Role Of The Vagus Nerve In Humans And Horses: Learn To Recognize It, To Include It In Your Clinical Reasoning And To Influence It To Optimize Patients' Outcomes And Help Therapy Horses Thrive.

KINETIC BALANCE
Personalized Care. Exceptional Results.

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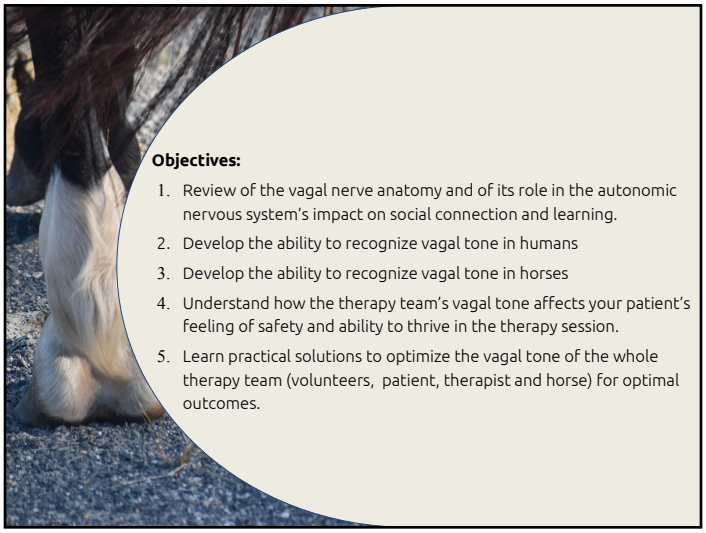
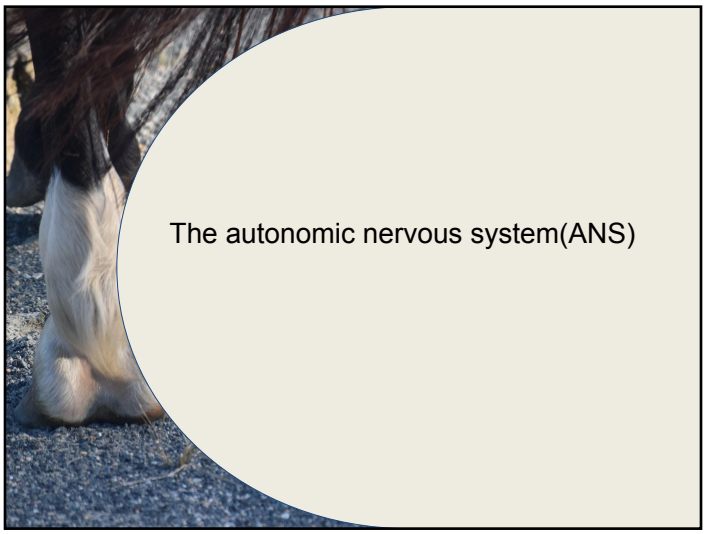
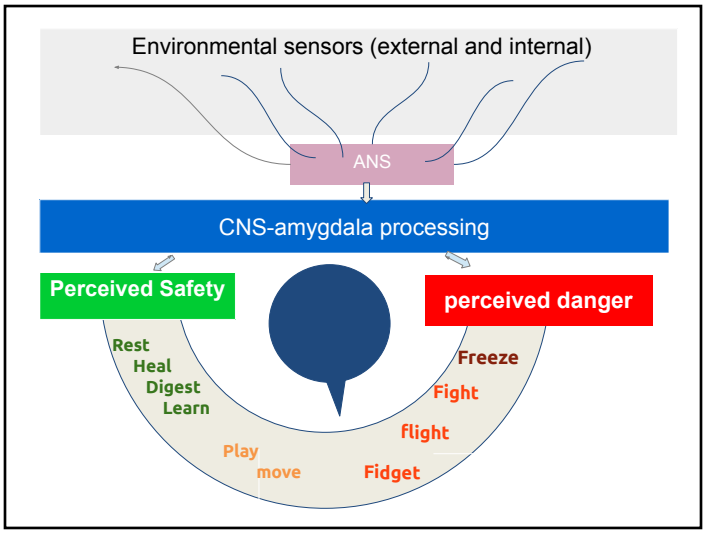


