process for progress
Report 161
Ritual slaughter and animal welfare
A literature study
September 2008
ANIMAL SCIENCES GROUP
WAGENINGEN UR
Ritual slaughter and animal welfare

‘Slaughter cannot be humane by any method, for slaughter is cruel. And yet, the slaughter of animals being a necessity, it must be performed as humanely as possible’

(Levinger; Medical aspects of Shechita; 1976)

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September 2008
Foreword

Ritual animal slaughter is a current topic of public debate. The process of slaughtering animals in accordance with religious rites rarely involves stunning. There are therefore concerns that animals suffer more when ritually slaughtered than if they are stunned beforehand.

The Animal Sciences Group was requested to clarify the extent to which animal welfare is impaired in ritual slaughter without stunning. It is worth noting that all methods of killing animals impair animal welfare, and the question must therefore be viewed in the perspective of the conventional slaughter of animals with stunning.

This document provides an extensive literature study of current knowledge about the animal welfare aspects of ritual slaughter, and gives recommendations for reducing the fear and pain of the animals that undergo the practice. We hope that this report will support a vigorous debate about ritual slaughter, and possible improvements to address associated animal welfare issues. We also hope that the debate is not restricted to political circles, but extends to religious organizations, with a view to using the scope for interpreting rules in a way that minimizes animal suffering.

P.W.J. (Paul) Vriesekoop
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Animal Sciences Group of Wageningen UR
Summary
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1 Introduction

For humans, animal products are traditionally an important source of protein, and their flavour is highly valued. However, Muslims, Jews, Buddhists, Hindus and other religious groups forbid the consumption of certain kinds of meat. For instance, their faith prevents Muslims and Jews from eating pork, and insists that other animal species are slaughtered ritually. On the other hand, the Christian faith imposes no restrictions or conditions on meat consumption. These cultural differences often impede mutual understanding in the Western world, and are also frequently aired in discussions about integration, such as of Muslims in Dutch society.

Kosher slaughter attracts less attention, possibly because of its small scale, or the far longer established traditional presence of the Jewish community in Western society. People may assume that they are familiar with kosher.

The Torah, which comprises the first five books of the [Old][Hebrew] Testament, is the core of traditional Jewish law. The Talmud is its detailed elaboration, [written]wrought by the rabbinate in the course of time. They jointly form the Halacha, Jewish religious law, with fairly precise instructions for how to deal with animals, and how to slaughter them.

Islam is currently the world’s fastest growing religion. The number of Muslims worldwide is now estimated at 1.4 billion. Between 12 and 13 million Muslims live in Europe, mostly with origins in North Africa and Turkey (Bonne and Verbeke, 2008). There are just under one million Muslims in the Netherlands. It is unknown how many of them eat halal meat from animals slaughtered ritually without stunning.

Ritual slaughter in accordance with Jewish or Muslim tradition normally involves exsanguination, or bleeding out, from a throat cut, without prior stunning. This practice is at odds with animal welfare. [An assumption without proof!!] However, the Dutch constitution safeguards religious freedom, and permits ritual slaughter on constitutional grounds (Health and Welfare of Animals Act (GWD), 1992). Opponents of ritual slaughter without stunning argue that the animals have to endure avoidable pain, and that freedom of religion does not outweigh the harm to animal welfare.[So have you banned hunting?] Supervision of slaughtering in the Netherlands is carried out by vets of the Food and Consumer Product Safety Authority (VWA). The Royal Dutch Society for Veterinary Medicine (KNMvD), which represents vets’ interests, recently expressed moral objections [What does that mean? That usually means they have no sound basis for doing so – Morality is about reason!] to ritual slaughter without prior stunning (KNMvD, 2008). [The vet community has often let their anthropomorphic view trump their reason.] Parliament likewise recently raised the subject of ritual slaughter without stunning. The Minister of Agriculture, Nature and Food Quality (LNV) responded to parliamentary questions by requesting the Animal Sciences Group of Wageningen UR to perform a literature study. This document answers the Minister’s request.

We first discuss the cultural backgrounds to ritual slaughter and the surrounding legislation and regulations. We then address the phases involved in slaughtering. After presenting conclusions and providing recommendations, an appendix briefly lists the tangible measured animal welfare differences between slaughter with stunning and ritual [I strongly prefer the word “religious” slaughter as the least prejudicial!] slaughter without stunning.
2 Ritual slaughter without stunning

Ritual slaughter is a sacred event, in which a God-created being is killed to provide food for humans. Respect for animals dictates that they should suffer as little as possible. What this meant in the times in which the relevant religious rules were written was rapid death by bleeding through a throat cut. How much the animals suffered therefore depended strongly on the condition of the knife used.[[Proof?]] Slaughtering practices have no connection with rituals in the Christian culture. Animals were viewed as subordinate to people, and slaughter was merely something that had to happen in order to obtain food. Slaughtering procedures have adapted as respect for animals and concern for their welfare have increased in Western society. For instance, it has been usual since the early twentieth century for animals to be stunned before being slaughtered.[[But not when hunted? Or at the bullfight?]] The stunning sometimes follows immobilization, and involves gassing with carbon dioxide, electric discharge, or a stunning pistol, followed by exsanguination.[[Multiple methods suggest problems with each – why aren’t they trying to resolve these?]] Depending on the type, a stunning pistol may fire a bullet or captive steel bolt into the brain, or administer a non-penetrating impact to the forehead. The intention in all cases is for the animal to lose consciousness immediately, albeit temporarily, and become insensible.[[These are separate words and need to be carefully defined.]] The subsequent exsanguination renders the loss of consciousness permanent, and is the ultimate cause of death.

Jewish and Muslim custom requires animals to be intact at the onset of exsanguination. A shot or electric discharge would destroy the animal’s integrity. Jewish tradition requires animals to be fully conscious before the throat cut. Some Muslim groups do permit a reversible form of stunning prior to the throat cut. Jewish rules are more stringent, in that the animals must be thoroughly inspected for health disorders immediately after exsanguination, and the slightest irregularity may lead to rejection of the meat. Prior stunning could cause irregularities of this kind. Nonetheless, Jewish groups vary in how strictly they observe this point. For instance, the practice in Sweden for many years has been for cattle that are ritually slaughtered to be electrically stunned first (Berg, 2005).[[This is very misleading – it is a hardship exemption given the anti-Semitism of Sweden. Actually it is my understanding that they quietly slaughtered but made sure no meat entered the public supply.]]

