**Application:** Infrared thermography can be used as a non-invasive tool to detect surface temperature changes of piglets

**Introduction:** Procedures such as Teeth clipping (TEE), tail docking (TAI), and ear tagging (TAG) are conducted routinely in commercial pig production units during the first days of a piglet’s life. However, as these procedures are conducted without anesthetics, there is controversy surrounding these procedures due to the pain/stress they may cause. The assessment of vasomotor activity using non-invasive infrared thermography (IRT) is increasingly being promoted as a tool to detect acute stress (Ghezzi et al. 2024). Within this study, IRT was used to assess the surface temperature of new-born piglets before and after the aforementioned routine procedures and various thermal windows were compared.

**Materials and methods:** A total of 116 crossbred piglets (Duroc Danish x Landrace x Large white) from multiparous sows were randomly assigned to one of ten cross-over experimental groups of procedure combinations; 1: TEE, 2:(TEE+) TAI, 3:(TEE+TAI+) TAG, 4:TAI, 5:(TAI+) TEE, 6: (TAI+TEE+) TAG, 7:TAG, 8: (TAG+) TEE, 9: (TAG+TEE+) TAI, 10: All At Once (AAO), further descriptions of the groups an procedures are presented in Table 1.. Between 09:00 and 16:00 h, thermal images of four thermal windows (ocular (OCU), nose (NOSE), ear (EAR) and upper lip (LIP)) were collected using a high-resolution handheld infrared camera FLIR® model T650sc (FLIR Systems, Wilsonville, OR, USA) at an uniform distance of 1 m on the left side of the face. Images were taken before and after each individual procedure. GraphPad Prism 10.0.2 (San Diego, CA, USA) statistical software was used to analyze the obtained data. A linear mixed model for repeated measures was performed and Multiple comparisons were calculated using a post-hoc Tukey test.

**Results:** Results from the analysis comparing surface temperature before and after each procedure combination group and comparisons between procedure combination groups for each of the thermal windows are presented in Table 2.There was no significant difference in the ‘before’ surface temperature between any of the procedure combinations for any of the thermal windows assessed (OCU, EAR, NOSE, or LIP; P=0.99, respectively). This was also the case when the ‘after’ procedure surface temperatures of each of the four thermal windows were compared between procedure combination groups (OCU, EAR, NOSE, or LIP; P=0.99, respectively). When comparing temporal changes in surface temperatures within each procedure combination group, significant differences were observed in OCU and NOSE temperatures (Table 1). Specifically surface temperature of the OCU ‘before’ was significantly greater than ‘after’ in 2: (TEE+) TAI (0.57◦C reduction, P<0.001), 6: (TAI+TEE+) TAG (0.65 ◦C reduction, P<0.001), 7:TAG (0.58◦C reduction, P<0.001), 9: (TAG+TEE+) TAI (0.50◦C reduction, P<0.001) and 10:AAO (0.75◦C, P<0.001). For NOSE, significant reductions in the surface temperature before and after 2:(TEE+) TAI (0.77◦C reduction, P<0.001), 7:TAG (1.07◦C reduction, P<0.05) and 10:AAO (2.08◦C reduction, P<0.001) were observed.

Table 1. Description of each of the experimental procedure groups.

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| --- | --- | --- |
| **Experimental group number** | **Procedure(s)** | **Description** |
| **1** | **TEE** | Teeth clipping first procedure performed on the piglet |
| **2** | **(TEE+) TAI** | After a period of recovery\* following teeth clipping, piglet tail docked |
| **3** | **(TEE+TAI+) TAG** | After a period of recovery following teeth clipping & tail docking, piglet ear tagged |
| **4** | **TAI** | Tail docking first procedure performed on the piglet |
| **5** | **(TAI+) TEE** | After a period of recovery following tail docking, piglet teeth clipped |
| **6** | **(TAI+TEE+) TAG** | After a period of recovery following tail docking & teeth clipping, piglet ear tagged |
| **7** | **TAG** | Ear tagging first procedure performed on the piglet |
| **8** | **(TAG+) TEE** | After a period of recovery following ear tagging, piglet teeth clipped |
| **9** | **(TAG+TEE+) TAI** | After a period of recovery following ear tagging & teeth clipping, piglet tail docked |
| **10** | **AAO** |  TEE, TAI, and TAG were performed consecutively without any recovery time allowed in between procedures. |

\*A recovery period (12±2.5 min) was allowed between procedures

Table 2. Results of comparisons between the mean (±SD) surface temperatures of each thermal window before and after each procedure combination group