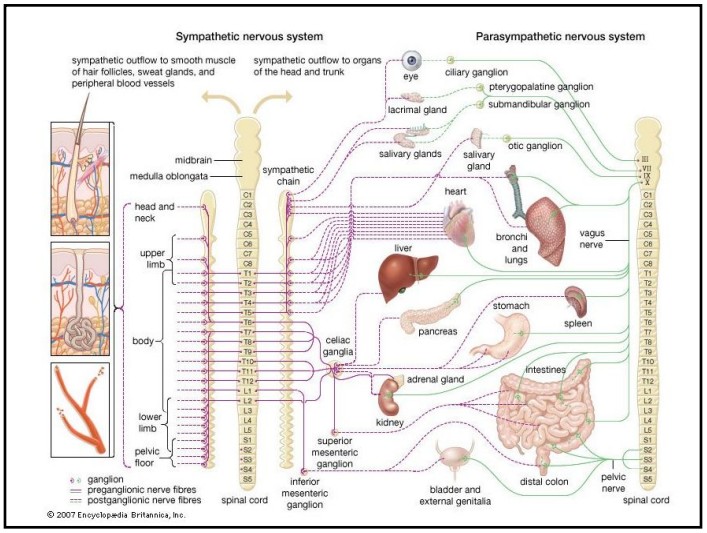
Objectives:

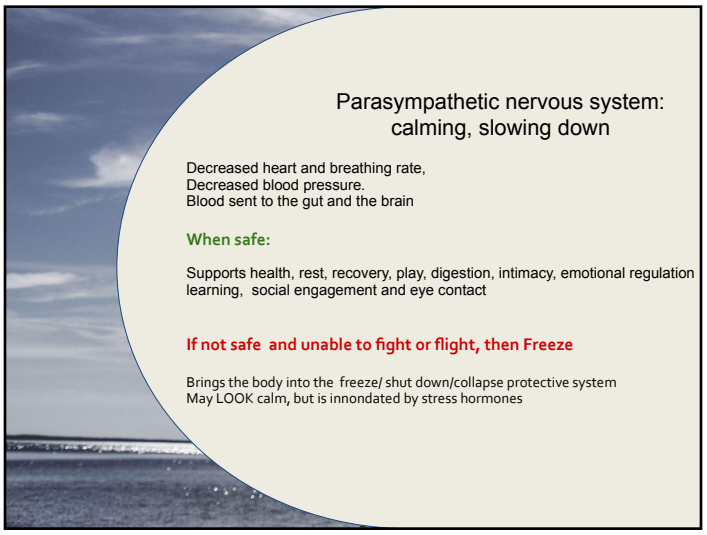
1. Review of the vagal nerve anatomy and of its role in the autonomic nervous system's impact on social connection and learning.
2. Develop the ability to recognize vagal tone in humans
3. Develop the ability to recognize vagal tone in horses
4. Understand how the therapy team's vagal tone affects your patient's feeling of safety and ability to thrive in the therapy session.
5. Learn practical solutions to optimize the vagal tone of the whole therapy team (volunteers, patient, therapist and horse) for optimal outcomes.



The autonomic nervous system(ANS)







