American Journal of Animal and Veterinary Sciences

Original Review Paper

Diagnosis of Pain in Small Companion Animals

[1]Giorgia della Rocca, [1]Alice Catanzaro, [1]Alessandra Di Salvo and [2]Mary Ellen Goldberg

[1]Dipartimento di Medicina Veterinaria, Università degli Studi di Perugia, Italy
[2]Executive Secretary International Veterinary Academy of Pain Management, Instructor VetMedTeam, LLC, Boynton Beach, FL, USA

Article history
Received: 19-12-2014
Revised: 25-12-2014
Accepted: 30-12-2014

Corresponding Author:
Giorgia della Rocca
Dipartimento di Medicina Veterinaria, Università degli Studi di Perugia, Italy
Tel: +390755857605
E-mail: giorgia.dellarocca@unipg.it

Abstract: It is now widely accepted that animals are able to experience pain in a similar way to humans. Acute and/or chronic pain is associated not only with many surgical procedures, but also with various medical diseases, where pain may increase morbidity and mortality. Moreover, some types of pain (e.g., neuropathic pain) can be considered as an illness in themselves. Recognizing pain and assessing its intensity are both essential for its effective management: If pain is not recognised, then it is unlikely to be treated. Two major problems account for the difficulties in pain diagnosis in veterinary patients: (1) animals are not able to verbalise and cannot refer to the state of pain they are experiencing and (2) almost all animal species tend instinctively to mask signs of pain and weakness. Therefore, pain recognition in a diseased animal may be challenging. However, practitioners can rely on different strategies, which can be put in place to reveal the presence of pain in their patients. A presumptive diagnosis, a clinical exam, the evaluation of psychomotor changes and pain expressions, the attribution of pain scores and the response to therapy are all tools which, especially when used in combination, can help the veterinary practitioner recognise a subject suffering from pain and allow a correct approach to therapy. This review summarizes the current available information regarding the methodology that could be applied in small companion animals for a correct diagnosis of pain, offering veterinarians with some "easy to use" tools to apply in their daily practice.

Keywords: Pain Recognition, Companion Animals, Diagnostic Strategies

Introduction

Pain is a complex, subjective and emotional experience, due to the activation of the nociceptive system followed by modulation and integration of the nociceptive input at the spinal and supraspinal level. Naturally occurring for adaptive purposes (protection against potentially dangerous stimuli), pain is associated with several medical and surgical conditions, where, at a certain extent, it maintains its adaptive role (facilitating healing and protecting against further damage).

Depending on the cause, pain may be acute, persistent or chronic.

Acute pain accompanies all inflammatory processes and usually disappears as soon as the damaged tissue heals. Persistent pain is due to the persistence of an inflammatory status and accompanies chronic processes such as osteoarthritis or cancer. Chronic pain is due to a damage or to a dysfunction of the nervous system (neuropathic pain) and it's often long lasting. Persistent inflammatory pain and neuropathic pain lose their adaptive purposes and may be considered as an illness in themselves (Orlandini, 2005).

When pain is particularly severe and prolonged, it may produce a series of physiological changes that, in turn, may increase the morbidity and mortality rate. Long-term pain (i.e., persistent and chronic pain) is often invalidating, leading to a deterioration of the lifestyle of the patient (Grant, 2006a).

Scientific research has confirmed that nearly all animals possess the anatomical and physiological features that enable them to perceive pain (Grant, 2006). Therefore, the treatment of pain should become an integral part of a good veterinary practice.

Recognising pain and assessing its intensity are mandatory for its correct management.

In humans, self-reporting and discussion of both the sensory and affective aspects of the pain experience represent the "gold standard" in the diagnosis of a painful condition. The ability to self-report actually

Science Publications

© 2015 Giorgia della Rocca, Alice Catanzaro, Alessandra Di Salvo and Mary Ellen Goldberg. This open access article is distributed under a Creative Commons Attribution (CC-BY) 3.0 license.

facilitates pain treatment in most human patients. For animals, as for humans who cannot self-report (e.g., neonates, paediatric patients and those with cognitive impairment), other assessment tools must be put in place (National Research Council, 2009).

In non-human species, there are two important factors limiting the recognition of the presence of pain by the clinician or the pet owner: (1) animals cannot transform their experiences into words; (2) almost all animal species tend to hide the presence of pain, as showing pain could be a sign of weakness which put the individual at a disadvantage. The evaluation of the presence and intensity of pain in animals is, therefore, far more difficult than in people, leading to a certain limitation in carrying out a proper pain therapy.

No "Gold standards" exist to assess pain in animals. However, various strategies, especially when used in combination, may help the practitioner recognise an animal in pain and in need of analgesic therapy.

These strategies should include: (i) a presumptive diagnosis; (ii) a clinical exam (searching for specific physical and biochemical findings); (iii) the evaluation of psychomotor changes and pain expressions; (iv) the attribution of pain scores; and (v) the evaluation of the response to the analgesic therapy.

Strategies for Pain Diagnosis in Companion Animals

Presumptive Diagnosis

When dealing with animal pain, a presumptive diagnosis is a good initial strategy.

As in humans, the level of pain perceived by animals is likely to be proportional to the extent of the damage following a traumatic or surgical stimulus or due to a medical pathologic condition. In other words, we may presume that the greater the insult, the greater the inflammatory response and the number of terminations or nerve trunks involved and, therefore, the greater the perceived pain (Mathews, 2000).

Thus, different levels of pain (from mild to excruciating) may be associated with many illnesses or surgical procedures occurring in the veterinary setting.

Some procedures, such as thoracotomy, joint surgery, many ocular procedures and all interventions requiring extensive tissue trauma should be considered extremely painful on principle. However, relatively non-invasive techniques (e.g., intravenous catheterisation) can also cause a certain level of pain (Mathews, 2000).

Table 1 lists some examples of anticipated pain levels associated with surgical procedures, illness, or injuries.

