradycardia in a cat should warrant aggressive diagnostics and therapy. Regardless of the cause, one should maintain a high index of suspicion that cardiac output is decreased when bradycardia is detected. While the contributors to stroke volume (e.g., preload, contractility, and afterload) may compensate for a low heart rate, this may not always be the case.

One may be able to assess blood volume by the presence of jugular pulses. Remember that jugular pulses can be normally seen in dogs while lying down or at the level of the thoracic inlet. If jugular pulses are seen above the thoracic inlet, ruleouts such as increased right atrial filling pressures, fluid overload, right-sided congestive heart failure (CHF), or cranial/mediastinal masses must be ruled out. Jugular
pulses may be difficult to see in obese animals, and often times, shaving/clipping over the jugular groove made aid in this diagnosis.

The presence of increased vascular permeability should be monitored for; this may be clinically detected as third spacing of fluid, peripheral edema, or pitting edema, and ruleouts such as vasculitis, coagulation disorders, systemic inflammatory response syndrome (SIRS), anuria, volume overload, or hypoalbuminemia (with a resultant decreased colloid osmotic pressure) should be considered. Appropriate treatment (such as colloid therapy, frequent body weight monitoring, measuring ins and outs, or low-dose furosemide therapy) may be necessary, depending on the underlying cause.

Patients should be assessed for adequate vasculature tone or systemic vascular resistance (SVR). Septic shock or SIRS may result in vasoconstriction at the vascular bed level resulting in maldistribution of blood flow; these clinical signs would be consistent with hypovolemic shock/perfusion failure (or less commonly, hyperdynamic stages of shock). Signs of hypovolemic shock include tachycardia, pallor, a prolonged CRT, and poor pulse quality. When signs of a hyperdynamic state are seen (e.g., presence of brick red mucus membranes, warm extremities, rapid CRT, tachycardia, bounding pulses, or an altered mentation), one must rule out septic shock. Regardless, aggressive therapy (e.g., fluid resuscitation) should be implemented immediately as long as cardiogenic shock has been ruled out (where fluid therapy would be contraindicated).

Pulse quality is the estimated difference between the systolic and diastolic pressures and the duration of the pressure waveform. It is an estimate of stroke volume, and indirectly, blood pressure. The pulses should be strong and synchronous, and no pulse deficits should be palpated. In general, the presence of a palpable dorsal metatarsal pulse is consistent with a systolic > 90 mmHg, while the palpable presence of a femoral pulse is consistent with a systolic > 60 mmHg.

In the figures listed below, one can imagine the pulse quality based on the duration, width, and strength of the pulse. Feeling a moderate difference in pulse pressures and full (waveform duration) pulses would be normal (Figure 1a). Feeling a thready pulse indicates a narrow waveform (Figure 1b). Thready pulses are often associated with peripheral vasoconstriction. The presence of thready pulses may also indicate a low diastolic pressure, and is consistent with a volume deplete state. Bounding pulses have a large pulse pressure difference and wide waveform usually associated with increased cardiac output and vasodilatation (Figure 1c). However, this may also be due to a larger difference between the systolic and diastolic pressure. This is classically seen with a chronic anemia IMHA patient. These patients can chronically adapt to their anemia and thus are able to maintain their normal systolic function, but their blood vessels may be “empty” and hence their diastolic pressure is low. This large net difference often results in bounding pulses as demonstrated in Figure 1c.

Hypotensive patients should be treated appropriately for their primary cause. Ruleouts include hypovolemia (e.g., “my vessels are empty and need IV fluids”), decreased cardiac output or cardiac contractility (e.g., “my heart needs a positive inotrope like dobutamine”), or peripheral vasodilation (e.g., “my vessels are full but need some tone like dopamine or norepinephrine”). While more rare, hypertension may be seen with Cushing’s reflex (e.g., “treat me ASAP because I have severe, increased intracranial pressure”), renal disease, hyperadrenocorticism, protein losing nephropathy, pain, fear, pheochromocytomas, or underlying cardiac disease.

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Patient temperature should be taken frequently to make sure the patient does not have hypothermia, fever, or hyperthermia. Presence of a core temperature < 98.5°F/36.9°C should warrant concern for poor perfusion, frostbite, poor hair coat, or inability to adequately maintain body temperature (e.g., hypothyroidism, neonate, etc.). Hyperthermia should be distinguished from fever; ideally, the patient’s temperature should be re-evaluated after an appropriate “cool down” period if necessary (e.g., once the animal has calmed down in the ER on a hot, sunny day). Temperatures > 103.5°F/39.7°C should warrant the evaluation for inflammation, infection, or neoplasia. Ruleouts include pneumonia, abscesses or infection, malignant hyperthermia, soft-tissue injury, heat stroke, sepsis, and neoplasia. The temperature between the extremities and the body is another indicator of perfusion. The paws or ears should normally feel warm to the touch, indicating adequate perfusion. Cold extremities may be seen as a result of peripheral vasoconstriction in an attempt to preserve blood flow to the core organs (e.g., brain, heart, lungs).