In the Jewish rite of shechita, a specially trained shochet performs the throat cut with a knife used exclusively for the purpose, the chalaf. In a single stroke he severs all the blood vessels in the neck (the jugular veins and the carotid arteries). The shochet is responsible for keeping the chalaf in flawless condition. After exsanguination, the slaughtered animal is scrutinized for imperfections, and the non-kosher parts (the hindquarter) removed.[[Not true – this is an economic not religious decision.]] Animals with imperfections are rejected, as are those that died before their throats were cut, or where the cut was not performed in accordance with the requirements. Rejected animals are sold as non-kosher, which means that the meat enters the normal circuit, with the risk [[Strong word – we are not given a choice of how other animals are killed – full labelling is needed]] that consumers may unknowingly buy the meat of animals ritually slaughtered without stunning.

The Muslim laws are set down in the Koran. Halal is Arabic for legal, or permissible. The opposite is haram, which is illegal, or forbidden. For example, pork is haram. The concepts of halal and haram relate not only to food, but also to such things as cosmetics and banking practices. Halal slaughter requires the head of the animal to point towards Mecca, and the cut to be made by a Muslim, who must recite the words ‘Bismillah Allah u Akbar’ (in the name of Allah the great). The animal is restrained, after which both jugular veins and carotid arteries are severed with a razor-sharp knife. The animal sheds a substantial volume of blood in a short time, and therefore loses consciousness. After death the slaughtering process continues. Contact with pigs, or mixing with parts of pigs, are forbidden both before the slaughter and in the preparation of meat products. For example, the consumption of products containing pig gelatine, such as some sweets, is not halal. [[Actually there is a concept of “ištihalal” that may for some make pork gelatin acceptable.]]

The halal procedure is not formally specified. It is derived from Koranic verses, which are not always interpreted in the same way. Sometimes animals may also be slaughtered by a non-Muslim, for example a Christian, or a Jew (Grandin, 2008). Certain fatwas also permit slaughter with stunning under special circumstances. For instance, an electrical stunning apparatus was developed in New Zealand after 1980 that met with the approval of the Muslim authorities [[for some countries]], because the animals were able to regain consciousness within one minute, and able to eat again within five (Grandin, 2008). The halal meat sold by the Albert Heijn supermarket chain in the Netherlands is also from animals that were stunned beforehand (Albert Heijn, 2008). Sikhs also have a slaughter ritual, jhatka, in which animals are decapitated without prior stunning. This method is not practised in the Netherlands.

Table 2.1 Numbers of animals ritually slaughtered without stunning in the fourth quarter of 1983

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle and calves</td>
<td>92762</td>
<td>Unknown</td>
<td>567</td>
<td>567</td>
</tr>
<tr>
<td>Sheep</td>
<td>Unknown</td>
<td>Unknown</td>
<td>15465</td>
<td>2686</td>
</tr>
</tbody>
</table>
1) Not including calves, only mature cattle. The number of cattle given in the report is the same as the number slaughtered in the fourth quarter for the Festival of Sacrifice.

The current number of ritually slaughtered animals in the Netherlands is unknown. A 1984 report by Dierenbescherming, the Netherlands animal protection society, shows that in the fourth quarter of 1983 the animals slaughtered for the Jewish community were mainly cattle and calves, and for the Muslim community mainly sheep and goats (Table 2.1), in particular during the Festival of Sacrifice.

It is also known that the Ministry of Agriculture, Nature and Food Quality granted dispensation in 2004 for the slaughter without prior stunning of 850,000 sheep (van Dinther, 2006). This number exceeds the total number of sheep slaughtered in that year, suggesting that all sheep slaughter in the Netherlands is by ritual means. Permits were granted in the same year for the ritual slaughter without prior stunning of 101,000 cattle (van Dinther, 2006). The Royal Dutch Society for Veterinary Medicine also estimates that approximately two million animals were ritually slaughtered in 2006 (Table 2.2) (KNMvD, 2008). Table 2 shows that up to one quarter of mature cattle are ritually slaughtered (Productschappen Vee, 2007). The annual number of calves ritually slaughtered in the Netherlands is unknown. Poultry accounts for only about three per cent of the total of ritually slaughtered animals.

Table 2.2  Maximum number of ritually slaughtered animals for which permits were granted in 2006 (KNMvD, 2008) and the total number of slaughters (Productschappen Vee, 2007).

<table>
<thead>
<tr>
<th>Category of animal</th>
<th>Permitted number of ritually slaughtered animals</th>
<th>Total number of slaughtered animals</th>
<th>Maximum proportion ritually slaughtered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature cattle</td>
<td>125,000</td>
<td>581,000</td>
<td>21.5 %</td>
</tr>
<tr>
<td>Calves</td>
<td>Unknown</td>
<td>1,340,000</td>
<td></td>
</tr>
<tr>
<td>Sheep and goats</td>
<td>850,000</td>
<td>715,000</td>
<td>100 %</td>
</tr>
<tr>
<td>Poultry</td>
<td>1,170,000</td>
<td>325,000,000</td>
<td>3.6 %</td>
</tr>
<tr>
<td>Rabbits</td>
<td>25,600</td>
<td>2,000,800</td>
<td>1.3 %</td>
</tr>
<tr>
<td>Pigeons</td>
<td>2,000</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>Ducks</td>
<td>500</td>
<td>4,500,000</td>
<td>0.01 %</td>
</tr>
</tbody>
</table>

1) 615,000,000 kg
2) own estimate

Also in 2006, the number of ritual slaughter applications for sheep and goats exceeded the estimated total number of slaughtered animals in the Netherlands. It is unclear how many of the total applied for were actually slaughtered, and it is also unknown how many slaughterhouses may have exceeded the expected number of slaughters. It is impractical to segregate the statistics into domestic and export categories, although this would be a desirable exercise in view of the highly charged nature of the subject. There is also a lack of statistics on ritual slaughter numbers in Europe. An EU-financed project is working on filling this gap (DIALREL; FP6-2005-FOOD-4-C), but the group has yet to publish a report [on religious slaughter numbers].
3 Legislation

EU legislation (Council Directive 93/119/EC) permits slaughter without stunning provided it is dictated by certain religious convictions. This legislation is elaborated in the Netherlands in Article 44 of the 1992 Health and Welfare of Animals Act (GWD) and the Ritual Slaughter Decree, which specify conditions to guarantee that animals do not suffer avoidably. Until recently, slaughterhouses required dispensation for slaughter without stunning.

