Identifying pain in reptiles

Reptiles are unique in both their physiology and anatomy. Some of these characteristics enable them to survive long periods of time without food and water. Mammals in a similar situation could not survive. However, reptiles share the same neural pathways as mammals and experience pain. Recognising the signs of pain can be challenging.

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Siuna graduated from Glasgow University Veterinary School in 1990 and worked in Thornton-Cleveleys, Lancashire, before buying The Veterinary Health Centre, Lytham St Annes in 1995. In 2000, the practice moved to Greenways, Lytham St Annes.

Siuna enjoys all aspects of small animal medicine and surgery with a particular interest in exotic medicine and surgery and in 2012, she was awarded the Certificate in Advanced Veterinary Practice (Zoological Medicine). She has written a series of six books under the Reptiles Are Cool banner – designed to provide simple and clear care instructions for owners of these fascinating creatures.

1.0 hours*

**Suggested Personal & Professional Development (PPD)*

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REPTILES

Thermoregulation

All reptiles have an inert metabolism and are all dependent on an external source of heat to provide energy for muscular movement. There are many different subtypes of ectotherms (**Table 1**); however, the basics are the same. Heat is transferred from an external source, providing energy to the body. Reptiles are also heterothermic – their bodies adapting and changing to the temperatures in the environment.

Ectotherm	an animal that is dependent on external sources of body heat
Endotherm	an animal that is dependent on – or capable of – the internal generation of heat
Heliotherm	an animal that gains heat from the sun
Poikilotherm	an animal that cannot regulate its body temperature except by behavioural means such as basking or burrowing
Thigmotherm	an animal uses heat conduction to the body by direct contact with a warm substratum

Table 1. Subtypes of thermoregulation

There is enormous variety in the body shape of reptiles, demonstrating adaptation to maximise heat uptake. For example, bearded dragons (*Pogona vitticeps*) are able to 'pancake' where they position themselves as flat as possible, increasing the available body area to absorb heat (**Figure 1**).

Figure 1. *A bearded dragon in a 'pancake' position.*

Thermoregulation is vital for the reptile to be able to function. It is one of the simplest and most overlooked facts that many reptiles housed in vivariums are kept at suboptimal temperatures. This slows all physiological pathways. Digestion is slowed, heart rate slowed and kidney clearance rate drastically reduced. Correct temperature range is also important for nerve function – in order for the nervous system to work properly, the reptile must be in a preferred temperature zone.

Reptiles and mammals share similar neural pathways. Receptors are used to first sense temperature, transmit the information to the brain and then to use the information to adapt in the environment – for example, by moving to a warmer basking point.

Consideration of pain

Pain is a subjective term. It is defined as an unpleasant sensory or emotional experience associated with actual or potential tissue damage. Medical diagnostics regard pain as a symptom of an underlying condition. A more accurate term for reptiles would be nociception. This refers to the physiologic or neuro-anatomical components necessary to sense and transmit the noxious stimulus to the brain, where it is interpreted as a painful experience.

Nociception

Nociception has not been extensively studied in reptiles; but there is strong evidence that nociceptive neuroanatomy exits in reptiles. Chemicals that block nociception are collectively known as analgesics. These have been proven to be effective in reptiles.

Traditional pain pathways are analysed by transecting the spinal cord and then studying

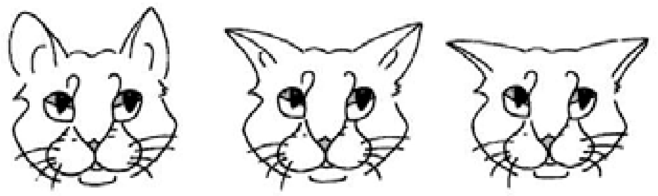

Figure 2. *Circle the drawing which best depicts the cat's normal ear position (Source: Glasgow Composite Measure Pain Scale).*

Figure 3. *Circle the drawing which appears most like the muzzle of the normal cat (Source: Glasgow Composite Measure Pain Scale).*

the effect of noxious stimulus. In lizards, there are spinal projections that originate in the brainstem region and project to the superficial layers of the dorsal horn. It has been hypothesised that these structures suggest the presence of tracts that mediate descending inhibition of nociception, similar to those found in mammals.

Reproduction and thermoregulation have endogenous opioid receptors; so, although not much is known about these receptors in nociception, there is enough evidence to suggest that, physiologically, reptiles experience nociception in a similar way to mammals.

