

## EFFECT OF STUNNING AND SLAUGHTER METHOD ON BRAIN FUNCTION AND BLEEDING EFFICIENCY IN CALVES

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### SUMMARY

Three studies were performed to evaluate the problems that are said to arise when bobby calves are slaughtered by head only electrical stunning followed by sticking. The first study examined spontaneous and reflex physical behaviour following sticking at 3 abattoirs in Australia. Only one of 332 calves examined showed obvious signs of conscious behaviour, and in this animal only one carotid artery had been cut. The second study examined the effect of different stunning and sticking methods on bleeding rate. A faster bleed out was obtained when the thoracic compared with neck sticking was used, and with electrical compared with captive bolt stunning. The position of the cut within the neck did not influence bleeding rate. In the third study it was found that the time to an isoelectric EEG was at least three times longer when only one carotid artery was cut.

### INTRODUCTION

The recognised method for Halal slaughter of calves in Australia is to apply head only electrical stunning, followed within 10 sec by a "gash-stick" of all the soft tissues in the underside of the neck, such that both jugular veins and both carotid arteries are severed. However, there is concern that this method may not provide a humane kill. Firstly, there have been reports that calves undergo lateral head righting movements after the cut has been made, and these are regarded as being symptomatic of consciousness. Secondly, a proportion of cattle take some time to lose brain function following exsanguination (Newhook and Blackmore 1982; Daly et al. 1987), and this time could be longer than the duration of anaesthesia provided by the electrical stun (Blackmore and Newhook 1982).

Three experiments were conducted to determine; (i) whether obvious resumption of consciousness occurred with head only electrical stunning followed by gash sticking, (ii) some of the factors which affect the rate of bleeding from the sticking wound, as this could influence the time to loss of brain function, (iii) the effect of unilateral sticking on the time to loss of brain function as determined from the electroencephalograph (EEG).

### EXPERIMENTAL METHODS

*Experiment 1.* The physical behaviour of 332 calves and 154 sheep was examined at three abattoirs after they had been head only stunned (202 to 291V measured across a 115 ohm load) and stuck. The sticking was performed by experienced Halal slaughtermen at 2 plants and by non-Halal slaughtermen at the third plant ("Imitated Halal"). Head righting behaviour, the eye reflex, and breathing behaviour were examined whilst the calves passed through the bleeding area. When an animal had either a positive eye reflex or normal rhythmic breathing, its carotid arteries were examined to determine whether

they had been cut. In addition, the size of clots in severed carotid arteries was evaluated in 160 separate carcasses at 1 to 5 min post-sticking. The clots at the caudal cut end were assessed subjectively using a 0 to 6 point scale, where 0 represented no significant swelling and 6 was a large clot usually more than 1 cm in diameter and 2 cm in length. Samples of clots were removed and examined under a light microscope after fixing, routine wax processing, sectioning and staining for connective tissue (Mallory's trichrome method) and for fibrin (Lendrum's MSB method).

TABLE 1: Number of calves and sheep showing a positive eye reflex and normal rhythmic breathing after Halal slaughter

| Slaughter method | Species | Number tested | Positive eye reflex Number (%) | Normal rhythmic breathing Number (%) |
|------------------|---------|---------------|--------------------------------|--------------------------------------|
| Imitated Halal   | Calf    | 133           | N.R.                           | 9(7)                                 |
| Halal            | Calf    | 199           | 86(43)                         | 18(9)                                |
| Halal            | Sheep   | 154           | 54(35)                         | 10(6)                                |

N.R. Not recorded

TABLE 2: Incidence of unilateral cutting of the carotid arteries in animals which had either a positive eye reflex or normal rhythmic breathing after slaughter

| Slaughter method | Species | Number tested | Only one carotid completely cut Number (%) | One carotid completely cut, the other incompletely cut Number (%) |
|------------------|---------|---------------|--|---|
| Imitated Halal   | Calf    | 19            | 7(37)                                      | 0(0)  |
| Halal            | Calf    | 91            | 2(2)                                       | 2(2)  |
| Halal            | Sheep   | 55            | 7(13)                                      | 1(2)  |

TABLE 3: Subjective scores for blood clot size in the carotid arteries

| Slaughter      | Species | Number | Subjective score   | ± SEM |
|----------------|---------|--------|--------------------|-------|
| Imitated Halal | Lamb    | 30     | 1.13 <sup>A</sup>  | 0.19  |
| Imitated Halal | Wether  | 17     | 2.65 <sup>bc</sup> | 0.23  |
| Imitated Halal | Calf    | 23     | 3.33 <sup>b</sup>  | 0.35  |
| Halal          | Lamb    | 26     | 0.58 <sup>d</sup>  | 0.14  |
| Halal          | Wether  | 33     | 1.88 <sup>e</sup>  | 0.24  |
| Halal          | Calf    | 31     | 2.31 <sup>ce</sup> | 0.30  |

Means with different superscript letters were significantly different at least at  $p < 0.05$ .