Under new ritual slaughter notification rules that were introduced in October 2006, slaughterhouses are no longer required to provide a declaration of need from a religious organization, and can suffice with a notification. This obligation to notify applies to slaughterhouses engaging in ritual slaughter for the first time, or that have performed none for a year or more. Since the date of the Festival of Sacrifice moves earlier each year, slaughterhouses that operate only in this period are relieved of the need to renotify. Notification is made on a form available from the Dutch Food and Consumer Product Safety Authority (VWA). The form calls for an estimate of the number of slaughters. The VWA performs spot checks in its enforcement of ritual slaughter rules.

Some seventy-five slaughterhouses had permission to perform ritual slaughter in the Netherlands in 2008. Since the introduction of the new rules it is unclear how many animals are ritually slaughtered each year, or how many violations of the regulations are observed.
4 The state of affairs in the EU and elsewhere

Nearly all EU Member States have adopted the ritual slaughter provisions of Directive 93/119/EC, and translated them into national legislation. Some EU countries, including the Netherlands, Belgium, France, Greece, Italy, Portugal and the United Kingdom, permit ritual slaughter without stunning. Other countries, such as Austria, Denmark and Finland, allow the throat to be cut without prior stunning, but insist on immediate post-cut stunning (D’Agostino, 2003).

Although ritual slaughter is permissible in the countries mentioned above, the practice in many slaughterhouses is nonetheless one of prior stunning. A study of 135 slaughterhouses in France, Germany, Italy, Spain, the Netherlands and the United Kingdom has shown that sixty-five per cent of all halal slaughtered cattle, fifty per cent of sheep and goats and fifty per cent of poultry were stunned in advance. [[Often without Muslim consumers knowing this!]] For cattle, a stunning pistol [[Is this really reversible?]] was used in seventy-five per cent of cases, whereas the main method of stunning sheep, goats and poultry was electrical. At variance with the above, shechita was performed without prior stunning (Velaarde et al., 2008).

Slaughter without prior stunning is against the law in countries including Sweden, Norway, Estonia, Iceland and Switzerland (D’Agostino, 2003; Luy et al., 2005; Veerman, 2006; Meijer, 2008).[[And how does this relate to Nazi Germany and that history. Certainly does for Sweden!]]

In 1950 the Jewish community in Sweden approved the practice of slaughter following electrical stunning (Berg, 2005). However, Sweden banned the electrical stunning of cattle in 1979, when the stunning pistol was adopted, although this method is incompatible with shechita. [[And probably with halal??]] The Jewish community now uses kosher meat imported from Denmark.

Kosher meat is imported into Switzerland from the Netherlands (personal statement of I.M. Levinger 2008). A movement has started there for banning even the import of meat of animals slaughtered without stunning, but as yet there are too few registered supporters for a referendum quorum (Modiya project, n.d.).

Croatia and Germany permit the slaughter of certain animals without stunning only for the domestic market (Veereman, 2006). Although in Germany most halal slaughter occurs after stunning, the meat of animals ritually slaughtered without stunning is also imported from the surrounding countries (von Holleben and Calkara, 2007).

In the Netherlands too, there is discussion of whether ritual meat should be slaughtered only for the local market. Rules and conditions are equally diverse outside Europe. Ritual slaughter without stunning is legal in the United States, as provided for in the Humane Slaughter Act. The scientist and slaughter expert Dr Temple Grandin has lobbied energetically in recent decades for the humane conduct of ritual slaughter without stunning [[this is critical and is where the discussion ought to be focused]] in the United States (Grandin, 2008). She is known mainly for her designs of slaughterhouses and equipment for improving the way animals are led to slaughter and restrained. Moreover, the controversy in the United States that followed an internet video of cattle undergoing shechita helped improve the slaughtering method (less distress) in the slaughterhouse involved (YouTube, 2004). [[Again, this really needed attention and this plant is now operating with Dr. Grandin’s approval. So the issue is one of “doing it right”]]

Slaughter without stunning is forbidden in New Zealand, where the techniques that have been developed for electrically stunning animals prior to the throat cut have been approved by Muslim importers in several countries (Pleiter, 2005). Halal slaughtered animals in Malaysia too are allowed to be stunned in advance (Malaysia, 2001; D’Agostino, 2003).

Table 4.1 Ritual slaughter, the international state of affairs (Sources: D’Agostino (2003), Bergeaud-Blackler (2007), von Holleben and Calkara (2007) and unpublished information DIALREL).

<table>
<thead>
<tr>
<th>Country</th>
<th>Permitted without stunning</th>
<th>Compulsory stunning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>X</td>
<td>only for domestic market afterwards In advance</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Estonia</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Iceland</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Export Meat of Animals Stunned in Advance</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Croatia</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Latvia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithuania</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Luxembourg</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Malta</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The Netherlands</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

1) Various large slaughterhouses do export the meat of animals stunned in advance.
5 The halal mark and the market

Meat cannot be identified as halal from its appearance. There is a halal mark, which is roughly analogous with the Dutch EKO eco-label for organic products, as, to some extent, is the mark’s background. Halal is religiously motivated, whereas EKO has its roots in anthroposophic principles. Perhaps surprisingly, the EU has drawn up legislation for the eco-labelling of organic farming products, but not for halal products. [[Now that is a political statement!!]]