It should be emphasised that these levels are only presumed, as pain intensity can change due to a number of factors, such as the individual pain threshold, previous painful experiences, the concomitant presence of other sources of pain, the breed, age and gender of the animal and the surgeon's experience, among others (Mich and Hellyer, 2009). Indeed, a presumptive scoring usually leads the use of a pain therapy that is proportional to the attributed level of pain (Mathews, 2000; Mich and Hellyer, 2009).

Clinical Exam

In the WSAVA Guidelines for recognition, assessment and treatment of pain (Mathews *et al*., 2014) and in the AAHA Pain Management Guidelines for Dogs and cats (Hellyer *et al*., 2007; Epstein *et al*., 2015), pain has been considered as the "4th vital sign", together with temperature, pulse and respiration. Within a clinical evaluation, all patients should, therefore, always be assessed for the presence and intensity of pain. A thorough clinical evaluation is mandatory, in order to reveal any modification of the organ's functions related to the presence of pain.

Pain can modify physiological, neuroendocrine and metabolic parameters. It can produce changes in the heart and respiratory rate, blood pressure, capillary perfusion, ventilation, gastrointestinal motility, urinary functions, muscle contractility and nervous activity, as well as changes in glucose content, protein and lipid metabolism, water-electrolyte balance, blood concentrations of cortisol, β-endorphin, catecholamines, glucagon, ADH, insulin, etc. (Grant, 2006a; Ledowski *et al*., 2012).

Physical examination should thus focus on the cardiovascular and respiratory system, the digestive and urinary tract, the nervous system and the musculoskeletal apparatus. Laboratory investigations should also be performed in order to detect any changes in the neuroendocrine and metabolic parameters attributable to the presence of pain.

Table 2 summarises the main physiological, biochemical and neuroendocrine changes that can be present in a painful animal. However, it must bear in mind that clinical and laboratory findings in themselves do not constitute sure pain indicators, as they are influenced by many factors other than pain, such as any stressful condition (Mich and Hellyer, 2009).

Within the clinic exam, an "algologic exam" should be taken into account. Applied in the human clinical setting (Orlandini, 2005), it could be transferred, at least in part, to the veterinary medicine. The "algologic exam" should enable the veterinarian to ascertain not only the location and severity of pain, but also the type of pain (inflammatory or neuropathic). In fact, depending from its pathogenesis, pain responds to different treatment protocols (Orlandini, 2005).

Table 1. Anticipated levels of pain associated with surgical procedures, illness or injuries: Some examples (Mathews, 2000; Mich and Hellyer, 2009)

Mild pain	Minor trauma, small wounds, tracheal inflammation (intubation), esophagitis (endoscopy), myositis, burnings or clipper injuries, venous or arterial catheterization, intestinal or bladder repletion, emptying of perianal glands, small incisions or skin scrapings, minor surgery procedures such as removal of nodules and other mini-invasive surgical procedures (removal of eyelashes, entropion)
Moderate pain	Cystitis, otitis externa, endoscopy associated to biopsies, teeth cleaning with or without extraction, arterial catheterization, muscular biopsies, stabilization of long bone fractures (tibia/fibula, radius/ulna), extra-articular orthopedic procedures, posterior abdomen surgical procedures (spay, ovariectomy, hysterectomy, cystotomy), removal of small masses not adherent to the surrounding tissues
Severe pain	Narrow area of burning or ulcers, osteoarthritis, peritonitis, organomegaly, ocular disorders (ulcers, glaucoma, uveitis), tumors, torsion or distension of the gastrointestinal tract, the uterus or the testis, urethral obstruction, thrombosis or ischemia, otitis media or interna, anterior abdomen surgical procedures (diaphragmatic hernia), laparatomy, thoracotomy, medium and low spine surgical procedures (included disc surgery), long bone or pelvis stabilization, articular surgery, ovariohysterectomy, claw amputation, enucleation of the eye, mastectomy
Excruciating pain	Herniated disc, neuritis, meningitis, necrotizing pancreatitis, necrotizing cholecystitis, extensive inflammation (e.g., peritonitis), severe intestinal distension, inflammation, burning or ulcers involving a large area of the body, osteosarcoma, multiple and/or exposed fractures, total ear canal ablation, limb amputation, thoracic surgical procedures (with opening of thorax), other major extensive surgery (e.g., total mastectomy, thoracotomy, extensive joint surgery)

Table 2. Main physiological, biochemical and neuroendocrine changes that can be associated with pain in animals (Grant, 2006a)

Cardiovascular system	Increased heart rate and cardiac output
	Increased blood pressure
	Arrhythmias
	Shock (with very severe pain)
Respiratory system	Increased respiratory rate
	Reduced ventilation
	Decreased blood oxygen saturation
Gastrointestinal and urinary system	Reduction of gastrointestinal motility
	Vomiting
	Constipation or diarrhoea
	Urine retention
Musculoskeletal system	Muscle spasms, tremors
	Stiffness
	Muscle flaccidity
	Muscle atrophy
Nervous system	Twitching, tremors, convulsions, paralysis
	Hyperesthesia
	Reduced pain threshold
	Sluggish reflexes
	Insomnia
Endocrine system	Increased protein catabolism
	Lipolysis
	Hyperglycemia
	Raised cortisol, catecholamines and endorphin levels
Electrolyte balance	Na^{++} retention
	Water retention
	Metabolic acidosis

The "algologic exam" should include patient signalmen, remote and recent anamnesis, particular examination of organs and apparatuses, instrumental investigations and, eventually, diagnostic tests. Within the anamnesis, chronology, topography and characters of pain should be investigated both with questions to the pet owner and a direct approach to the animal. With regard to chronology of pain, the practitioner should ascertain length of pain (short or long duration), onset (sudden, gradual, post traumatic, etc.), evolution, maintenance and development (continuous, intermittent, episodic during the day) of pain. Topography of pain should address the involved area as well as if pain is localized or widespread, superficial or deep, primary or secondary. Within the characters of pain, its intensity and its quality over time should be investigated: Pain could be uniform or paroxysmal, not incident (i.e., not stimulated by movements), partially incident or totally

incident. Once identified the location of pain, a particular examination of the painful area should be performed, by inspection, palpation and examination of the posture, joint mobility (ROM), motility, reflexes and sensitivity. With regard to the latter, the eventual presence of allodynia (superficial or deep, thermal or mechanical) should be investigated (Orlandini, 2005).