Parasympathetic nervous system: calming, slowing down

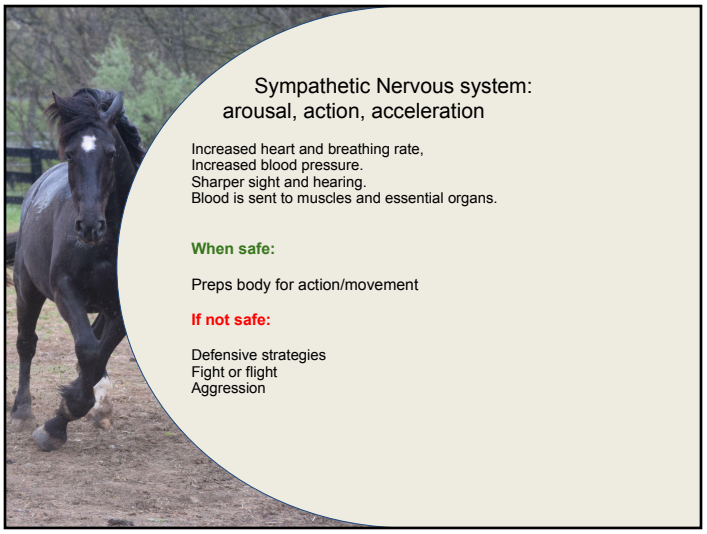
Decreased heart and breathing rate,
Decreased blood pressure.
Blood sent to the gut and the brain

When safe:

Supports health, rest, recovery, play, digestion, intimacy, emotional regulation learning, social engagement and eye contact

If not safe and unable to fight or flight, then Freeze

Brings the body into the freeze/ shut down/collapse protective system
May LOOK calm, but is innondated by stress hormones



Sympathetic Nervous system: arousal, action, acceleration

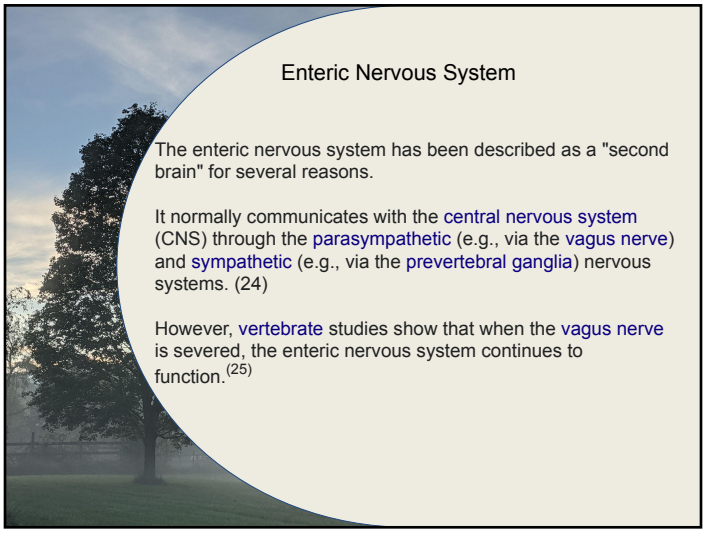
Increased heart and breathing rate,
Increased blood pressure.
Sharper sight and hearing.
Blood is sent to muscles and essential organs.

When safe:

Preps body for action/movement

If not safe:

Defensive strategies
Fight or flight
Aggression



Enteric Nervous System

The enteric nervous system has been described as a "second brain" for several reasons.

It normally communicates with the central nervous system (CNS) through the parasympathetic (e.g., via the vagus nerve) and sympathetic (e.g., via the prevertebral ganglia) nervous systems. (24)

However, vertebrate studies show that when the vagus nerve is severed, the enteric nervous system continues to function.[25]

The vagus nerve

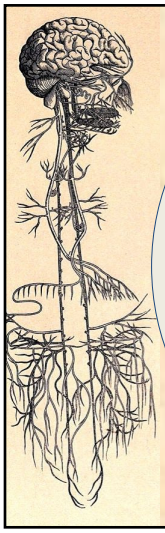
Afferent role:

(80 to 90 % of fibers)

Continuously monitor our internal environment through information sent by receptors located in every organ (including fascia)

It uses different types of receptors:

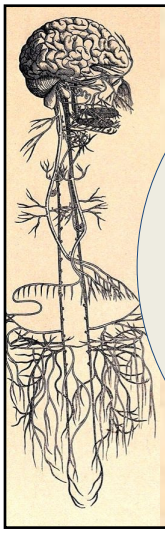
- chemoreceptor (lungs, gut)
- Mechano recepteurs (stomach diaphragm)
- Baroreceptors (blood vessels)



Efferent role:

(20 % of fibers)

- Based on analysis by the CNS of the input, it sends commands to the various organs it monitors to maintain homeostasis and to help with survival.