Meat products may be given the halal mark if the animals were from a farm that does not keep pigs, and were not transported to the slaughterhouse in a vehicle that had ever carried pigs. All contact with pigs, pig remains, or droppings must also be avoided in the slaughterhouse itself. The slaughter must proceed in accordance with Muslim religious rules, and the resulting meat products must be free of pork byproducts and alcohol.

There is currently no uniform halal meat standard, and the halal mark is not protected. [[There are those which are trademarks – guess that hasn’t happened in the Netherlands.]]

Local imams often determine whether or not a procedure followed by a slaughterhouse is halal (Bonne and Verbeke, 2008). Customers too may often impose specific requirements on the procedures.

Consumers on the domestic market will often buy unmarked products from local Muslim butchers on the basis of trust. But as the worldwide halal meat market grows, the call for international standards is also becoming louder. Foreign customers are demanding certification.

There are currently several halal certifying organizations in the Netherlands (Table 5.1). HIC handles certification for major supermarket chains such as Albert Heijn, Jumbo, Vomar, C 1000 and Super de Boer. Inspection and certification are sometimes handled by different organizations. COHS has fifty per cent of the market for halal inspections, with TQHC and HVV each with some fifteen per cent (Siebelink, 2007).

There are no figures about the size of the domestic market for halal products, except the fact that there are almost one million Muslims in the Netherlands.

Table 5.1 Halal certifying organizations in the Netherlands

<table>
<thead>
<tr>
<th>Organization</th>
<th>Activities</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Quality Halal Correct Certification (TQHC)</td>
<td>Audits, inspections and certification</td>
<td><a href="http://www.Halalcorrect.com">www.Halalcorrect.com</a></td>
</tr>
<tr>
<td>Halal Feed and Food Inspection Authority (HVV)</td>
<td>Information, inspections and certification</td>
<td><a href="http://www.Halal.nl">http://www.Halal.nl</a></td>
</tr>
<tr>
<td>HIC (Halal Internationale Controle U.A.)</td>
<td>Inspections and certification</td>
<td><a href="http://www.wahidhalalmeat.com">http://www.wahidhalalmeat.com</a></td>
</tr>
<tr>
<td>Stichting Nationale Halal</td>
<td>Promotion, lobbying, umbrella organization</td>
<td>None</td>
</tr>
</tbody>
</table>
6 Ritual slaughter without stunning and animal welfare

The animal welfare aspects of ritual slaughter without stunning have been a public concern for several decades. Almost a quarter of a century ago, a Dierenbescherming working group concluded that the correct performance of the throat cut was such an uncertain factor in practice that substantial risks of severe animal suffering would always remain, despite conceding that the adverse effects for the animals with an expert and well executed throat cut were negligible. [[This feels like double talk – all methods have a finite risk of failure – the key is to minimize it by improving systems, management and people training.]] The most compelling animal welfare grounds for recommending the urgent introduction of a ban on slaughter by throat cut without stunning were the practical course of events surrounding this kind of slaughter. The working group, which did not provide exact figures, observed serious shortcomings in the kosher slaughter of veal calves. They also observed abuses in Muslim slaughterhouses, in particular where large numbers of animals had to be slaughtered in a short space of time for the Festival of Sacrifice (Dierenbescherming, 1984). [[This may be true – but that is a weak argument for banning slaughterhouses, in particular where large numbers of animals had to be slaughtered in a short space of time for the Festival of Sacrifice (Dierenbescherming, 1984).]]

Much research has been carried out into aspects of ritual slaughter [[But have they been done right?]] in the almost quarter of a century since. Dierenbescherming has also refined its position in the meantime. Their view now, alongside their objections to the practical course of events surrounding slaughter that were mentioned above, is that the throat cut itself also causes avoidable animal suffering to unstunned animals. We present the current state of affairs below, focusing on four aspects: transport and the slaughterhouse environment; restraint of the animal; the throat cut; and the process of exsanguination and loss of consciousness.

Anyone wishing to assess animal welfare on the way to and during slaughter has a wide range of parameters at their disposal, such as:

- the number of animals that slip or fall down;
- the use of electric prods;
- the incidence of incomplete stunning;
- the total duration of the slaughtering process;
- assessments of directly observable behaviour;
- assessments of throat cut quality;
- the interval between the throat cut and loss of consciousness;
- corneal reflex measurements;
- hormone and metabolite levels in blood or tissues;
- brain activity (EEG) or heart function (ECG) measurements.

The behavioural observations given in the literature vary widely, and not all have clear ethograms. Relevant hormones and metabolites that can be measured in the blood include catecholamines (adrenaline and noradrenaline) and cortisol, which are an indicator of an animal’s exposure to acute stress (Shaw and Tume, 1992; Tume and Shaw, 1992). Using an EEG, an ECG and the corneal reflex, we can measure how long after administering certain interventions an animal remains capable of perceiving and processing signals, and establish the onset of brain death. [[I need an expert to verify all of these statements?]]

6.1 Transport and slaughterhouse environment

The transport to and lairage in the slaughterhouse do not differ materially from conventional slaughter practice, albeit that ritual slaughter occurs on a somewhat more modest scale, and smaller cattle transporters are likely to be used. Because the animals are usually slaughtered by local butchers, it is reasonable to assume that the animals travel less far on average than in the conventional slaughter process. However, there are no hard data, and equally little clarity as to the numbers and origins of ritually slaughtered animals in the Netherlands. [[The absence of any data suggests that folks really didn’t care until it is now becoming a political issue.]] The VWA has supervisory responsibility for how animals are led to slaughter at the slaughterhouses, and also for export, but not for transport as such, which falls under the General Inspection Service (AID) and the police. It is unknown whether any abuses have been observed in transports to slaughterhouses that have permission to perform ritual slaughter. [[Relevance: If done wrong they ought to be punished. It is not relevant to the issue except to suggest bad faith.]]

There is likewise no known information about the design of slaughterhouses with permission to perform ritual slaughter, nor about how their design differs from conventional slaughterhouses. It should be observed that most slaughterhouses with permission to perform ritual slaughter also use conventional methods. Once again, however, no exact figures are available. [[This is a really critical piece of information – those doing religious slaughter ought to have the RIGHT equipment to do so. That is a potential legitimate role of the government.]]