Instrumental investigations (e.g., radiology, scintigraphy, echography, CT, NMR, neurophysiological investigations, telethermography, etc.) as well as diagnostic blocks and pharmacologic tests could be of some diagnostic aid (Orlandini, 2005).

Somatic pain (i.e., pain arising from superficial and deep somatic tissues) is easier to identify because of the closer relationship between cause and effect (easy identification of the location and extent of the lesion). Visceral pain (i.e., pain arising from visceral tissues) is a bit more difficult to identify given the vague location, but in this case a presumptive diagnosis can be of some help. Neuropathic pain is undoubtedly harder to detect, the type and location of the lesion being more difficult to identify. However, being able to distinguish somatic (acute or persistent) from neuropathic pain is of paramount importance for the application of a successful pain management protocol and veterinarians should start to think about this approach (Orlandini, 2005).

Assessment of Psychomotor Changes and Pain Expressions

The assessment of psychomotor changes and pain expressions related to pain is the best way to determine the presence and the degree of pain experienced by animals during acute, persistent or chronic pain. In fact, although it may be difficult to quantify pain, there are characteristic attitudes and postures that are recognisable in a subject that is experiencing pain. Both spontaneous and evoked (interactive) behaviours are useful for evaluation (Mathews, 2000; Taylor and Robertson, 2004; Cloutiera *et al*., 2005; Grant, 2006b; Weary *et al*., 2006; Hellyer *et al*., 2007; Wiese, 2014).

Psychomotor changes and pain expressions related to pain in companion animals can be summarised in changes of posture, activity, gait, response to manipulation, mood, facial expressions, appearance, vocalisations, appetite and elimination habits.

Assuming abnormal postures with respect to the normal behavioural repertoire of the species (i.e., hunched back, “prayer position", lowered head, unnaturally shaped body, stiff posture), reluctance to position changes or to move, reluctance to lie down or to rise, restlessness and frequent changes in body position, moving from side to side or frequently standing up and lying down, looking at the painful area, compulsively licking or biting a localised body area (sometimes leading to self-mutilations), are all signs possibly related to the presence of pain. Sometimes, small movements are accompanied by other behaviours, such as abnormal gait (e.g., lameness or wobbling), aggressiveness, or vocalisations, clearly demonstrating that the animal is experiencing pain (Wiese, 2014).

Lameness of various degrees and an attempt to protect an injured limb from additional insults are obvious signs of limb pain, regardless of its origin (bones, joints or soft tissue). Unsteady gait, excessive load on the forelegs and reluctance to move are expressions of both acute and chronic pain (Wiese, 2014).

Animals often respond with targeted movements and sometimes become aggressive in response to palpation of a painful area. During palpation, animals may vocalize and/or try to bite the handler. Animals can be defensive or can evade palpation and avoid being touched, in the attempt to protect the sore area. Passive subjects may remain motionless (frozen) or look at the painful area when manipulated (Wiese, 2014).

Pain is often accompanied by mood changes compared to the previous character of the animal, especially during severe or chronic pain. Subjects with severe pain may be anxious, restless and aggressive. In some cases, the aggressiveness is provoked by a slight manipulation of the painful area. Conversely, some animals may become mentally depressed, reluctant to interact with people or other animals and to be engaged in any activity. Others animals may become more alert, timid and fearful. Cats are more likely to hide or to escape (Wiese, 2014).

Animals in pain can change their facial expressions and appearance. Fixed glare, glazed appearance, oblivious or depressed face, furrowed brow, squinted eyes, poor hair and ungroomed coat are all signs that can be shown by an animal in pain (Wiese, 2014).

Vocalizations in animals that do not usually vocalize, or the lack of vocalization in animals than usually do, can be associated with painful situations from mild to severe, depending on the animal's behaviour patterns and environmental conditions. Dogs usually groan, whine, whimper or growl. Cats frequently groan, growl, hiss or purr (Wiese, 2014).

Inappetance and anorexia are common in animals with significant, acute or chronic pain. When long-lasting, they can lead to weight loss and dehydration (Wiese, 2014).

Animals in pain may lose their usual elimination habits and house training, starting to urinate frequently and/or failing to use the litter box (e.g., cats) or to go outdoors to urinate or defecate (e.g., dogs) (Wiese, 2014).

When assessing pain in an animal, it has to be remembered that each individual experiences and demonstrates pain in a unique way. The absence of normal behaviour is often related to the presence of pain, whereas the absence of a pain-related behaviour is not an indication of the absence of pain. Behaviour shown at home may be considerably different from behaviour in unknown and often stressful environments. Moreover, many factors can affect the behaviour of an animal in pain. Among these, we can mention objective parameters, such as the species, breed, age and sex of the animal and subjective parameters, such as the character and emotion of the subject, environmental and social interactions, as well as previous experiences.

Table 3. Pain-associated signs that can be frequently found in dogs and cats (Mathews, 2000; Wiese, 2014)

