CURRENT PROFILES DURING ELECTRICAL STUNNING

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Background

When an animal is electrically stunned, it must receive the recommended minimum current as soon as the current starts to flow. In addition the current flow should be uninterrupted. If this does not occur, there is a risk that, instead, the animal will experience an electric shock before it is unconscious. Pre-stun shocks are known to occur with some poultry waterbath stunners (Wotton and Gregory, 1991), and interrupted current flow can occur when unrestrained lambs are stunned using calliper-type electrodes (Gregory and Wotton, 1984).

Objectives

It is not always easy to recognise poor delivery of the current simply by examining the behaviour of the animal and the performance of the operator. Poor current delivery is especially difficult to identify in plants using automatic stunners or operating at fast linespeeds. Poor current delivery can be identified by recording the current profile electronically. The current profile is the overall shape of the current flow that is delivered to individual animals. This paper describes a preliminary trial which examined the current profiles at six slaughterlines in New Zealand. The aim was to use the current profile to determine whether or not problems with current delivery are common. This preliminary trial also provided an opportunity to examine the relationship between stunning current profile and the prevalence of haemorrhagic lesions in the carcass at one of the plants.

Methods

The stunning current profiles were examined using a current clamp, plus an A to D convertor and a laptop computer. The current clamp was placed around the supply from the stunner control box to the stunning electrodes. The laptop computer (Rocky ANW110) displayed the profile in analog form, and each profile was assigned to one of five categories as follows:

1. *Satisfactory.* The current rose rapidly to a level which is known to produce an adequate stun.
2. *Poor initial contact.* The current did not rise promptly. Instead the animal experienced a low current for at least 0.2 sec.
3. *Interrupted current.* There was a break in the current flow during the stunning episode.
4. *Failure to maintain current.* Current towards the end of the stunning episode declined gradually to about zero amp before the current supply was switched off.
5. *Spiking.* A current surge occurred at the start or end of the current application.

Examples of these profiles will be shown in the poster presentation. Ideally, the current profile should all be 'Satisfactory'. The current rises promptly, it is continuous and there is no spiking. If there is spiking or an interruption in the current flow, the body will give sudden jerks which could damage the carcass. A poor initial contact may not stun the animal immediately, and instead it could experience an electric shock. Failure to maintain contact may not be a concern to animal welfare or carcass quality.

Results and Discussion

A total of 585 profiles were examined at the six slaughterlines (Table 1). Two of the slaughterlines (1 and 2) were in the same processing plant, and so a total of five plants were visited. Lines 1 to 4 were stunning lambs using handheld pin-type electrodes that were applied from above with the animal held in a restraining conveyor. At line 5, the lambs were held in a restraining conveyor and they were stunned using calliper-type handheld tongs by an operator who was positioned in front of and below the lambs. The calliper-type tongs were suspended with a recoil balancer to reduce operator fatigue. Line 6 was electrically stunning cattle using a Jarvis Equipment (NZ) Ltd Electric Beef Stunner. A current-limiting stunner was used at each line. At lines 1 to 3 the setting for the stunning current was 0.8 amp for 2.5 or 3 sec. At line 4 the lambs were stunned with 1.4 amp applied head-to-back for 4 sec, and in line 5 they were stunned with 1.7 amp applied for 2 sec. The cattle in line 6 were stunned with 3.2 amp applied for 2.5 sec.

In general the standard of stunning was good. Eighty five percent of the profiles were satisfactory, and 91% were acceptable from the welfare perspective. However, when there is a poor initial contact and when there is an interrupted current flow, there can be animal welfare problems, and these types of profile occurred in 9% of cases. In general, the standard of stunning was better in the lines that used automatic stunning.

There was one plant that was not performing to the same standard as the others (line 3, Table 1). It had a lower prevalence of satisfactory stunning current profiles in comparison with each of the other slaughterlines ($p<0.05$, using a ^{2} test). This line had a high prevalence of poor initial contact and spiking, and the spiking usually occurred at the end of the current flow. At this plant there was a moderately high prevalence of back haemorrhages. This provided an opportunity to evaluate the effect of current profile on this carcass defect. The back haemorrhages were scored with a four point grading system that was developed with the guidance of the carcass grading staff at the plant. Zero represented no haemorrhages, grade 1 slight haemorrhages, 2 moderate haemorrhages, 3 severe haemorrhages. Carcasses with grade 3 haemorrhages would be downgraded commercially, as would many of the carcasses in grade 2.