There are a limited number of animal welfare indicators while at the slaughterhouse prior to slaughter, irrespective of whether animals are stunned in advance. Grandin says an annual audit, as a basis for adapting the slaughter environment, would be an effective way of improving animal welfare. [[We’re moving towards video auditing in the US with a trained evaluator getting the video feed. This needs to happen in more aspects of...]]
slaughter. The audit should address the proportion of animals that:

- are successfully stunned on the first attempt;
- are completely insensible before being hung (with one hundred per cent required to pass the audit);
- vocalize on the way to the restrainer and while being restrained;
- slip or fall down during unloading and in the slaughterhouse;
- are moved using an electrical prod.

When McDonald’s introduced this audit in its United States slaughterhouses, it observed an increase in the effectiveness of the first stunning pistol firing for cattle from 89.5 per cent in 1996 to 98.6 per cent in 2004. The improvements made were in employee training, stunning apparatus maintenance, and flooring.

Simple changes solved problems with restive and agitated vocalizing animals. Lighting was provided at the restrainer entrance, and reflections were avoided by relocating the lamps. Hissing equipment was banned, and screens were placed to prevent draughts on the way to the slaughter and to keep workers out of sight of the animals. Grandin says these indicators are also effective in ritual slaughter without stunning (Grandin, 2006).

Possible additional indicators for ritual slaughter include the number of cuts per animal and the quality of the throat cut (see Table 6.3). (These needs to be carefully evaluated – and is part of training even shochets – a quicker more aggressive cut closer to the top of the permissible range are all part of room for improvement.)

6.2 Fixation

An important preparatory measure for the actual slaughter is the restraint or fixation of the animal. The purpose of restraint is to restrict an animal’s freedom of movement in such a way that it can be stunned and killed as rapidly, effectively and efficiently as possible.

Article 6 and Appendix B of EU Directive 93/119 (1993) sets down the requirements for restraint that apply to all animal species (see below). In the Netherlands the VWA supervises enforcement of this legislation. It is unknown how often violations are observed.

Article 6

1. Instruments, restraint and other equipment and installations used for stunning or killing must be designed, constructed, maintained and used in such a way as to achieve rapid and effective stunning or killing in accordance with the provisions of this Directive. The competent authority shall check that the instruments, restraint and other equipment used for stunning or killing comply with the above principles and shall check regularly to ensure that they are in a good state of repair and will allow the aforementioned objective to be attained.

ANNEX B

RESTRAINT OF ANIMALS BEFORE STUNNING, SLAUGHTER OR KILLING

1. Animals must be restrained in an appropriate manner in such a way as to spare them any avoidable pain, suffering, agitation, injury or contusions.

However, in the case of ritual slaughter, restraint of bovine animals before slaughter using a mechanical method intended to avoid any pain, suffering or agitation and any injuries or contusions to the animals is obligatory.

2. Animals’ legs must not be tied, and animals must not be suspended before stunning or killing. However, poultry and rabbits may be suspended for slaughter provided that appropriate measures are taken to ensure that, on the point of being stunned, they are in a sufficiently relaxed state for stunning to be carried out effectively and without undue delay. Furthermore, holding an animal in a restraint system may in no circumstances be regarded as suspension.

3. Animals which are stunned or killed by mechanical or electrical means applied to the head must be presented in such a position that the equipment can be applied and operated easily, accurately and for the appropriate time. The competent authority may, however, in the case of solipeds and cattle, authorize the use of appropriate means to restrain head movements.

4. Electrical stunning equipment must not be used as a means of restraint or immobilization or to make animals move.

**These are a reasonable basis for insisting on better conditions in religious slaughterhouses. Bad practices are bad practices and need to be dealt with.**

6.2.1 Fixation of cattle

Much more distress may be caused on the way to the slaughter than by the pain of the throat cut in ritual slaughter without stunning, and this aspect therefore deserves careful attention. (And none of this is a problem for those doing religious slaughter. This is as strong statement that ought to be built upon.) Fear is a strong stressor in cattle, and it may be caused by restraint, contact with unknown people, and exposure to novel, unfamiliar surroundings (Grandin, 1997; von Wenzlawowicz and von Holleben, 2007). Slaughter without stunning was
banned in Sweden because the restraints used at the time caused too much distress (Grandin and Regenste in, 1994). How much fear and distress cattle experience before they are led to the restraint apparatus depends on breed, gender and age, previous exposure to people, and the presence of other animals of the same breed, and of people. The presence of familiar people has a calming effect (Grandin, 1997; von Wenzlawowicz and von Holleben, 2007). [[So let’s all work on this instead of solving non-problems by anti-Semitism and Islamophobia!]]

As many as six different types of restraint for ritual slaughter have been developed over the years (Gregory, 2005). In Berlin a chain was used for many years to restrain cattle for halal slaughter with stunning. The head was first sprayed with water to lower the resistance of the skin before electrical stunning. The animals were bled from a throat cut immediately after the stun (Figure 6.1) (Nowak, 2005).

**Figure 6.1** Restraint of cattle with a chain prior to ritual slaughter in Berlin. Animals were electrically stunned after being restrained, and then exsanguinated by means of a throat cut (Nowak, 2005).

**Figure 6.2** Upright restraint of cows prior to ritual slaughter without stunning.

**Figure 6.3** Modified Weinberg rotary pen used in ritual slaughter in Austria. The throat cut is made without stunning the animals, with the shot to the head following immediately (Gsandtner, 2005). [[This is a lousy piece of equipment.]]

In general cows and calves are restrained upright in a Cincinnati pen or ASPCA box (Figure 6.2), or in devices that rotate them onto their sides or backs, such as the Weinberg pen shown in Figure 6.3.

The throat cut can be made more easily with the animal on its back or side. Nonetheless, the Weinberg pen is banned in some countries, such as Denmark. In a position paper, the Federation of Veterinarians of Europe (FVE) also called for the Weinberg pen to be banned. They are of the opinion that cattle must not be rotated through 180°, arguing that animals that have their throats cut while on their backs may aspirate blood, and that plasma cortisol levels indicate greater distress than with upright restraint (FVE, 2005). [[There is evidence that a properly designed rotating pen works fine. Temple has permitted that to be used at Agri-Star. We all would prefer upright and that might be something for the Orthodox Rabbis and appropriate Muslim leadership to consider.]]