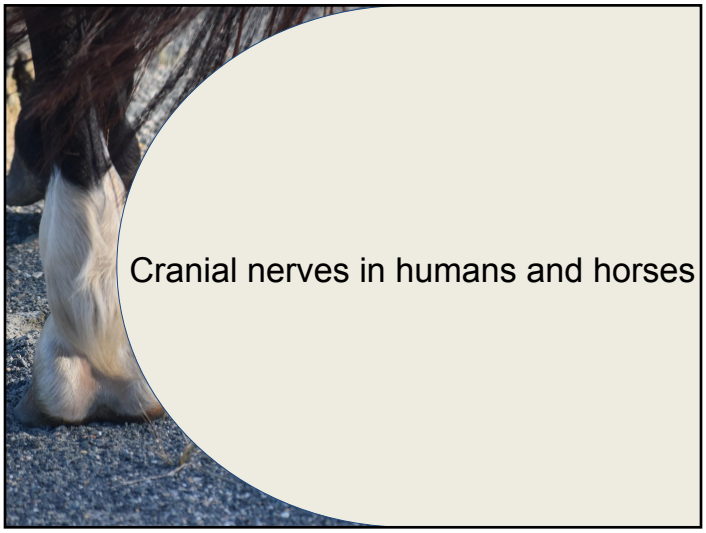


vagal tone

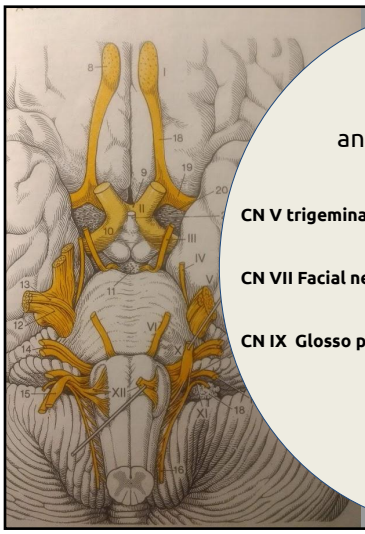
- A measure of the activity of the vagus nerve.
- It cannot be directly measured.
- It is estimated through observation of the phenomenon that result from its activation.
- The most common way to measure it is Heart Rate variability (HRV)

Common symptoms of low vagal tone

- Anxiety
- Isolation
- Decreased social involvement
- Low impulse control
- Palatal, pharyngeal and laryngeal paralysis (swallowing issues)
- inflammation



Cranial nerves in humans and horses

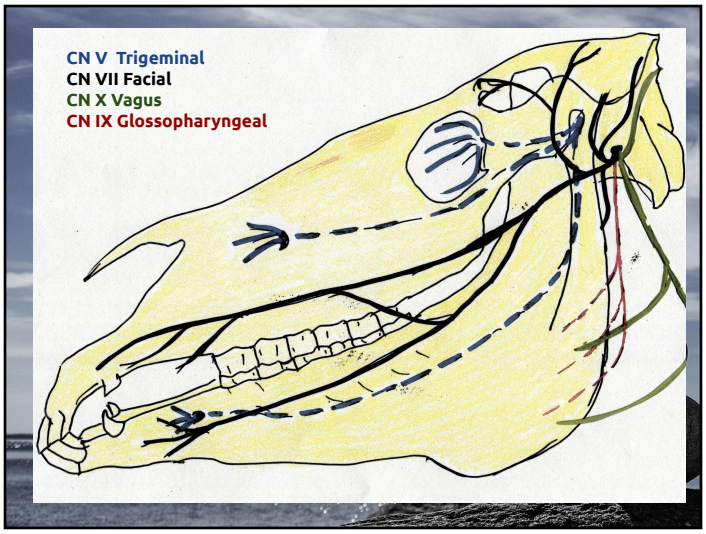


Cranial nerves and social engagement

CN V trigeminal nerve :
Motor to muscles of mastication
Sensory to the skin of the face