Body posture	Tail between its legs (dog) or continuous movements of the tail (cat), hunched back, head held down, "prayer position" (dog), retracted abdomen, sternal or lateral recumbency in flat extended position, unnaturally shaped body, prolonged standing or sitting, stiff posture
Activity and gait	Licking or chewing the painful area (up to self-trauma), looking at the painful area, frequent changes in body position (standing up and lying down frequently, moving from side to side), restlessness, shivering, reluctance to move or to change position (reluctance to climb up or down stairs, to run or jump), reluctance to lay down or to stand up, difficulties in maintaining station, flexed limbs kept under the body or distended limbs, lameness, abnormal or unsteady gait, excessive load on the forelegs, stumbling, tremor
Response to palpation	Attempts to avoid palpation of the painful area or aggressive reaction to it (vocalization, attempt to bite the handler), avoiding being touched, stillness
Facial expression and aspect	Half-closed eyes, dilated pupils, fixed glare, furrowed brow, lowering of the ears, oblivious or depressed face, dirty and ruffled coat (ungroomed)
Vocalization	Groaning, barking, whining, whimpering or growling (dog) Groaning, growling, hissing, meowing, spontaneous purring (without any stimulation) (cat)
Appetite	Anorexia, dysorexia
Elimination habits	Loss of usual elimination habits, frequent urination, failure to use the litter box (cats)
Mood	Anxiety, irritability, aggressiveness, depression, immobility, fear, reluctance to interact with people or other animals, tendency to hide or to escape (cat)
Miscellaneous	Inability to perform normal activities, psychomotor slowdown (reduced activity), reduced interest in environment (e.g. Interaction with owner or playing), tendency to isolate (especially cats), aggression against other animals or people, inability to sleep, panting, weight loss, reduced or excessive grooming

Table 4. Pain-associated signs that can be frequently found in ferrets (Johnston, 2005; Van Oostrom *et al*., 2011)

Body posture	Reluctance to curl-up to sleep, retract, tense and rigid abdomen, hunched back
Activity and gait	Bruxism, rhythmic movements of facial muscles, reluctance to move, stillness, lethargy, rigid gait, abnormal gait with the head lifted and stretched forward, dragging of hind (as they were paretic)
Response to palpation	Attempts to avoid palpation or aggressive reaction to it
Facial expression and aspect	Tense facial expression, staring off into space, half-closed eyes
Appetite	Anorexia
Elimination habits	Modification of elimination habits
Mood	Depression, aggressiveness
Miscellaneous	Increased breathing rate and depth

Table 5. Pain-associated signs that can be frequently found in rabbits (Kohn *et al*., 2007; Barter, 2011)

Body posture	Abnormal body position or posture to avoid contacts with the affected area, lifted and stretched forward head
Activity and gait	Jerk, wince, stumbling, stretching, abdomen pressed against the floor, arched back, contraction of oblique muscles of the flank, tremors (rapid movements of the back coat), bruxism, chewing of the painful area, stiffness, lethargy, reluctance to move
Response to palpation	Reaction to the palpation of the painful area (attempts to escape, vocalization), freezing
Facial expression and aspect	Half-closed eyes, stare, ruffled and opaque coat
Vocalization	Squeals (acute pain), wheeze and growl (chronic situations)
Appetite	Reduced water and food intake
Elimination habits	Reduced fecal pellets production (smaller)
Mood	Aggressiveness, isolation, tendency to hide
Miscellaneous	Increased sleeping time, reduced interest in environment, reduced grooming, coat stripping

Table 6. Pain-associated signs that can be frequently found in rodents (mouse, rat, guinea pig) (Kohn *et al*., 2007; Miller and Richardson, 2011)

Body posture	Arched posture, abnormal body position or posture to avoid contacts with the affected area, station with stretched forward head
Activity and gait	Reduced exploring behaviour (movements, sneezing, head lifting) immobility, excessive grooming, licking, chewing and scratching of the painful area, muscular spasms, abdominal muscles contraction, hunched back, abdomen pressed against the floor, bruxism, stumbling
Response to palpation	Vocalization in response to palpation, attempts to escape, freezing
Facial expression and aspect	Tense facial expression with exophthalmos, piloerection, ruffled and opaque coat, porphyrinic color around the eyes
Vocalization	Increased vocalization, mostly in response to palpation
Appetite	Reduction of food and water intake, polydipsia
Elimination habits	Reduced fecal pellets production
Mood	Occurrence of aggressiveness in subjects usually docile, isolation, tendency to hide
Miscellaneous	Stop grooming, increased of sleeping time and standing time, cold ears and limbs, increased respiratory rate and superficial breathing, pale mucous membrane

Table 7. Pain-associated signs that can be frequently found in reptiles and birds (Hawkins, 2006; Hawkins and Paul-Murphy, 2011; Mosley, 2011)

Saurian	Arched posture, lameness, lifted and stretched forward head, closed eyes, agitation, irritability, scratching or hitting with paws the painful area, subtraction to palpation, aggressiveness, alert, escape attempts, isolation, immobility, ataxia, lethargy, biting the painful area, aerophagia/dilated esophagus/dysphagia, anorexia, livery color changes
Chelonii	Head protrusion from the shell, lifted and stretched forward neck, lameness, ataxia, closed eyes, immobility, lethargy, anorexia, withdraw into the shell/avoidance, biting the painful area
Snakes	Body less curled-up in the painful area, retraction and contortion of the painful area, subtraction to palpation, aggressiveness in docile subjects, escape attempts, agitation, fear, immobility, lethargy, anorexia
Birds	Restlessness, reluctance on perch, frequent posture changes, rolling or clatter, lameness, ataxia, drooping wings, immobility, lethargy, isolation, abdominal tension, rigid posture, excessive or absent grooming, stripping feathers, ruffled feathers, biting, scratching, painful area protection, aggressiveness in docile subjects, aggressive reaction to avoid manipulations, flight response, vocalization, closed or half-closed eyes, tachypnoea, mouth breathing, anorexia

The severity, type and duration of pain can also modify the entity of behavioural responses (Muir and Gaynor, 2009; Mathews *et al*., 2014).

Persistent and chronic pain is typically more difficult to assess, because its manifestations, which are less obvious and more hidden, result mainly in lifestyle modifications (loss of appetite, decreased activity, fewer interactions, lack of grooming, etc.). Those assessing pain should be trained to reveal subtle changes in animal behaviours (Mathews *et al*., 2014).

Table 3-7 summarize the main behavioural attitudes most frequently associated with the presence of pain in dogs and cats, ferrets, rabbits, small rodents, reptiles and birds.