The FVE is not alone in this view. Dunn compared the upright restraint of cattle with the Weinberg rotary pen, and concluded that upright systems have a better welfare score (Table 6.1) (Dunn, 1990).[[His work was done at a plant that was doing a terrible job – it is the same plant the Swedes used to determine that the ban on religious slaughter was justified. Both Temple and I would support banning such equipment as well as banning shackles and hoist and other such slaughter in Latin America. Given the newer equipment, there is no excuse for poor equipment.]]

Dunn also found higher plasma cortisol levels after rotation than after upright restraint, which Japanese researchers were able to confirm (Tagawa et al., 1994). They observed that plasma cortisol levels trebled in Holstein cows after being rotated onto their backs. Arterial oxygen tension and oxygen saturation also reduced substantially.[[This is tricky equipment to design and use right – so it becomes technically important to do it with the state of the art equipment. And if some forms of equipment fail, these may need to be banned – but if better equipment is developed it should be permitted – the key is to establish maximal/minimal levels for key parameters.]]

The researchers concluded that rotating an unstunned cow causes considerable distress. [[Again, under what conditions?]]

Research into the amount of time that animals remain in a restrainer before being stunned in conventional slaughter or having their throats cut in shechita has shown that the Jewish method takes far longer. The animals slaughtered conventionally were also calmer. The researchers did not test the differences for statistical significance. (Table 6.2) (Koorts, 1991; Gregory, 2005).

**Table 6.1** Comparison of two types of cattle fixation used in slaughter without stunning (Dunn, 1990).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Weinberg (rotary)</th>
<th>ASPCA (upright)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixation-throat cut interval</td>
<td>103 seconds ± 18</td>
<td>11 seconds ± 12</td>
</tr>
<tr>
<td>Total struggling time</td>
<td>11 seconds ± 7</td>
<td>1 second ± 4</td>
</tr>
<tr>
<td>Number of vocalizations</td>
<td>4.6 ± 6.1</td>
<td>0.3 ± 0.75</td>
</tr>
</tbody>
</table>

[[**The high vocalization suggests poor equipment. Both Temple and I strongly favour upright slaughter.]]

**Table 6.2** Holding time in seconds of cows in restraint box prior to stunning or throat cut (Gregory, 2005).

<table>
<thead>
<tr>
<th>Category</th>
<th>Conventional slaughter</th>
<th>Shechita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seconds before electrical stunning</td>
<td>Number of investigated animals</td>
<td>Seconds before throat cut</td>
</tr>
</tbody>
</table>
Calm & 7 & 1085 & 33 & 511 \\
Agitated & 14 & 418 & 62 & 868 \\
Wild & 22 & 58 & 81 & 208 \\
Uncontrollable & 35 & 2 & 99 & 41 \\
Total & 1563 & 1628 \\

[**Again – which plants? Are these well run plants or one that was not doing a good job of religious slaughter?**]

Grandin has spoken out in recent years in favour of upright restraint in kosher cattle slaughter in the United States, and has reached agreement with Jewish organizations (Grandin and Regenstein, 1994). Upright restraint prevents the aspiration of blood and rumen content into the lungs after the throat cut. Adding a supporting restrainer to a box with upright animals represents a marked improvement. The cattle lie on the restrainer with their belly and brisket supported (Figure 6.4). [[Misleading – it is not a support device. And The head holder is also very important.]]

Grandin says that with constant refinement of the fixation apparatus, the environment in which it is used, and the expertise of the operators, it is possible to slaughter cattle humanely without prior stunning (Grandin, 2008). This view is confirmed by the observation that cattle slaughtered in calm surroundings have lower blood cortisol levels, which indicates less stress (Tume and Shaw, 1992). An alternative is the development of an improved restraint method that rotates to the maximum side orientation, allowing the throat cut to be made more conveniently.

**Figure 6.4** Design of a cattle slaughterhouse for ritual slaughter without stunning, with a supporting structure under the animal’s belly and brisket (Grandin, 2008). [[The belly lift is specifically NOT for support but is more of a quiet constraint.]]

6.2.2 Fixation of sheep

Sheep can be held with special restrainers, or laid by an experienced assistant on their backs in a V-shaped holder, before severing the carotid arteries with a sharp knife. Behavioural studies have shown that sheep prefer upright restraint to being laid on their backs (Rusken, 1986).

In the Netherlands, most sheep and lambs are slaughtered ritually, and the majority of those without stunning. Lamb meat imported from New Zealand and Australia is halal, but does come from animals that were electrically stunned before slaughter (Pleiter, 2005; Van Dinther, 2006). Halal slaughtered sheep for export from Germany are also electrically stunned prior to the throat cut (Nowak, 2005) (Figure 5). No literature was found on investigations of the animal welfare effects of the fixation of sheep prior to ritual slaughter.

[**Eblex has a video showing both stunned and un-stunned sheep slaughter. The plant I believe is in the UK and does a good job of un-stunned slaughter. A key to both the V-constrainer and the double rail is the dramatic calming effect of these systems on the animal once their feet are off the ground.**]

**Figure 6.5** Halal slaughter of sheep with prior electrical stunning (Nowak, 2005).

6.2.3 Fixation of chickens

According to B.J. Odink, the chairman of the Association of Dutch Poultry Processing Industries (NEPLUVI), no chickens are ritually slaughtered in the Netherlands without prior stunning (Van der Lugt, 2006). Chickens destined for ritual slaughter in the Netherlands are hung by the legs, passed through an electrically charged water bath and then exsanguinated with a throat cut. [[Malaysia has just banned mechanical slaughter – since they were singled out earlier, this is worth now mentioning!]] However, there are doubts about the effectiveness of the stunning method in practice. In the interests of avoiding heart failure, which would impede complete exsanguination, a lower voltage is administered than that necessary for full stunning. Animals are then merely immobilized prior to mechanical cutting (Gerritzen, personal statement). The usual procedure is therefore still painful for the animal. [[This I believe is the normal situation used in America – the key is to be sure that animals are NOT immobilized but actually lightly stunned.]]