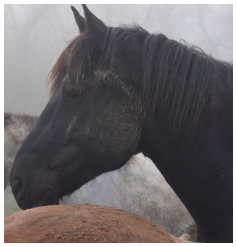
CN VII Facial nerve:
Motor to muscles of facial expression
Stapedius (Hyperacusis)

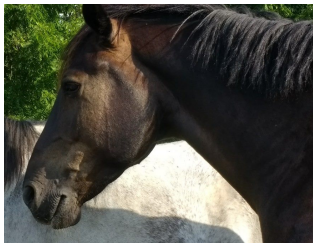
CN IX Glosso pharyngeal, CN X vagus nerve and CN XI
Motor for swallowing
Sensory to pharynx, middle ear and posterior third of the tongue

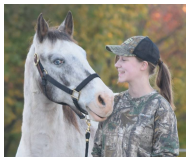


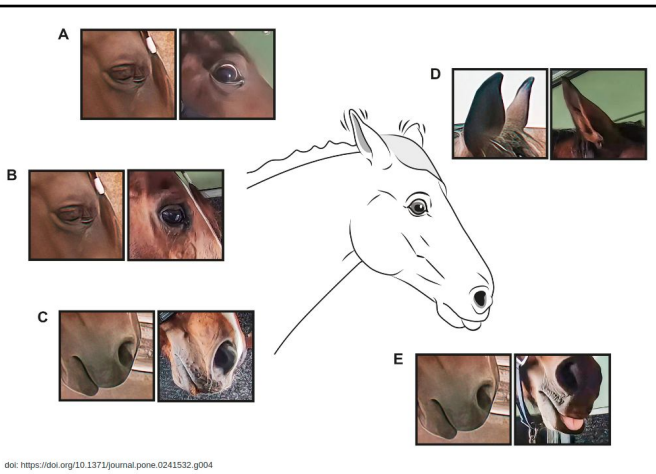
Observable biological clues in humans and horses :

- Breathing rhythm
- Heart rhythm
- Facial expression
- Skin coloration
- Eyes
- Nose









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- Muscle tension/posture/tail swish
- Fight
- Flight
- Fool around/fidget
- Freeze
- Faint

Studies about Vagal Tone and learning/healing

Human studies

Thus, vagally mediated HRV may serve to index the functional capacity of a set of brain structures that support the effective and efficient performance of cognitive executive-function tasks including working memory and inhibitory control.
Persons with better vagally mediated HRV perform better on executive function tasks in a wide range of situations (20)

HRV could be altered by behavioral programs and that the manipulation of HRV also affects cognitive functions (20)

Chronic vagus nerve stimulation (VNS) has been reported to improve learning and memory in humans (**Clark et al., 1999**) and rats (**Clark et al., 1995**). Previous studies have demonstrated that VNS during rehabilitative training improves recovery of motor function in several models of brain injury (**Hays et al., 2014a**,**b**, **2016**; **Khodaparast et al., 2014**, **2016**; **Meyers et al., 2018**). The therapeutic benefits of VNS during motor rehabilitation persist even after the cessation of stimulation, suggesting that VNS-induced plasticity and learning are long-term (**Hays et al., 2014a**; **Khodaparast et al., 2016**).

Horse studies:

The capacity to learn to learn, …, allows animals to establish conceptual learning, when a normal or positive emotional state (in this case modulated by semiochemicals) is used to control limbic system activation and, consequently, decrease stressful/fearful reactions, resulting in better learning capacities during the cognitive test.(21)

Vagal Nerve stimulation (10):

- The effects of the vagal tone on the many organs it monitors have been studied through the use of vagal nerve stimulation (VNS).
- VNS can be done through stimulation of the vagal nerve either internally (at the neck level) or externally through stimulation of the auricular branch of the vagal nerve, which is the only superficial branch of the vagal nerve.
- Internal stimulation has been used to control epileptic seizure and depression with some success.
- Several studies have demonstrated that external stimulation of the auricular branch of the vagus nerve has been successfully used to decrease inflammation and pain.

