Relationship of captive bolt stunning location with basic tissue measurements and exposed cross-sectional brain area in cadaver heads from market pigs

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The work in this presentation has been published in the following peer-reviewed article:
Captive Bolt Euthanasia

Penetrating captive bolt is an approved method of euthanasia for swine (AVMA, 2013; NPB, 2008).

The frontal location is the common application; however, two other possible sites have been identified: temporal and behind the ear toward the opposite eye (AVMA, 2013).
Captive Bolt Euthanasia

It is difficult and not advised to perform captive bolt euthanasia on an unrestrained pig.

The behind the ear location cold make it possible to euthanize pigs via penetrating captive bolt without restraint, thus improving the welfare state.

Peer-reviewed published data to validate either the temporal or the behind the ear location did not appear to exist at the time of this study.

This study was designed to serve as a first step in scientifically validating the behind the ear location.
Equipment

Captive bolt
- Jarvis Model PAS - Type P 0.25R Caliber Captive Bolt Pistol
- Medium Stunning Rod Nosepiece Assembly
- Jarvis Blue Powder Cartridges - 0.25R Caliber, 3GR
Objective

To compare the following measurements from the common frontal application of captive bolt euthanasia with the alternative location behind the ear in cadaver swine heads:

- Soft tissue thickness
- Cranial thickness
- Total tissue thickness
- Cross-sectional brain area
- Bolt - brain contact
Captive Bolt Placement

**Frontal (A)**
- Shot placed 2.54 cm superior to a line drawn across the top of the eyes at midline (Woods et al., 2010)

**Caudal to pinna (B)**
- Shot placed directly caudal to the pinna of the right ear on the same plane as the eyes and targeting the middle of the opposite eye (AMVA, 2013)
Description of Cadaver Heads

23 heads were obtained from pigs that were commercially slaughtered at a processing facility under federal inspection.

The heads had skin-on and intact jowls.

The source pigs were approximately 6 mo of age and estimated to have an average BW of 136 kg.
Distance Measurements

Soft tissue thickness (mm)
  • Tissue from the application site to the exterior surface of the cranium
Cranial thickness (mm)
  • Thickness from the exterior surface of the cranium to the interior surface of the cranium along the bolt path
Total tissue thickness (mm)
  • Total soft tissue and cranium thickness from site of application to the interior surface of the cranium along the bolt path
Post-hoc Analyses

Cross-sectional brain area (cm sq.)
- Determined from images collected at the time of head processing
- An online irregular area calculator was utilized to calculate the cross-sectional surface area of the exposed brain within the plane of bolt travel

Bolt - brain contact
- Determined from images collected at time of head processing
- Determined on yes/no basis
  - Yes = brain contacted by bolt
  - No = brain not contacted by bolt
Statistical Analysis

SAS Enterprise Guide 7.1 Environment

Analyses conducted on tissue measurements:
Student's T-tests with Tukey's Test adjustments specified within the model.

Analysis conducted on bolt - brain contact:
Generalized linear mixed model constructed in GLIMMIX procedure of SAS

Differences were considered significant when alpha was less than or equal to 0.05
Results
Table 1. Effects of location on tissue parameters and cross-sectional brain area of cadaver heads from market weight hogs assigned to two shot location treatments\(^1\) and sectioned by band saw following the plane of bolt entry (N = 23).

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Captive Bolt Placement Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FRONTAL (n = 11)</td>
</tr>
<tr>
<td>Soft tissue thickness, mm</td>
<td>8.3</td>
</tr>
<tr>
<td>Cranial thickness, mm</td>
<td>23.4</td>
</tr>
<tr>
<td>Total tissue thickness, mm</td>
<td>31.7</td>
</tr>
<tr>
<td>Cross sectional brain area, cm(^2)</td>
<td>25.2</td>
</tr>
<tr>
<td>Bolt – brain contact(^2), count / %</td>
<td>11 / 100</td>
</tr>
</tbody>
</table>

\(^1\) Treatments: FRONTAL – Medial bolt entry approximately 2.54 cm superior to a line across the top of both eyes and perpendicular with the external surface of the head; CAUDAL TO PINNA – Bolt entry directly caudal to the right pinna with aim toward the left eye on a plane that included both eyes.

\(^2\) Bolt – brain contact: Images of heads sectioned by band saw within the plane of bolt entry were assessed for occurrence of bolt contact with brain tissue.
Relationship of captive bolt location with bolt - brain contact (N = 23)
Discussion
Implications

Of the 2 locations for captive bolt euthanasia that were analyzed, the frontal position appears to be a more reliable location at this time.

Refinement of the caudal to pinna position is necessary to ensure its reliability in practice.

The frontal location may present less risk for the captive bolt euthanasia of swine at market weight at this time.

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Works Cited


Thank You