SEM = Standard error of the mean

TABLE 4: Values for blood loss at 60 sec after sticking (as % of live weight)

| Trial number | Number of calves | Stunning method | Sticking procedure | Mean | Range     |
|--------------|------------------|-----------------|--------------------|------|-----------|
| 1            | 6                | Captive bolt    | Thoracic           | 4.67 | 3.98-5.55 |
|              |                  |                 | Halal (high)       | 3.58 | 2.46-4.52 |
| 2            | 6                | Captive bolt    | Thoracic           | 4.26 | 3.39-5.09 |
|              |                  |                 | Halal (high)       | 3.76 | 2.47-4.94 |
|              |                  |                 | Halal (low)        | 3.95 | 2.30-5.22 |
|              |                  |                 | Unilateral         | 3.21 | 2.56-4.04 |
| 3            | 15               | Electric        | Halal (high)       | 4.43 | 1.94-5.33 |
|              |                  |                 | Halal (high)       | 3.53 | 2.19-4.05 |

*Experiment 2.* The effect of two stunning and four sticking methods on the weight of blood collected at slaughter was examined in 60 calves (27-50 kg live weight). Electrical stunning was performed with head only tongs using 313V (measured across a 115 ohm load) for 4 sec. The Cash X pistol with 2.5 grain cartridges was used for captive bolt stunning. The sticking methods are shown in Table 4; with the "Halal high" method the cut was made at the angle of the jaw, whereas in the "Halal low" treatment the cut was made at the brisket end of the neck. The weight of blood leaving the sticking wound in the first 60 sec was recorded.

*Experiment 3.* Six calves (33-41 kg liveweight) were anaesthetised with 18 mg pentobarbitone sodium per kg, administered intravenously. After recording a stable EEG for approximately one minute, either one or both carotid arteries and their accompanying jugular vein or veins were cut in the neck. The EEG was recorded until it became isoelectric. Blood was collected for the first minute following sticking to provide an estimate of bleeding rate.

## RESULTS

*Experiment 1.* Forty three per cent of the Halal slaughtered calves had a positive eye reflex after sticking and 9% showed normal rhythmic breathing movements (Table 1). In the 18 calves that were breathing normally following Halal slaughter, only one did not have both its carotid arteries severed.

None of the Halal slaughtered calves showed overt signs of consciousness such as head righting, escape behaviour and/or vocalisation. One of the calves slaughtered using the imitated Halal method was breathing and vocalised in such a manner that it was thought to be conscious. This animal was found to have only one of its carotid arteries cut. The incidence of unilateral cutting is shown in Table 2.

A characteristic feature of the majority of the carotid arteries was the way in which ballooning of the cut end of the artery occurred. Microscopic examination of the cut end of the artery showed that it was plugged with a white (platelet) clot and overlying this there was a variable sized red clot associated with the connective tissue sheath around the outer surface. Clot size was found to be smaller in the lambs than in the calves (Table 3).

*Experiment 2.* The blood released in the first 60 sec (as a % of live weight) is shown in Table 4. When the results for the two treatment groups common to trial 1 and 2 were combined, blood yield was greater for the thoracic stick in comparison with the Halal high method ( $p < 0.05$ ). There was no difference between the Halal high and Halal low methods. Blood loss following electrical stunning was greater than that after captive bolt shooting ( $p < 0.05$ ).

*Experiment 3.* The average time to isoelectric EEG activity was 33 (30 to 35 range) and 189 (109 to 343 range) sec for the bilaterally and unilaterally cut calves respectively. The average blood yield was 3.7 and 3.9% for the two treatments.

## DISCUSSION

Halal slaughter as practiced in Australia, i.e. electric stunning followed by neck slash, has three effects which help to induce or sustain unconsciousness. Firstly, there is the direct effect of electrical stunning on the brain. Secondly, cutting the carotid arteries leads to cerebral ischaemia and therefore hypoxia, and thirdly, electrical stunning results in a degree of augmentation of brain hypoxia by causing apnoea. The studies of Newhook and Blackmore (1982), Blackmore and Newhook (1982), and Blackmore (1984) have indicated that in calves loss of consciousness induced by cutting the carotids without prior stunning is too slow relative to the period of unconsciousness produced by an electrical stun. Thus ischaemia alone is not thought to be a means of causing a rapid enough loss of consciousness in calves. Devine et al. (1986) measured the degree of hypoxia induced in calves by electrical stunning, and the values they obtained are not considered to be sufficient to sustain unconsciousness in their own right (Kerem and Elsner 1973; Hattingh et al. 1986). Therefore, it appears that neither the ischaemic nor the hypoxic effects of Halal slaughter would be sufficient in themselves to induce a prompt enough loss of consciousness. In practice, however, Halal slaughter depends on the combined effect of ischaemia and apnoea-induced hypoxia, as well as the direct action of the current on the brain.

## CONCLUSIONS

Overt signs of consciousness were not observed following Halal slaughter of calves, provided that the cut was performed properly. Abattoir investigations and laboratory experiments indicated that failure to cut one of the carotid arteries could lead to resumption of consciousness.

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