Attribution of Pain Scores (by the use of Pain Scales)

The use of pain scales or "pain scores" represents a valuable diagnostic aid, as such evaluation systems provide the veterinarian with an objective, ready-to-use tool. Attributing a score to a painful condition may direct the veterinarian to an appropriate therapeutic approach (proportional to the degree of pain). Moreover, pain scales allow the veterinarian to have a baseline for evaluating the efficacy of the treatment and the evolution of the disease.

Many pain scales, mono- or multi-parametric, have been drawn up, most of them extrapolated from human experience, for their use as a diagnostic aid in various painful conditions. Not only acute pain scales (mostly suitable for scoring pain of surgical origin) and chronic pain scales, but also questionnaires to evaluate the animal's Quality Of Life (QOL), are now available for the veterinary practitioner (Mathews, 2000; Mich and Hellyer, 2009).

Mono-parametric scales are used to measure a single parameter associated with pain, namely its intensity. They include the *"Visual Analog Scale*" (VAS), the "*Numerical Analog Scale*" (NAS), the "*Numerical Verbal Scale*" (NVS) and the "*Simple Descriptive Scale*" (SDS). These scales are universal and are widely used in the assessment of pain in small animals (Anil *et al*., 2002; Sharkey, 2013).

The first three scales score pain on the basis of a graphic representation, consisting of a horizontal line of 100 mm (which in NAS and NVS is numbered from 0 to 10 or from 0 to 100), where 0 (left side) means absence of pain and 10 or 100 (right side) the worst possible pain. The observer puts a mark on the line (or verbally attributes a score from 0 to 10 or from 0 to 100), identifying the number corresponding to the pain level likely suffered by the animal. The SDS accounts for 4 or 5 degrees of pain intensity: absent, mild, moderate, severe, excruciating. A value (from 0 to 4) is awarded to each level and the observer will choose the most appropriate value attributed to the animal's level of pain. Due to the lower scoring numbers, the SDS lack sensitivity compared with VAS, NAS and NVS (Holton *et al*., 1998). An expanded form of the SDS is the "*Canine Simple Descriptive Pain Scale*" proposed by the Colorado State University for the canine species. In this scale, 5 levels of pain (from 0 to 4) are associated with descriptive categories and with iconographic images, which may be of some help in choosing the score to be attributed to the animal's pain. The "*Mathews Pain Scoring System*" is another numeric scale set for dogs and cats where 10 levels of pain are considered, based on its intensity, each of which is accompanied by a thorough description of animal features and behaviour that can be related to that level of pain (Mathews, 2000). Compared to the SDS, the latter two systems include a wide range of behavioural descriptions which can help the practitioner in the choice of the score to be assigned to the animal. However, some features included in these forms are not necessarily indices of a pain status. For example, an intense vocalisation can be related to a pain state (from moderate to intense) or may account for fear, dysphoria during recovery from anaesthesia, or the side effect of opioid analgesia. A critical, professional judgment is, therefore, imperative.

The *"Colorado State University Canine Acute Pain Scale*" and the *"Colorado State University Feline Acute Pain Scale*" are a type of categorized SDS, for dogs and cats, respectively. Even though these tools do not add up the scores from different categories of observation,

they stimulate the observer into considering the psychological and behavioural aspects, the response to palpation and body tension.

All the aforementioned scales are simple and quick to use, which makes them attractive in the clinical setting. However, they only consider the intensity of pain experienced by the patient, without providing any qualitative description of that pain. Furthermore, as they are based on different inter-subject sensitivity, these scales vary greatly in the operator's response (Holton *et al*., 1998). However, the use of these scales before and after surgery and the comparison between the obtained readings, help not only in assessing the level of pain, but also in determining the time lapse between treatments and the treatment efficacy, in order to better manage pain.

Multi-parametric scales (Numerical Rating Scales-NRS) consist of numerical gradation (scoring) systems, which include various categories (e.g., comfort, movement, behaviour, response to manipulation, vocalizations and in some cases physiological parameters). The sum of the scores obtained by scoring the various categories gives a measure of the pain experienced by the animal. With these scales, the observer is encouraged to evaluate various aspects of the patient which would not otherwise be considered (e.g., the effects of verbal and physical interactions between the animal, the observer and the surroundings; reactions to palpation of a painful area or to palpation of the surgical site; physiological changes). Therefore, these scales evaluate not only the intensity of pain, but also the behavioural and in some case the physiological responses to it,, thus capturing the "multidimensional aspect" of pain (Mich and Hellyer, 2009).

Various multi-parametric scales are now available for scoring acute postoperative pain in dogs or cats, such as the *"University of Melbourne Pain Scale*", the "*4AVet scales*", the "*Glasgow Composite Pain Tool – Short Form (GCPT-SF)*" and the *UNESP-Botucatu Multidimensional Composite Pain Scale (MCPS)* (Firth and Haldane, 1999; Laboissière, 2006; Reid *et al*., 2007; Brondani *et al*., 2011; 2012; 2013a). The last two scales have been validated in the English language through a validation process by the mean of psychometric test (Reid *et al*., 2007; Brondani *et al*., 2013b).

As the mono-parametric tools, these scales should be used by repeating the assessment (before and after treatment), in order to improve the therapy protocol (choice of drug, route and times of administration, etc.). Multi-parametric scales appear to be very useful in comparing drug dosages or the analgesic efficacy of different drug therapies. Pain scales should be used not only by the veterinary staff for hospitalised patients, but also by the animal's owner during post surgical "at-home recovery". An assessment of the level of activity of the animal made at home by the owner can provide the veterinarian with very valuable feedback information. Educating the owner about pain and its behaviours is essential for proper feedback.

Formulated for acute pain of surgical origin, the aforementioned tools are not applicable in other acute pain conditions, as in pain originating from medical conditions, or in persistent or chronic pain states. Moreover, they are strictly species-specific, as they include indicators that are specific for a certain species. Being more complex than mono-parametric scales, NRS are more time-consuming. However, this type of scoring system seems to be more sensitive than a SDS and less vulnerable to inter-observer variability than a VAS (Holton *et al*., 1998). Moreover, the GCPT-SF and the UNESP-Botucatu MCPS in languages different from the original one have been submitted to a validation process by mean of psychometric tests (Reid *et al*., 2011; Brondani *et al*., 2013b), rendering them applicable in different Countries.

