How can we assess pain in pigs?

We need accurate ways to assess pain in pigs in order to evaluate the welfare consequences of interventions and to develop more effective pain mitigation strategies, according to a recently published review of various methods currently under investigation.*

The review notes that pigs on farms can suffer pain due to tissue damage from management procedures such as tail docking, injecting and castrating. Painful experiences also can occur because of lameness as well as injuries, disease effects and parturition. Pigs used in biomedical research undergo procedures that are regarded as painful in humans and pet pigs experience potentially painful conditions.

Accurate pain assessment could involve observing how the pigs behave or measuring changes in their physiological processes. In fact, a combination of measurements covering both behaviour and physiology may be necessary to assess fully the impact of a painful condition or event on the individual pig.

Behavioural Observations

Observed changes in behaviour offer the most promising method of assessing pain in pigs, the reviewers state. Behavioural indicators that are specific to the painful condition seem to be the most reliable in showing that pain is being experienced. By contrast, escape or avoidance behaviour has low specificity – it can also occur with handling alone. Overall, what is needed to monitor clinical pain on-farm and in biomedical research is a validation of complex behavioural patterns into simplified scores or rating scales.

In one instance, researchers have been trying quantitative sensory testing. This has meant finding the threshold at which animals responded physically to avoid a potentially painful stimulus, in circumstances such as injury or disease. The problem with such testing is that it measures only the sensitivity of the animals to detect the stimulus – therefore it indicates sensory perception, but not necessarily perceived pain.

Some vocalizing by pigs has been validated as indicating pain, but pigs may call out simply because they resent handling. A better interpretation of calls would rely on complex sound analysis. For example, sonograms of piglet calls at castration time have found a broader range of frequencies within the sound, a change of pitch and a shift in volume when compared with the rest of the handling period.

Other investigations of vocalizing during castration have used spectrograms to identify three different call types: grunts, squeals, and screams. The number of screams, but not of the other two call types, was significantly more frequent for piglets castrated without anaesthesia, suggesting that an increase in the rate of screams is a good indicator of pain.

Physiological Indicators

Physiological indicators tend to be less specific in this respect. Blood-plasma concentration of a neurotransmitter called Substance P (SP) could be a useful measurement because this is released directly from nerve fibres at the site of tissue damage, although more study is needed to determine its value as a biomarker of pain in pigs. Another candidate is the expression of the c-fos gene and its protein product Fos in neurons of the spinal cord, already used in other species as a measure of neural activity in response to painful stimuli.

Hormonal responses to stress include secretion of ACTH from the anterior pituitary gland which acts on the adrenal gland to produce cortisol. Cortisol/ACTH can be quantified reliably and has been validated in relation to painful conditions. However, the specificity is low since these hormone levels can increase due to non-pain factors and also may have a ceiling point beyond which they do not rise further.

Among possible signs of pain associated with the autonomic nervous system are blood pressure and pulse rate. The temperature of the animal's ears, skin, rectum and eyes have also been measured. Again, however, the drawback to using such autonomic responses may be their low specificity.

Beta-endorphin is being considered for measurement because it is an opioid peptide (protein) synthesized primarily by the pituitary gland and involved in regulating the body's response to stress, including pain. But while endogenous opioids can be reliably quantified, their validity and specificity appear to be low as their levels can alter even without pain and show little change with analgesia of the pig.

Low validity and specificity are similarly concerns regarding measurements of immune function. Inflammation from injury or infection is not necessarily proportional to any pain experienced. Acute-phase proteins and cytokines from injured or infected cells could be indicative but seem unreliable: studies have found cytokine increases both in castrated pigs and in others that were simply handled.

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Clearly, therefore, most measurements reported in experimental studies investigating pain in pigs await validation and many need to be simplified for field application. Methodologies established in other species deserve examination in pigs, says the review. A large body of novel methodological approaches from clinical research focused predominantly on laboratory rodents could be adapted for use in pig assessments. There now exists a Facial Grimace Scale for piglets, after grimace scaling was created first for laboratory mice and later for various other species such as rats, rabbits, horses and sheep.

Another approach is to look at tests that involve motivational trade-offs in relation to pain. Examples have included using lame sows trained to retrieve food rewards and investigating how long castrated piglets took to navigate a handling chute. The review suggests looking further at such an approach in pigs, adapting examples of behavioural tests used in rodent models of pain.

Pig farm owners and managers may wonder how much of this is relevant to the practical business of producing pork.

The reviewers answer by noting how most respondents to a recent survey of pig farmers and veterinarians disagreed with the statement that "pigs are not as sensitive to pain as humans" --- in other words, both the farmers and their veterinary advisers believed that something causing pain in humans was likely to be equally painful to a pig. Therefore, the review declares, "research is warranted into the causes and consequences of pain in livestock production, to evaluate the trade-off between the cost of painful procedures and the longer term welfare benefit or improvement in product quality".

TABLE 1 | Summary of pain indicators used in experimental studies involving the assessment of pain in pigs and how they have been assessed in relation to pain using the following methods: (1) individuals studied before, during, and after a painful event; (2) comparing individuals thought to be in pain to controls or shams; (3) observing individuals with and without analgesia or anesthesia; and (4) observing whether indicators increase with the severity of pain, counts of studies using these measures, followed by some advantages and disadvantages in relation to validity, specificity, and reliability.

Pain indicator category		Testing method				Counts of studies	Advantages	Disadvantages
		1	2	3	4			
Behavior	Spontaneous "pain-related"	Yes	Yes	Yes	Yes	23	Validated by several studies, specific to pain, and reliable with observer training	Validation needed for specific painful conditions
	Escape/avoidance	Yes	Yes	Yes	No	6	Validated by some studies and reliable with observer training	Low specificity – can occur with handling alone
	Posture or posture change	Yes	Yes	Yes	No	20	Validated by some studies and reliable with observer training	Low specificity – can be altered with factors other than pain
	Variation to normal	Yes	Yes	Yes	No	26	Validated by some studies and reliable with observer training	Low specificity – can be altered with factors other than pain
	Behavior scores	No	Yes	Yes	Yes	17	Validated by some studies, can be specific to pain, and reliable with observer training	Validation needed for specific painful conditions and only an instantaneous sampling point
	Quantitative sensory testing	Yes	Yes	Yes	Yes	18	Reliable with training and specific to the sensory perception of noxious stimuli	Low validity to pain – indicates sensory perception but not necessarily perceived pain
	Vocalization	Yes	Yes	Yes	Yes	18	Some vocal characteristics validated as pain indicators, reliable with analysis of vocal characteristics	Some vocal characteristics can occur in other situations, requires complex analysis

Ison S.H. et al. (2016), A Review of Pain Assessment in Pigs. Front. Vet. Sci. 3:108