Slaughter without stunning is permissible in England, but halal poultry slaughter with prior electrical stunning also occurs (Wesche, 2005). Shechita involves no stunning. The chickens have their throats cut immediately after being removed from the crate, and are therefore not hung while conscious. Barnett reports that the average interval between being picked up from the crate and exsanguination is five seconds, with a minimum of 3.6 and a maximum of 7.7 seconds (Barnett et al., 2007).[[The holding of the birds for kosher slaughter actually serves a calming effect. I’ve seen both good and bad holding of animals prior to kosher slaughter. I also spent my 60th birthday in the blood pit of a halal slaughter plant that slaughtered after hanging and did a great job. It actually was as calm (possibly calmer) than a traditional US poultry slaughter plant.]]
6.3 The throat cut

The blood vessels in the neck play an essential part in brain energy and oxygen management. Between fifteen and twenty per cent of the oxygen-rich blood that the heart pumps to the body goes to the brain. The main supply to the brains of larger mammals such as cattle is through the carotid arteries and the vertebral artery that runs behind the spine along the back. [This is misleading – the main arteries are what are cut. Only cattle among the major animals have additional arteries/veins behind the spine that are not cut. But the drop in pressure with a cut causes loss of consciousness although clearly slower than sheep. However, the speed of unconsciousness versus the quality of that death needs to be carefully considered. An animal calmly dying with no behavioural symptoms is not necessarily a stressed animal.] Sheep have no vertebral artery. The throat cut severs the jugular veins, the carotid arteries, the oesophagus and the trachea, as well as neck muscles and nerves, leaving vertebrae and the spinal cord intact. Blood pressure then falls sharply and the brain blood supply is interrupted, so that the animal soon loses consciousness.

The throat cut in halal slaughter may be made with or without stunning the animal. Shechita requires the animal to be conscious, and it is therefore not stunned. But, as mentioned above, kosher slaughter has been practised in Sweden for several years with prior electrical stunning. (Berg, 2005). [[And is misleading – emergency legislation to permit food.]]

**Figure 6.6** The blood supply to the brain of cattle, under normal circumstances (a) and after the throat cut (b) (from Rosen, 2004). Differences of opinion exist about the blood flow direction through the vertebral artery after the throat cut (EFSA, 2004). [[So another critical piece of information that is used negatively for religious slaughter has not received the appropriate experimental work]]

The knife used in shechita is of surgical quality and is handled by specially trained personnel. The knife used in halal slaughter is shorter than the Jewish chalaf. The person handling the knife in halal slaughter is given no specific training. [[But why not talk about the amount of training given a shochet? And the Muslim community is willing to use a longer knife and receive knife sharpening training – again instead of attacking the religious community – doing things Temple Grandin’s way, i.e., working with the community, especially with positive (including financial?) help from the government might actually lead to significant improvements in animal welfare by providing an attitude that supports good practices.]]

The throat cut may evoke a pain response. Scientists have differing opinions about the degree of pain, fear and other discomfort. Grandin says that a throat cut that is skilfully executed without stunning while an animal is calm is not painful (Figure 7; (Grandin and Regenstein, 1994)). She reaches this conclusion on the basis that animals that are led to slaughter correctly and restrained effectively bleed out calmly after the cut, with no head or leg spasms. Rosen also considers that a throat cut without stunning does not necessarily cause the animals pain (Rosen, 2004). [[Thank you for including this.]]

A European Food Safety Authority (EFSA) report from 2004 notes nonetheless that the neck area has a large number of pain and other receptors that have evolved as a means of warning an animal of tissue damage. A severe injury in the neck area would therefore definitely cause pain (EFSA, 2004). [[Is there real data or just their conjectured conclusions?]] On the other hand, Zimmerman notes that humans feel pain only several seconds or minutes after an accidental knife cut. He also concludes that an animal slaughtered without stunning may go into shock, with the release of endogenous substances [[Endorphins with a positive impact]] that would suppress any sensation of pain (Zimmerman, 2005). This ‘stress-induced pain suppression’ is said to have evolved in prey as a mechanism for improving the species’ chances of survival. Serious injuries to animals are often caused by attacks from predators or fights with members of the same species. Rather than paying attention to its wounds, the animal would be more likely to survive by first seeing off the threat, for example by freezing, fleeing, or fighting back (Harris, 1996). It is unclear whether this form of pain suppression occurs in all animals of a given species. Without it, serious suffering would result. [[But why not study this before jumping to conclusions?]]

Severing the phrenic or other nerves in the neck region could produce [[Speculation]] a sensation of breathlessness or suffocation (von Wenzlawowicz and von Holleben, 2007). Because the trachea is also severed, the animal would be unable to express feelings of fear and pain by vocalizing.

At any rate, much depends on the correct execution of the throat cut. Little data are available in the literature about the incidence of poorly executed throat cuts, although there is mention that an incorrectly executed throat cut or inadequate neck restraint can lead to obstruction of the severed blood vessels, which prolongs exsanguination (Gregory et al., 2006; Gregory et al., 2008) [[This is part of what needs to be worked on in a positive and supportive way to see that it happens even less than it does now.]]

**Figure 6.7** Restraining the head prior to making a throat cut without stunning, with fixation on a supporting restrainer as in Figure 6.4 (Grandin, 2008).

### 6.3.1 The throat cut for cattle

Both halal and kosher slaughter regulations require the throat cut to be made bilaterally (Waalkens and Zeijlemaker, 2007), in one or two fluid movements. [[actually it is all about a continuous cut and not the number of strokes.]] Research (Gregory et al., 2008) has shown that more cuts often have to be made. Shechita takes 3.2 cuts on average, and halal slaughter 5.2. Notably, for ten per cent of animals, one neck artery appeared to be
incompletely severed, if at all (see Table 6.3). [These suggest a failure of training and something to work on.]