Veterinarians or veterinary nurses should also use all the aforementioned scales as a "check list" of psychomotor changes and expressions of pain to monitor within the clinical exam.

Pain scores for persistent and chronic pain, as well as questionnaires designed to define the Quality Of Life (QOL) of the animal (which can be strongly affected by the presence of long-term pain), have also been developed. They usually tend to assess the interference of pain with the normal daily activities of the animal.

Worthy of mention among the scales already available for scoring chronic pain are the "*Canine Brief Pain Inventory"* (CBPI) (Brown *et al*., 2007; 2008), the "*Helsinki Chronic Pain Index"* (HCPI) (Hielm-Björkman *et al*., 2009) and the "*Feline Musculoskeletal Pain Index*" (FMPI) (Benito *et al*., 2013). The CBPI is a two-part instrument. The first part scores pain severity and the total score is the arithmetic mean of four items scored on an 11-point (0-10) numerical scale. The second part scores pain interference with daily activities and the total score is the mean of six categories similarly scored. The HCPI is an 11-item instrument; all categories are reported on a 5-point Likert-type scale. Each item is scored 0-4 and the category scores are summed to give an overall instrument score. The FMPI is an owner questionnaire, that asks questions about the cat ability to do various activities (e.g., walk and move, jump up and down, climb stairs up and down, play and interact, grooming itself, etc.), compared to what the owner think a normal cat's ability would be.

The "*Karnofsky's Score modified for cats"* (Hartmann and Kuffer, 1998) and the "*Dr. Alice Villalobos' Quality of life Scale"* (Villalobos, 2011) are among tools available for measuring the QOL. The "Karnofsky's Score modified for cats″ has a first part (owner questionnaire) where eating, excretion, sleeping, comfort, playing and social behaviours are evaluated on

a 0-4 scale base and a second part (clinician questionnaire) where the general condition of the patient is determined on a 0-5 scale base. The "Quality of life scale" proposed by Dr. Villalobos allows to determine the success of pet hospice care using a scale from 1 (poor) to 10 (best), with regard to 7 items (i.e., hurt, hunger, hydration, hygiene, happiness, mobility and "more good days than bad"). These questionnaires are almost always destined for the animal's owners, who are more able to detect changes in their pet's lifestyle. Moreover, other questionnaires have been developed and validated in order to measure the effects of chronic pain on health-related quality of life in dogs suffering from osteoarthritis, cancer and other chronic conditions (Wiseman-Orr *et al*., 2004; Yazbek and Fantoni, 2005; Wiseman-Orr *et al*., 2006; Reid *et al*., 2013).

Intended for their application in some laboratory species, grimaces scales also have been developed. The Mouse Grimace Scale (MGS) (Langford *et al*., 2010), the Rat Grimace Scale (RGS) (Sotocinal *et al*., 2011) and the Rabbit Grimace Scale (RbGS) (Keating *et al*., 2012) are standardized facial coding systems developed by observing changes in facial expression after a noxious stimulus. For each considered species, anatomical landmarks from facial images were identified and distances between these were measured. Statistical analysis identified features discriminating pain-free from painful animals. Among several measurements, orbital tightening, nose bulge, cheek bulge, ear position and whisker change figured out to be able to differentiate animals with no pain, moderate and severe pain. These scales demonstrated high accuracy, reliability and validity. Although at present there are no studies attesting their applicability in the clinical setting, these scales could probably be applied in the clinical setting when working with non conventional species (i.e., mouse, rat and rabbit).

Recently, similar testing has involved the cat (Holden *et al*., 2014), where ear position and areas around the mouth/muzzle showed excellent discrimination properties. Further studies are required for development of such a clinical tool.

Response to Therapy

Response to appropriate analgesic therapy represents the closest marker we have for diagnosing presence and intensity of pain (Mathews, 2000). If, after an analgesic treatment, the animal even partly resumes its customary behaviour, then it is a sign that previously it was in pain.

Conclusion

Recognition and assessment of pain is essential in providing effective treatment.

Notwithstanding recognizing pain in animals is sometimes challenging, the veterinarian can now dispose of several information that help him in carrying out a correct diagnosis of pain. In fact, whether pain is inflammatory or neuropathic various tools have been developed to identify it. Tools can range from a clinical exam, diagnostic testing, pain charts and scales, evaluation of pain expressions and response to analgesic therapy.

Looking for the presence of pain should be always part of a clinic exam, whatever the reason for the exam is. Likewise the main physiologic functions are routinely monitored in a healthy animal, the veterinarian should search for pain even when it's quite sure pain is not present. Only then, he will be able to easily diagnose it when present. Veterinarians should be sensitized and trained with this regard, in order to assure to their patient a prompt and effective treatment in all clinical conditions.

Author's Contributions

Giorgia della Rocca: Conceived the review and wrote the manuscript.

Alice Catanzaro: Contributed to write the text.

Alessandra Di Salvo: Searched for references.

Mary Ellen Goldberg: Contributed to the contents and checked for English spelling.

Ethics

No ethical issues are concerned with the present article.