Recognising pain in mammals

It has only been during the last 20 years that work has been done to try and qualify and quantify pain in dogs – and most recently – in cats, using the Glasgow Pain Scale. This is a means of trying to measure and assess, consistently the level of discomfort that a particular patient is experiencing. It uses a very simple – but ingenious – method of a series of pictures to resemble various facial, behavioural and postural patterns. This allows the system to be used over very different individuals, using different levels of sedation and also having had different surgical procedures.

All veterinary surgeons and nurses in practice use the same observations, without these observations being rationalised. The Glasgow Pain Scale collates this information to give consistency at recognising levels of pain, distress and nociception.

Looking at the caricatures in **Figure 2**, circle the drawing that best depicts the normal cat's ear position.

The second part of the pain scale uses muzzle position, so look at the shape of the muzzle in the caricatures in **Figure 3**. Circle the drawing that appears most like that of the normal cat.

Mammal-to-mammal

Mammals use facial, vocal, postural and olfactory communication. Urinating and excretion of anal gland contents are examples of olfactory signals. Some of these 'communications' are interpreted between animals of the same species, such as in a pack of dogs. Between other species, the interpretation becomes more complex.

Veterinary surgeons and veterinary nurses need to be able to recognise normal facial, vocal and postural behaviour, enabling them to observe changes indicating the need to provide suitable analgesia when an animal is displaying signs of nociception.

Mammal facial signs

All mammals have many facial muscles allowing complex facial movement. This is true of both humans and other mammals. Bared teeth can mean different communications dependent on the species. When humans smile this generally displays pleasure. A dog or a cat showing teeth would generally be considered a warning that the animal may bite.

The Glasgow Composite Measure Pain Scale, in cats, uses the position of ears and the flattening of the muzzle along with behaviour to grade the experience of the cat.

Reptile facial signs

The anatomical structure of the face in reptiles is very different to that of mammals. In general, there are far fewer muscles.

The maxillary areas are often covered in scales, providing a much more rigid structure to the skin (**Figures 4** & **5**). Snakes have no eyelids and, therefore, do not shut their eyes (**Figure 6**); and also have an iris that moves very slowly in diurnal species and in nocturnal species – the iris is a very thin vertical ellipse (**Figure 7**). The lips tend to be fixed rigid structures and the nostrils are small apertures in the front of the skull, with little or no soft tissue.

Reptiles do not have external pinnae. Some larger lizards have small scales on the inside of the ear; whereas the tympanic membrane can

Figure 4. *The maxillary areas have no facial muscles and are often covered in scales, providing a much more rigid structure to the skin.*

Figure 5. *The ear and rigid nostrils.*

"Thermoregulation is vital for the reptile to be able to function. It is one of the simplest and most overlooked facts that many reptiles housed in vivariums are kept at suboptimal temperatures"

Figure 6. *Snakes have no eyelids and, therefore, do not shut their eyes.*

Figure 7. *The iris is a very thin vertical ellipse.*

Figure 8. *Radiograph of a tortoise with pneumonia – the absence of a diaphragm makes respiratory infection a very serious condition in tortoises.*

Figure 9. *A sick reptile that has been brought to the surgery and needs hospitalising will need another change of environment.*

be seen on tortoises as a modified scale and are absent in snakes. Snakes do, however, have two bony ossicles and are thought to hear some sound of very low frequency.

Vocal – mammal

Most mammals have an advanced set of vocal chords capable of producing a variety of sounds, such as barking, whimpering and screaming. During mammal-to-mammal interpretation, most humans would associate screaming as an advanced level of pain, fear, or a mixture of both. This type of communication would normally be associated with postural communication, such as evasion or cowering when the animal is unable to escape the stimulus.

Vocal – reptile

Reptiles have a larynx and vocal cords that vibrate and dilate controlling airflow and producing a variety of noises. Crocodilians have an advanced vocal cord capable of advanced squeaks and grumbles. This method of communication is not expressed in the reptiles common to general small animal practice.

Most tortoises can grunt or squeak when air flow over the vocal chords is changed. Snakes hiss; as do most lizards when provoked. However, the range and different types of noise produced by reptiles is limited; and, indeed, if any noise is heard, this should be noted because there may be other underlying problems, such as respiratory infection. The absence of a diaphragm – other than the pseudo-diaphragm of tortoises – makes respiratory infection a very serious condition (**Figure 8**).