It is important to reiterate that one single parameter should not be evaluated alone when assessing hemodynamic parameters. Evaluate these indices together to allow the best clinical picture of effective circulating volume. Depending on a single parameter may misguide the evaluator to the patient’s condition. For example, in the feline species, HR is often not increased as predicted in compensation to maintain cardiac output. Relying solely on a “number” or requiring the presence of an increased HR alone could misguide the evaluator in the triage of cats. Repeating the evaluation of these eight parameters provides the caregiver with an inexpensive and readily available monitoring tool to evaluate the cardiorespiratory system.

Disability

In the search for gross neurological disability, observe the patient’s mentation along with the pupillary responses to a bright light. If pupils are equal and responsive to light (PEARLs) and an alert and responsive patient are observed, move on to ensure there is no gross spinal cord trauma. If the patient is suspected of having suffered a traumatic event, is recumbent, has an abnormal posture, and is not seen to ambulate or make voluntary movements, then assume that the patient has a spinal cord injury until proven otherwise. A complete neurological examination should be part of the secondary survey; in the meantime, avoid spine manipulation and stabilize the patient before moving them (e.g., backboard).
evaluating for dehydration based on skin turgor, mm, or the presence of sunken eyes. Remember that an animal may be severely dehydrated and still have good pulse quality; some patients have profound interstitial dehydration but are still cardiovascularly stable (e.g., chronic renal failure cat). On the other hand, some patients may be severely dehydrated and hypovolemic (e.g., parvovirus puppy).

<table>
<thead>
<tr>
<th>% dehydration</th>
<th>Clinical signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5%</td>
<td>Not detectable</td>
</tr>
<tr>
<td>5-6%</td>
<td>Slight loss of skin elasticity</td>
</tr>
<tr>
<td></td>
<td>Definite delay in return of skin to normal position</td>
</tr>
<tr>
<td></td>
<td>Slight prolongation of CRT</td>
</tr>
<tr>
<td></td>
<td>Possibly dry mm</td>
</tr>
<tr>
<td>10-12%</td>
<td>Tented skin stands in place</td>
</tr>
<tr>
<td></td>
<td>Definite prolongation in CRT</td>
</tr>
<tr>
<td></td>
<td>Sunken eyes</td>
</tr>
<tr>
<td></td>
<td>Dry mm</td>
</tr>
<tr>
<td></td>
<td>Possible signs of shock</td>
</tr>
<tr>
<td>12-15%</td>
<td>Definite signs of shock</td>
</tr>
<tr>
<td></td>
<td>Death imminent</td>
</tr>
</tbody>
</table>

Patients should be evaluated for ocular and otic disease, and a thorough oral exam should be performed if possible (to evaluate for ulceration, halitosis, string foreign material under the tongue, dental disease, etc.). Next the lymph node system should be thoroughly palpated, knowing that only the submandibular, prescapular, and popliteal should be normally palpated. Both hands should be run over the whole thorax and abdomen to palpate for masses, swelling, etc. Auscultation and assessment of cardiovascular parameters previously mentioned should be repeated and reassessed. Next, abdominal palpation should be done to carefully to rule out the presence of organomegaly, pregnancy, ascites, gastric dilatation-volvulus, neoplasia, intestinal obstruction, diarrhea, or abdominal pain. The integument (especially the ventral abdomen) should be evaluated from petecchia or ecchymoses. Musculoskeletal and neurologic exam should follow, evaluating for appropriate peripheral nerve function, joint swelling, muscle atrophy, fractures, etc. Finally, a rectal exam should always be performed to rule out problems such as melena, bloody diarrhea, sublumbar lymphadenopathy, a pyometra, or prostatic problems.

Intermittent re-evaluation of PE parameters is imperative, as it allows the clinician to assess if the patient is responding to therapeutic intervention. The PE is inexpensive, repeatable, and reliable (despite being subjective), and should be performed every 5-15 minutes during volume resuscitation to ensure that the patient is responding. Work with your nursing staff to establish appropriate notification orders (e.g., “notify me when the HR < 60 or < 160 bpm, Doppler blood pressure < 90 or > 160 mmHg, T < 98.5°F/36.9°C or > 103.5°F/39.7°C, etc.) to help improve the overall quality care of your patients. In summary, the use of a thorough PE by doctors and technicians together may yield appropriate assessment of critically ill patients. Utilize this highly underrated diagnostic tool!

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