References

Anil, S.S., L. Anil and J. Deen, 2002. Challenges of pain assessment in domestic animals. J. Am. Vet. Med. Association, 220: 313-319. DOI: 10.2460/javma.2002.220.313

Barter, L.S., 2011. Rabbit analgesia. Vet. Clinics North America: Exotic Animal Practice, 14: 93-104. DOI: 10.1016/j.cvex.2010.09.003

Benito, J., V. DePuy, E. Hardie, H. Zamprogno and A. Thomson *et al*., 2013. Reliability and discriminatory testing of a client-based metrology instrument, Feline Musculoskeletal Pain Index (FMPI) for the evaluation of degenerative joint disease-associated pain in cats. Vet. J., 196: 368-373. DOI: 10.1016/j.tvjl.2012.12.015

Brondani, J.T, S.P.L. Luna and C.R. Padovani, 2011. Refinement and initial validation of a multidimensional composite scale for use in assessing acute postoperative pain in cats. Am. J. Vet. Res., 72: 174-183. DOI: 10.2460/ajvr.72.2.174

Brondani, J.T., S.P.L. Luna, B.W. Minto, B.P.R. Santos and S.L. Beier *et al*., 2012. Validade e responsividade de uma escala multidimensional para avaliação de dor pós-operatória em gatos. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 64: 1529-1538. DOI: 10.1590/S0102-09352012000600019

Brondani, J.T., S.P.L. Luna, B.W. Minto, B.P.R. Santos and S.L. Beier *et al*., 2013a. Confiabilidade e pontuação minima relacionada à intervenção analgésica de uma escala multidimensional para avaliação de dor pós-operatória em gatos. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 65: 153-162.
DOI: 10.1590/S0102-09352013000100024

Brondani, J.T., K.R. Mama, S.P.L. Luna, B.D. Wright and S. Niyom *et al*., 2013b. Validation of the English version of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in cats. BMC Vet. Res., 9: 143. DOI: 10.1186/1746-6148-9-143

Brown, D.C., R.C. Boston, J.C. Coyne and J.T. Farrar, 2007. Development and psychometric testing of an instrument designed to measure chronic pain in dogs with osteoarthritis. Am. J. Vet. Res., 68: 631-637. DOI: 10.2460/ajvr.68.6.631

Brown, D.C., R.C. Boston, J.C. Coyne and J.T. Farrar, 2008. Ability of the canine brief pain inventory to detect response to treatment in dogs with osteoarthritis. J. Am. Vet. Med. Assoc., 233: 1278-1283.
DOI: 10.2460/javma.233.8.1278

Cloutiera, S., R.C. Newberry, A.J. Cambridge and K.M. Tobias, 2005. Behavioural signs of postoperative pain in cats following onychectomy or tenectomy surgery. Applied Anim. Behav. Sci., 92: 325-335. DOI: 10.1016/j.applanim.2004.11.009

Epstein, M.E., I. Rodanm, G. Griffenhagen, J. Kadrlik and M.C. Petty *et al*., 2015. 2015 AAHA/AAFP pain management guidelines for dogs and cats. J. Feline Med. Surg., 17: 251-72.
DOI: 10.1177/1098612X15572062

Firth, A.M. and S.L. Haldane, 1999. Development of a scale to evaluate postoperative pain in dogs. J. Am. Vet. Med. Association, 214: 651-9.

Grant, D., 2006. Concepts of Pain Management in Animals. In: Pain Management in Small Animals, Grant, D. (Ed.), Butterworth Heinemann Elsevier, London, ISBN-10: 0750688122, pp: 1-19.

Grant, D., 2006a. Evidence that animals feel pain and its consequences. In: Pain management in small animals, Grant, D. (Ed.), Butterworth Heinemann Elsevier, London, ISBN-10: 0750688122, pp: 21-38.

Grant, D., 2006b. Assessing Pain in Animals. In: Pain Management in Small Animals, Grant, D. (Ed.), Butterworth Heinemann Elsevier, London
ISBN-10: 0750688122, pp: 39-69.

Hartmann, K. and M. Kuffer, 1998. Karnofsky's score modified for cats. Eur. J. Med. Res., 3: 95-98.

Hawkins, M.G. and J. Paul-Murphy, 2011. Avian analgesia. Vet. Clinics North America: Exotic Anim. Practice, 14: 61-80.
DOI: 10.1016/j.cvex.2010.09.011

Hawkins, M.G., 2006. The Use of analgesics in birds, reptiles and small exotic mammals. J. Exotic Pet Medicine, 15: 177-192.
DOI: 10.1053/j.jepm.2006.06.004

Hellyer, P., I. Rodan, J. Brunt, R. Downing and J.E. Hagedorn *et al*., 2007. AAHA/AAFP Pain management guidelines for dogs and cats. J. Am. Anim. Hospital Association, 43: 235-248.
DOI: 10.5326/0430235

Hielm-Björkman, A.K., H. Rita and R.M. Tulamo, 2009. Psychometric testing of the Helsinki chronic pain index by completion of a questionnaire in Finnish by owners of dogs with chronic signs of pain caused by osteoarthritis. Am. J. Vet. Res., 70: 727-734.
DOI: 10.2460/ajvr.70.6.727

Holden, E., G. Calvo, M. Collins, A. Bell and J. Reid *et al*., 2014. Evaluation of facial expression in acute pain in cats. J. Small Animal Practice, 55: 615-21.
DOI: 10.1111/jsap.12283

Holton, L.L., E.M. Scott, A.M. Nolan, J. Reid and E. Welsh, 1998. Comparison of three methods used for assessment of pain in dogs. J. Am. Vet. Med. Association, 212: 61-66. PMID: 9426779

Johnston, M.S., 2005. Clinical approaches to analgesia in ferrets and rabbits. Seminars Avian Exotic Pet Medicine, 14: 229-235.
DOI: 10.1053/j.saep.2005.09.003

Keating, S.C.J., A.A. Thomas, P.A. Flecknell and M.C. Leach, 2012. Evaluation of EMLA cream for preventing pain during tattooing of rabbits: Changes in physiological, behavioural and facial expression responses. PLoS ONE, 7: e44437.
DOI: 10.1371/journal.pone.0044437

Kohn, D.F., T.E. Martin, P.L. Foley, T.H. Morris and M.M. Swindle *et al*., 2007. Guidelines for the assessment and management of pain in rodents and rabbits. J. Am. Association Laboratory Anim. Sci., 46: 97-108.

Laboissière, B.L.A., 2006. Validation statistique des grilles 4A-Vet d'évaluation de la douleur post-opératoire chez le chien et le chat. Thesis pour le diplôme d'Etat de Docteur Vétérinaire-Ecole Nationale Vétérinaire de Nantes, Nantes, France.