Elusive causes

Face/Neck

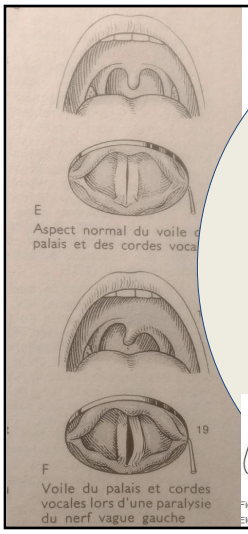
TMJ tightness (Bit, nose band)

Face pain/nerve dysfunction caused by ill fitted briddle/halter/muzzle (Dr Hillary Clayton, DVM)

Head injury leading to dysphagia (22)(23)

Tight neck and ulcers

Teeth/mouth issues



Throat

Motor to pharynx and larynx

Hard to talk when stressed

Study of the effect of "OM" singing during meditation

In Horses:

no gag reflex when scoped

HNP2 and HNP4 shown to decrease HRV (10)

Decreased in trachea diameter by 10 %

Tight neck and ulcers

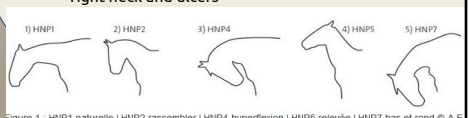
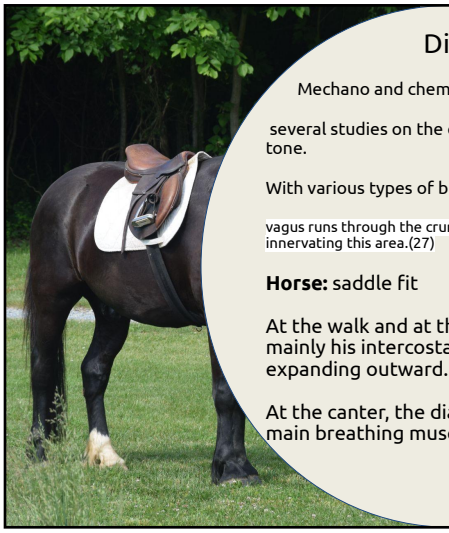


Figure 1 : HNP1 naturelle | HNP2 rassembler | HNP4 hyperflexion | HNP5 relevée | HNP7 bas et rond © A.E. Elgersma, complétant les références de M. Haab[1]



Diaphragm

Mechano and chemoreceptors, esophageal hiatus.

several studies on the effect of breathing on vagal tone.

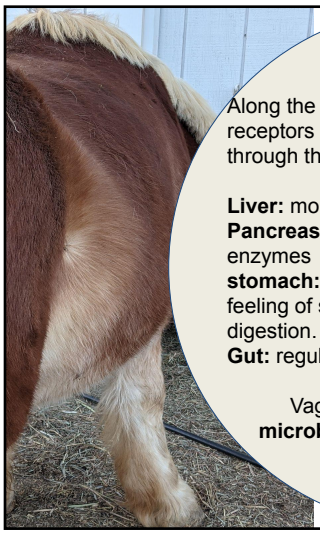
With various types of breathing.

vagus runs through the crural region of the diaphragm, innervating this area.(27)

Horse: saddle fit

At the walk and at the trot, the horse uses mainly his intercostal muscles to breathe, expanding outward.