Postural – mammals

Mammals kept as pets, in general, share the same temperature, UV exposure, humidity and light-and-day cycles as their human owners when living inside the house. Most small mammals are restricted in their movement around the house, by means of an appropriate cage.

In the surgery situation, a mammal will be out of its normal living conditions and may exhibit postural behaviour, such as sitting in the far corner of its kennel, with its tail tucked between the hind legs. Cowering, lying in dorsal recumbency, jumping up at the cage front are all examples of different types of behaviour.

Postural – reptiles

The UK is not a country that has a large number of indigenous reptiles – three snakes and three lizards, with some introduced species. Temperature and UV exposure limits the diversity of reptiles. All reptiles kept in the human household need a very specific, detailed environment, recreating the parameters found in their natural habitat. This is the most vital part of keeping reptiles and one of the main reasons why so many suffer – because most amateur keepers do not understand, or provide, the correct environment.

A sick reptile that has been brought to the surgery and needs hospitalising will need another change of environment *(***Figure 9***)*. It can be difficult to provide a hospital cage to suit all the different needs with the huge diversity of species kept. This then complicates further the interpretation of postural behaviour.

A reptile that is hypothermic – or suffering from metabolic bone disease – may not be physically able to move, or display any postural communication (**Figure 10**). It is vital to be aware of this point; and, in the author's opinion, it is much safer to assume, for example, that multiple fractures of long bones in a chameleon are painful. Any lack of movement in this scenario is a consequence of physical immobilisation. There is no 'choice' for the reptile.

Visual – mammals
Mammals are stimulated by what they see. Eye contact is important in many mammals and is seen as a direct threat. Kennels and catteries are often built traditionally, with kennels on one wall to prevent eye-to-eye stimulation. Pupil size is also important and, although part of the autonomic system, it can be over-ridden. Certain situations – such as a cat with widely dilated pupils – would generally be interpreted as a frightened or threatened cat.

Visual – reptiles
Eyesight varies greatly between the different reptilian species (**Figure 11**). Tortoise eyesight is poor compared to the acute eyesight of lizards and snakes. Reptiles are tetrachromatic and can both see and interpret UV light. Ultraviolet light does not exist indoors, but UV light should be present in all reptile enclosures. It is also possible that there are other methods in reptiles for communicating with UV that are – as of yet – undetected by humans. Most reptiles have a mobile lower lid, rather than a mobile upper lid, and the pupil varies from being fixed in snakes, to being highly specialised in chameleons.

Olfactory – mammal
Dogs and cats have anal glands and use defaecation, urination and anal gland expression to communicate heightened fear.

Olfactory – reptiles
Snakes have highly specialised and pungent cloacal glands that can be expressed in a similar manner to those of mammals.

Reptile sensory anatomy
Snakes have thermal pits capable of pinpointing the location of prey (**Figure 12**). At present, there is no known communication between species using this sensory anatomy, but the snake in a veterinary practice premises will receive information from the environment potentially affecting how it will behave.

Parietal eye
Most lizards have a parietal eye positioned midway on the skull between the eyes (**Figure 13**). This consists of a lens connected to the pineal body and is active in triggering hormone production and thermoregulation. This is seen as an opalescent grey spot on top of the skull. It feeds information about the environment to the brain and helps the lizard to thermoregulate. There is a geographical link – in that species with a parietal eye can live at higher altitudes than those without. Thermoregulation also affects nerve impulse speed.

Heat receptors in reptiles
Most reptiles have difficulty detecting noxious heat levels. Snakes are by far the most susceptible; and when in cold conditions will wrap themselves around any heat source, such as an unprotected bulb, thereby causing severe burns (**Figure 14**).

How do different reptiles display pain?
It is important to take into consideration the enormous role that heat plays in the ability of the reptile to have optimal function of skeletal muscles. A cold reptile will not respond in the same way as a reptile maintained within its optimal temperature range. The amount of pathology affecting the reptile will also affect its ability to respond.

Snakes and lizards are often aggressive and will try to bite and strike – changing from periods of restlessness to periods of inactivity. Tortoises will often lie with their heads out, resting the head and neck on the floor (**Figure 15**). They are often very inactive and do not move.