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Thermal window | Treatment | Before | After | P-value |
| OCU | TEE | 34.45 ± 0.55 | 34.27 ± 0.45 | 0.99 |
| (TEE+) TAI | 35.48 ± 0.18 | 34.91 ± 0.16 | 0.0005 |
| (TEE+TAI+) TAG | 34.15 ± 0.59 | 34.44 ± 0.16 | 0.99 |
| TAI | 34.98 ± 0.16 | 34.74 ± 0.15 | 0.99 |
| (TAI+) TEE | 34.63 ± 0.41 | 34.91 ± 0.13 | 0.99 |
| (TAI+TEE+) TAG | 35.34 ± 0.14 | 34.69 ± 0.12 | 0.0003 |
| TAG | 35.02 ± 0.18 | 34.44 ± 0.14 | 0.01 |
| (TAG+) TEE | 35.39 ± 0.19 | 34.96 ± 0.11 | 0.99 |
| (TAG+TEE+) TAI | 35.07 ± 0.19 | 34.77 ± 0.10 | 0.002 |
| AAO | 34.93 ± 0.12 | 34.18 ± 0.11 | 0.0001 |
|  | **P-value** | 0.99 | 0.99 |  |
| EAR | TEE | 35.93 ± 0.62 | 35.26 ± 0.75 | 0.99 |
| (TEE+) TAI | 36.61 ± 0.23 | 36.47 ± 0.25 | 0.99 |
| (TEE+TAI+) TAG | 35.54 ± 0.15 | 35.57 ± 0.16 | 0.99 |
| TAI | 36.28 ± 0.21 | 35.97 ± 0.22 | 0.99 |
| (TAI+) TEE | 35.77 ± 0.19 | 36.16 ± 0.24 | 0.99 |
| (TAI+TEE+) TAG | 35.68 ± 0.25 | 35.75 ± 0.16 | 0.99 |
| TAG | 35.71 ± 0.26 | 35.78 ± 0.18 | 0.99 |
| (TAG+) TEE | 36.52 ± 0.17 | 36.41 ± 0.15 | 0.99 |
| (TAG+TEE+) TAI | 35.50 ± 0.25 | 36.32 ± 0.18 | 0.99 |
| AAO | 36.38 ± 0.15 | 35.93 ± 0.16 | 0.99 |
|  | **P-value** | 0.99 | 0.99 |  |
| NOSE | TEE | 28.88 ± 0.58 | 28.61 ± 0.53 | 0.99 |
| (TEE+) TAI | 31.11 ± 0.73 | 30.34 ± 0.66 | 0.0001 |
| (TEE+TAI+) TAG | 29.62 ± 0.61 | 28.15 ± 0.68 | 0.99 |
| TAI | 28.85 ± 0.55 | 27.71 ± 0.52 | 0.99 |
| (TAI+) TEE | 28.56 ± 0.59 | 27.40 ± 0.45 | 0.99 |
| (TAI+TEE+) TAG | 30.19 ± 0.59 | 29.45 ± 0.53 | 0.99 |
| TAG | 28.49 ± 0.75 | 27.42 ± 0.62 | 0.006 |
| (TAG+) TEE | 29.59 ± 0.79 | 29.45 ± 0.73 | 0.99 |
| (TAG+TEE+) TAI | 29.15 ± 0.80 | 28.42 ± 0.64 | 0.99 |
| AAO | 29.91 ± 0.47 | 27.83 ± 0.32 | 0.0005 |
|  | **P-value** | 0.99 | 0.99 |  |
| LIP | TEE | 32.83 ± 0.31 | 31.43 ± 0.66 | 0.99 |
| (TEE+) TAI | 31.88 ± 1.35 | 33.11 ± 0.46 | 0.99 |
| (TEE+TAI+) TAG | 32.55 ± 0.53 | 32.11 ± 0.51 | 0.99 |
| TAI | 32.52 ± 0.34 | 32.39 ± 0.37 | 0.99 |
| (TAI+) TEE | 32.18 ± 0.33 | 32.23 ± 0.33 | 0.99 |
| (TAI+TEE+) TAG | 32.80 ± 0.41 | 32.61 ± 0.36 | 0.99 |
| TAG | 31.57 ± 0.61 | 31.57 ± 0.38 | 0.99 |
| (TAG+) TEE | 33.33 ± 0.45 | 32.82 ± 0.38 | 0.99 |
| (TAG+TEE+) TAI | 31.92 ± 0.48 | 31.85 ± 0.36 | 0.99 |
| AAO | 32.91 ± 0.24 | 31.64 ± 0.28 | 0.99 |
|  | **P-value** | 0.99 | 0.99 |  |

**Discussion:** From the thermal windows assessed, OCU and NOSE showed potential in their use to assess surface temperature changes in newborn piglets. According to the rapid drop in temperature observed in OCU and NOSE windows it could be suggested that TAG and TAI appear to trigger a more marked thermal change in piglets than TEE. This temperature change may be a result of a higher sympathetic nervous system response to a stressor, as cutaneous capillary blood flow shifts due to transient peripheral vasoconstriction. However, this would merit further investigation. This temperature change observed is further magnified when procedures are performed all at once (AAO) which suggests a period of rest between procedures to allow piglets to recover or adjust may be beneficial. However, to be sure if these changes in temperature are a result of an acute stress response, further comparison with simultaneous, direct physiological stress measures (e.g. cortisol) is required.

**Conclusions:** Infrared thermography shows potential as a tool to assess the reaction of newborn piglets to harmful stimuli, potentially linked to a stress response, via detection of surface temperature change. Allowing a period of rest between procedures may be beneficial in terms of reducing distress experienced by newborn piglets, however, confirmation with simultaneous, direct measures of stress is required to validate or confirm this.

**References:** Ghezzi, M.D., Ceriani, M.C., Domínguez-Oliva, A., Lendez, P.A., Olmos-Hernández, A., Casas-Alvarado, A. and Hernández-Avalos, I., 2024. Animals, 14(9),1366.