At the canter, the diaphragm becomes the main breathing muscle

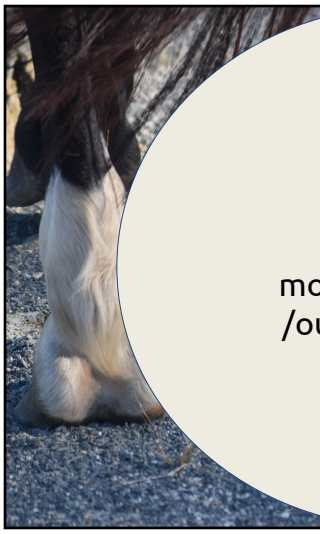


Brain-gut axis

Along the digestive system, mechano and chemo receptors send real time information to the brain through the vagus nerve

Liver: monitors and regulates insulin secretion
Pancreas: monitors and regulates digestive enzymes
stomach: reports distension to the brain to trigger feeling of satiety, regulates acid production for digestion.
Gut: regulates motility

Vagal tone is affected by the gut **microbiome** and by bacteria and parasites.



It's a 2 way street: Practical tools to monitor and modify our /our horses vagal tone?

Check your horse's and your patients "bucket"

- Warwick Schiller's 13th rabbit
- Suspense movie spook
- horse's communication options

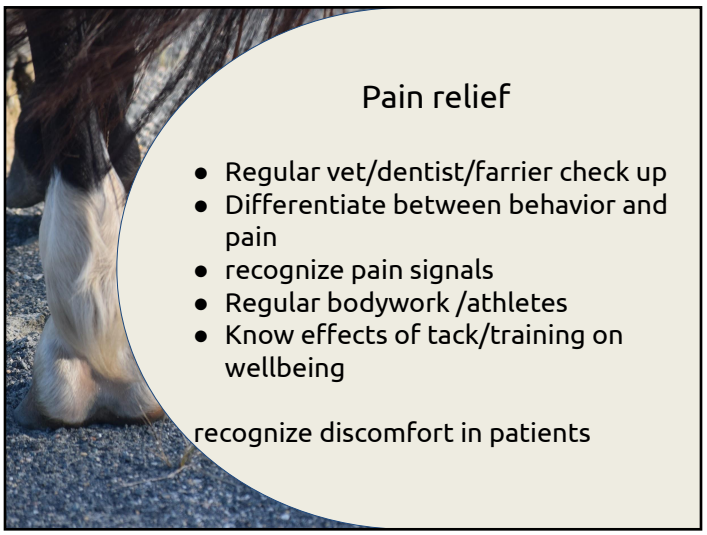
Touch

- teach volunteers to observe horse's reaction to grooming tools
- Respect horse's need for space
- bodywork: regular gentle bodywork

- teach side walkers to observe patient's reaction to their touch
- to the environment

Movement/exercise/socializing

- Allow horse free movement/play time
- observe herd dynamic
- regular exercise in hand
- regular ridden exercise with balanced riders
- Importance of a strong back and good balance



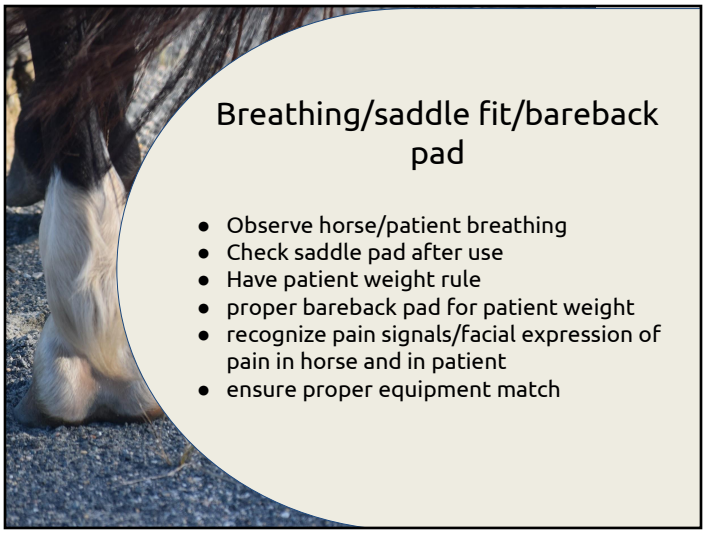
Pain relief

- Regular vet/dentist/farrier check up
- Differentiate between behavior and pain
- recognize pain signals
- Regular bodywork /athletes
- Know effects of tack/training on wellbeing