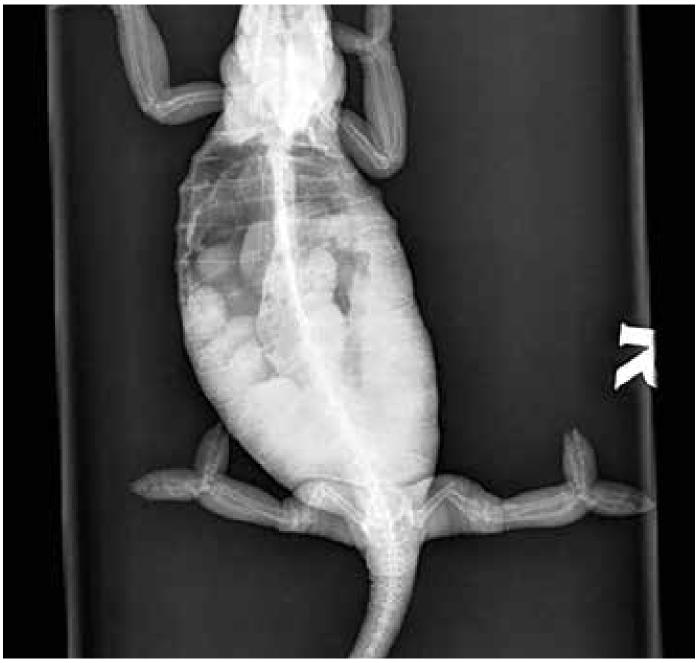

Figure 10. *Fractured bones and egg binding in a chameleon.*

Figure 11. *The independent eyes of a chameleon.*

Figure 12. *A dorsal heat pit with respiratory infection.*

Figure 13. *The parietal eye in a monitor lizard.*

Figure 14. *When in cold conditions, snakes will wrap themselves around any heat source, such as an unprotected bulb, thereby causing severe burns.*

Figure 15. *A sick tortoise with its head out.*

Importance of client observation

Listening to the client describe the changes in behaviour and other observations are always very important. Experience allows the veterinary surgeon to distinguish a good keeper from an inexperienced one. Good keepers will be able to identify slight changes that may appear subtle, yet turn out to be very important. This is also complicated by the fact that poor husbandry leads to inactivity – further reducing the chance of the keeper recognising significant illness.

Encouraging the client to weigh his or her pet regularly allows weight loss to be detected. In general, a reptile that is not eating will start to lose weight. Weight loss of more than 10 per cent of the bodyweight should trigger a visit to the veterinary practice. Encouraging the owner to keep a diary of appetite, defaecation and general observations on the temperatures inside the enclosure all provide vital information.

Analgesia in reptiles

Multimodal therapies are preferred to treat or reduce nociception. Renal function and hydration levels have to be considered before using non-steroidal drugs (meloxicam 0.2mg/kg sid).

Reptiles have more mu(μ) receptors than kappa(κ).

Traditional partial kappa and mui opioids, such as butorphanol, do not work as well as tramadol which is a mui receptor agonist and provides excellent analgesia (tramadol injection 5mg/kg sid).

These are simple examples, because many analgesics can be used safely in reptiles. For further information, refer to a compendium.

Conclusion

The physiology and anatomy of reptiles makes the determination of their pain and nociception harder than in mammals. Inability to find the optimum temperature range reduces muscular activity and neural pulses, thereby reducing the ability of the reptile to react.

Lack of facial muscles, eyelids and muzzle muscles makes interpretation of facial expression difficult; and reptiles can only be correctly observed when they are in their preferred optimal temperature range.

Disease processes also interfere with the reptile's ability to respond or to react to painful stimuli.

As a general rule, a condition considered painful in mammals should be considered painful to reptiles too. ■

"Good keepers will be able to identify slight changes that may appear subtle, yet turn out to be very important"

PPD Questions

1. What kind of pain receptors do reptiles have?
   A. none
   B. mui
   C. kappa
   D. more mui than kappa.

2. How do tortoises react to pain?
   A. bite
   B. lie with their neck out
   C. move in an agitated fashion
   D. hiss.

3. As mammals, what do we use to identify pain in other mammals?
   A. ear posture
   B. muzzle posture
   C. posturing
   D. all of the above.

4. When assessing pain in a reptile, what should we consider?
   A. the knowledge of the owner
   B. presence of underlying disease
   C. the husbandry
   D. the diet.

5. When hospitalising a reptile, what is the most important key element to correct housing?
   A. temperature
   B. UV light
   C. correct food
   D. water.

Answers
1.D 2.B 3.D 4.B 5.A