Langford, D.J., A.L. Bailey, M.L. Chanda, S.E. Clarke and T.E. Drummond *et al*., 2010. Coding of facial expressions of pain in the laboratory mouse. Nature Methods, 7: 447-449. DOI: 10.1038/nmeth.1455

Ledowski, T., M. Reimer, V. Chavez, V. Kapoor and M. Wenk, 2012. Effects of acute postoperative pain on catecholamine plasma levels, hemodynamic parameters and cardiac autonomic control. Pain, 153: 759-764. DOI: 10.1016/j.pain.2012.01.030

Mathews, K.A., 2000. Pain assessment and general approach to management. Vet. Clinics North Am.: Small Animal Practice, 30: 729-755.
DOI: 10.1016/S0195-5616(08)70004-4

Mathews, K.A., P.V. Kronen, D. Lascelles, A. Nolan and S. Robertson *et al*., 2014. Guidelines for recognition, assessment and treatment of pain. J. Small Anim. Practice, 55: E10-E68. DOI: 10.1111/jsap.122

Mich, P.M. and P.W. Hellyer, 2009. Objective, Categorical Methods for Assessing Pain and Analgesia. In: Veterinary Pain Management, Gaynor, J.S. and W.W. Muir (Eds.), Mosby Elsevier, St. Louis, Missouri, ISBN-10: 978-0-323-04679-4, pp: 78-109.

Miller, A.L. and C.A. Richardson, 2011. Rodent analgesia. Vet. Clinics: Exotic Anim. Practice, 14: 81-92. DOI: 10.1016/j.cvex.2010.09.004

Mosley, C., 2011. Pain and nociception in reptiles. Vet. Clinics: Exotic Anim. Practice, 14: 45-60. DOI: 10.1016/j.cvex.2010.09.009

Muir, W.W. and J.S. Gaynor, 2009. Pain Behaviors. In: Veterinary Pain Management, Gaynor, J.S. and W.W. Muir (Eds.), Mosby Elsevier, St. Louis, Missouri, ISBN-10: 978-0-323-04679-4, pp: 62-77.

National Research Council, 2009. Recognition and Assessment of Pain. In: NRC Recognition and Alleviation of Pain in Laboratory Animals, The National Academies Press, Washington DC, USA, ISBN-10: 978-0-309-12834-6, pp: 47-69.

Orlandini, G., 2005. Elementi Di Fisiopatologia Del Dolore. In: La Semeiotica Del Dolore: I Presupposti Teorici e la Pratica Clinica, Orlandini, G. (Eds.), Delfino A., Roma, Italy, ISBN-10: 8872873185, pp: 31-149.

Reid, J., A.M. Nolan, J.M.L. Hughes, D. Lascelles and P. Pawso, 2007. Development of the short-form Glasgow Composite Measure Pain Scale (CMPS-SF) and derivation of an analgesic intervention score. Anim. Welfare, 16: 97-104.

Reid, J., M.L. Wiseman-Orr, E.M. Scott and A.M. Nolan, 2013. Development, validation and reliability of a web-based questionnaire to measure health-related quality of life in dogs. J. Small Anim. Practice, 54: 227-233. DOI: 10.1111/jsap.12059

Reid, J., R. Colpo, E.M. Scott and A.M. Nolan, 2011. Creation of an Italian version (ICMPS-SF) of the short form of the Glasgow Composite Measure Pain Scale (CMPS-SF) to measure acute pain in dogs and its validation. Birmingham, UK.

Sharkey, M., 2013. The challenges of assessing osteoarthritis and postoperative pain in dogs. AAPS J., 15: 598-607. DOI: 10.1208/s12248-013-9467-5

Sotocinal, S.G., R.E. Sorge, A. Zaloum, A.H. Tuttle and L.J. Martin *et al*., 2011. The Rat Grimace Scale: A partially automated method for quantifying pain in the laboratory rat via facial expressions. Molecular Pain, 7: 55. DOI: 10.1186/1744-8069-7-55

Taylor, P.M. and S.A. Robertson, 2004. Pain management in cats-past, present and future. Part 1. The cat is unique. J. Feline Medicine Surgery, 6: 313-320. DOI: 10.1016/j.jfms.2003.10.003

Van Oostrom, H., N.J. Schoemaker and J.J. Uilenreef, 2011. Pain management in ferrets. Vet. Clinics North America: Exotic Anim. Practice, 14: 105-116. DOI: 10.1016/j.cvex.2010.09.001

Villalobos, A.E., 2011. Quality-of-life assessment techniques for veterinarians. Vet. Clinics North America: Small Anim. Practice, 41: 519-529. DOI: 10.1016/j.cvsm.2011.03.013

Weary, D.M., L. Niel, F.C. Flower and D. Fraser, 2006. Identifying and preventing pain in animals. Applied Anim. Behaviour Sci., 100: 64-76. DOI: 10.1016/j.applanim.2006.04.013

Wiese, A.G., 2014. Assessing Pain-Pain Behaviors. In: Handbook of Veterinary Pain Management. Gaynor, J.S. and W.W. Muir (Eds.), Mosby Elsevier, St. Louis (Missouri), ISBN-10: 978-0-323-08935-7, pp: 67-97.

Wiseman-Orr, M.L., A.M. Nolan, J. Reid and E.M. Scott, 2004. Development of a questionnaire to measure the effects of chronic pain on health-related quality of life in dogs. Am. J. Vet. Res., 65: 1077-1084. DOI: 10.2460/ajvr.2004.65.1077

Wiseman-Orr, M.L., E.M. Scott, J. Reid and A.M. Nolan, 2006. Validation of a structured questionnaire as an instrument to measure chronic pain in dogs on the basis of effects on health-related quality of life. Am. J. Vet. Res., 67: 1826-1836. DOI: 10.2460/ajvr.67.11.1826

Yazbek, K.V.B. and D.T. Fantoni, 2005. Validity of a health-related quality-of-life scale for dogs with signs of pain secondary to cancer. J. Am. Vet. Med. Assoc., 226: 1354-1358. DOI: 10.2460/javma.2005.226.1354