recognize discomfort in patients

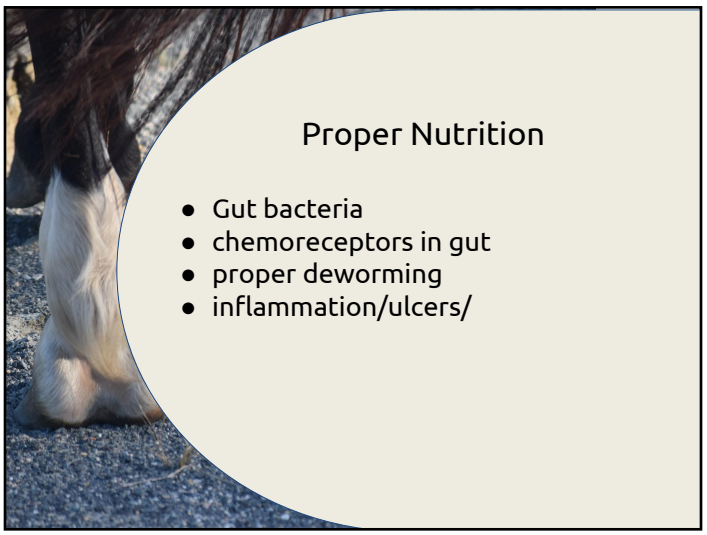
Bridle/headstall/halter

- Have staff put bridle on
- Have staff verify fit (nerve endings)
- Ask volunteer to check equipment
- recognize pain signals
- clean/check bit after use
- Be aware of elusive effects of tack



Breathing/saddle fit/bareback pad

- Observe horse/patient breathing
- Check saddle pad after use
- Have patient weight rule
- proper bareback pad for patient weight
- recognize pain signals/facial expression of pain in horse and in patient
- ensure proper equipment match

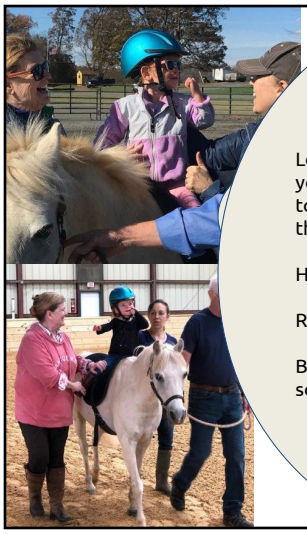


Proper Nutrition

- Gut bacteria
- chemoreceptors in gut
- proper deworming
- inflammation/ulcers/

Self awareness

- Learn to recognize your own vagal tone
- Verbalize your stress
- Learn to optimize it
- Our horses are influenced by and reflect our energy and vagal tone.



Learning to recognize those subtle signs in your horse, volunteers and patients will lead to better treatment outcomes and safer therapy sessions.

Have the team(patient included) breathe

Relax their eyes

Be aware of environmental disruptions (light, sounds, smells)

Summary:

The CNS relies heavily on the input from the vagus nerve to determine how to dial the sympathetic/parasympathetic dial.

The ability to learn/to heal and to be social is correlated with HRV/vagal tone .

It important to include awareness and ability to modulate the vagal tone of the whole team into the Tx session and in your volunteer training to improve:

- volunteer retention,
- overall safety
- Horse well being
- and optimize treatment outcomes.

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20. ManuelMengoli#PatrickPageat#CélineLafont-Lecuelle#PhilippeMonneret#AlineGiacalone#ClaudioSighieri#AlessandroCozzi#Influence of emotional balance during a learning and recall test in horses (*Equus caballus*)IRSEA – Institut de Recherche en Sémiochimie et Ethologie Appliquée, Le Rieu Neuf, 84 490 Saint Saturnin Les Apt, FranceDipartimento di Scienze Fisiologiche, Università di Pisa, viale delle Piagge 2, 56124 Pisa, Italy
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