In most cases the haemorrhages had a fresh, bright red appearance, but they varied from a bright purple to bright red. There were no signs of any greening, and so it was considered that they occurred within 24 hours of slaughter . The haemorrhages were usually diffuse, speckle-like blemishes, situated in and just below the fascia over the loin. In other cases they were associated with circular patches of concentrated haemorrhaging, which evidently had spread from a central point. These patches were often 7 cm^2 or larger. In the grading system, all types of back haemorrhages were evaluated in a collective score. No distinction was made between the types of haemorrhage, but, in hindsight, it is possible that the patches of blood had a different cause to the speckle-like haemorrhages. Back haemorrhages were less

obvious in carcasses with a fatter finish. This could simply be a dilution effect of the white fat relative to the red blood, and because leaking blood is not able to spread so far when the tissue is occupied by fat.

The current profile was examined in 65 lambs and related to each lamb's haemorrhage grade. On theoretical grounds it was anticipated that an interrupted current, and spiking, could lead to repeated body spasms and blood vessel tearing, and so the results are presented with those current profiles as the main comparison (Table 2). Although there were limited numbers of lambs, the results showed that interrupted current flow and spiking were contributing to severe forms of the back haemorrhages (grade 3, $p<0.05$). This finding was supported, circumstantially, by the fact that manual stunning at line 1 did not show any spiking or interrupted contact, and it did not cause a back haemorrhage problem.

Table 1 Current profiles during stunning at five slaughterlines. (Number of animals), h-b = head-to-back

	Satisfactory	Poor initial contact	Failure to maintain current	Interrupted current	Spiking
Line 1- manual (87)	81	3	2	1	0
Line 2- automatic (55)	54	0	0	0	1
Line 3- Manual (81)	40	18	1	3	19
Line 4- h-b manual (46)	37	4	0	5	0
Line 5- Manual (306)	279	8	7	12	0
Line 6- automatic beef (10)	9	0	0	1	0

Conclusions

When electrical stunning was first introduced into meatworks it was found that double stunning or interrupted stunning could cause haemorrhage problems in carcasses. This was overcome by ensuring that there was a continuous, uninterrupted flow of current. The likely explanation for this is that the repeated spasm at the start of current flow tears blood vessels in and around the muscle. The more spasms there are, the more likely there will be ruptured blood vessels. In some countries, these problems were controlled by increasing the current gradually. This allowed the body to gradually increase its force of contraction, instead of being thrown into a sudden sharp spasm. That method was known as Glissando stunning, and it is now considered inhumane because the low initial currents are not likely to induce an immediate stun. Similarly, for some animals an interrupted current flow at the start of stunning indicates improper contact and that the animal experienced an electric shock before it was stunned.

Table 2 Relationship between current profiles and back haemorrhages

	Number of carcasses / %	
Back haemorrhage grade	Current Profiles	
	Satisfactory + Poor initial contact + Failure to maintain current	Interrupted contact + Spiking
None + mild (0,1)	41 / 91	15 / 75
Moderate (2)	3 / 7	1 / 5
Severe (3)	1 / 2	4 / 20
	45 / 100	20 / 100

When the lambs are being stunned, there is considerable tension in the muscles in the back. This tension extends down to the loin, and it can be felt with the palm of the hand as the animal is being stunned. There is a sudden jerk in the back as the current starts to flow. The back then starts to arch and there may be a second jerk as the hindlegs strike the belly as they are flexed. It was not clear why this muscle tension should lead to haemorrhages in the fascia above the muscle. Intuitively, one would expect the haemorrhages to occur within the muscle, if the muscle was being over-stimulated. Instead, it may be that arching of the back in combination with electrically-induced vasospasm was causing vessels, that extend between the fascia and the skin, to shear. Repetitive stimulation, as in interrupted contact and spiking, appeared to be exaggerating this effect.

Spiking could be avoided by fitting a zero-crossing silicon switch with a snubber to the stunner. In addition, for safety reasons, an electromechanical contactor could be fitted which cuts in and out before and after the stunning current. Interrupted contact could be reduced by examining the cause of contact failure. If it is associated with particular operators, they should be shown how to overcome the problem. Alternatively, if it is linked to the position or posture of the operators, their aspect should be addressed.

Pertinent Literature

Gregory NG, Wotton SB. Sheep slaughtering procedures. I. Survey of abattoir practice. *Br Vet J* 1984;140:281-286.

Wotton SB, Gregory NG. How to prevent pre-stun electric shocks in waterbath stunners. *Turkeys* 1991;39 (2):15,30.