Grandin’s and Regenstein’s study of unstunned cattle’s reaction to the throat cut was mainly qualitative (Grandin and Regenstein, 1994). They reported that the throat cut caused less distress than an ear tag punch. Poorly constructed restraints also caused more stress than the actual throat cut. Grandin says that an animal hardly notices a throat cut performed with a razor-sharp knife. She considers the length of the knife to be important, and observes that the knives used by some Muslim butchers are too short. Grandin recommends that knives be at least twice as long as the width of the neck of the animal to be slaughtered. She encourages the use of straight knives if animals cannot be stunned in advance. She is also of the opinion that Muslim slaughtermen receive insufficient training to guarantee a properly executed throat cut with unstunned cattle, and therefore urges prior stunning for halal slaughter. The reversible stunning used in New Zealand is now accepted by most Muslim authorities (Pleiter, 2005). [This is often more business/industry than the actual Muslim consumer.]

With production rates rising, slaughterhouses can hardly avoid stunning, since slaughter is faster with than without it. The amount of pain caused by the incision depends greatly on the skill of the slaughterman and the quality of the knife. The pain sensation is difficult to measure, and opinions on the subject therefore tend to be subjective. Grandin says that jerky movements of the restraint equipment and hissing noises cause more distress than the incision (Grandin, 2008), and she therefore recommends training employees in calm animal handling and a proper cutting technique, adapting equipment to suit the animals, and eliminating distractions that make animals balk. [These are critical issues that seem to be ignored in the debate.]

Table 6.3 Incidence of pseudoaneurysms after throat cutting in cattle (Gregory et al., 2008).

<table>
<thead>
<tr>
<th>Method</th>
<th>Countries</th>
<th>Slaughterhouses</th>
<th>Animals</th>
<th>Cuts per animal</th>
<th>Animals with pseudoaneurysms</th>
<th>Animals with intact or incompletely severed neck artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shechita</td>
<td>Turkey, France, United Kingdom</td>
<td>3</td>
<td>231</td>
<td>3.2</td>
<td>18%</td>
<td>10%</td>
</tr>
<tr>
<td>Halal</td>
<td>Bangladesh, France</td>
<td>2</td>
<td>116</td>
<td>5.2</td>
<td>17%</td>
<td>1%</td>
</tr>
<tr>
<td>Stunning without cardiac arrest</td>
<td>United Kingdom</td>
<td>1</td>
<td>387</td>
<td>Not determined</td>
<td>25%</td>
<td>1%</td>
</tr>
<tr>
<td>Stunning with cardiac arrest</td>
<td>France</td>
<td>1</td>
<td>20</td>
<td>7.9</td>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>

["Why are countries being pooled? Some of this is very country specific. And these are not cuts per animal but number of back and forths and the last two items if I understand them correctly suggest that Halal stunning is being questioned?]

As mentioned above, in Austria the animals’ throats are cut while they are restrained without prior stunning, with immediate post-cut stunning by pistol (Gsandtner, 2005). This method is accepted by both the Muslim and Jewish communities. [This is again misleading. The post-slaughter stunning has more problems for the Muslim community although again locally may be accepted. And for Jews this has become the line between glatt which has become normative and non-glatt which is Hebrew National and others for the left wing of Orthodox and which is accepted by the Conservative Movement. It should be noted that I helped write that response.]

If the head is unsupported, the neck wound can close, which slows exsanguination and prolongs the animal’s consciousness. Sometimes severed vessels also become constricted in a phenomenon known as ballooning or pseudoaneurysm (Gregory et al., 2006; Gregory et al., 2008), as blood accumulates in the surrounding tissue. Blood pressure in the brain then cannot fall rapidly, and the brain blood supply is maintained through alternative branches that are still intact (Blackman et al., 1986). [That is why the Temple Headholder needs to be insisted on and properly designed for upside down slaughter also.]

Recently published research has shown that ballooning occurs regularly in both halal and kosher slaughter (Gregory et al., 2008). Gregory’s results, which were published in 2008, are briefly summarized in Table 6.3. The only cases where the phenomenon does not occur is in animals in cardiac arrest after electrical stunning. In halal slaughter in New Zealand, therefore, the throat cut is sometimes followed by chest sticking to ensure rapid exsanguination, even if the neck vessels are obstructed. [This is done, but its halal status is up for discussion.]

6.3.2 The throat cut for sheep

When sheep’s throats are cut without stunning, they are often laid on their sides beforehand. If sheep are electrically stunned in advance, the cut is made while the animal is already hoisted by chain (see Figure 6.5).
There has been little research into the welfare of sheep during ritual slaughter. Levinger describes the kosher slaughter of 150 sheep and reports that six of them (four per cent) continued to try to raise their heads after the throat cut. Two of these six sheep were found on later examination in the abattoir to have one unsevered carotid artery (Levinger, 1976).

The neck vein ballooning phenomenon that was described for cattle was not observed in the slaughter of lambs (Gregory et al., 2006).

Any fleece present in the neck region would hamper the execution of the throat cut, and would demand an extra shearing. Loose skin on a sheep’s neck could likewise hamper the execution of the throat cut, so that the cut might have to be repeated several times. There is only anecdotal information about the above. [[This is an area needing further research – and the issue of washing the animals neck or shearing is one that needs discussion and work.]]

The literature gives no exact figures (von Wenzlawowicz and von Holleben, 2007).

6.3.3 The throat cut for poultry

The throat cut for poultry in most ritual slaughterhouses is made after hanging the animals by the legs. Half of the animals in European slaughterhouses that perform ritual slaughter are immobilized electrically in advance. Halal slaughter differs little from the conventional method (van Dinther, 2006; Velarde et al., 2008), partly because the electrical parameters commonly used in conventional slaughter are incorrect for achieving effective stunning (EFSA, 2004). [[This sentence is confusing – not sure what is being said.]]

In an investigation of slaughter without stunning under experimental conditions,[[What does this mean? Sounds like it is not a valid situation?]] all halal chickens were found to have had both neck arteries severed, compared with only 58 per cent of shechita chickens (Gregory and Wotton, 1986). [[This is sorely lacking in details and requires more information. Clearly this is an issue that needs to be addressed if true. But 1986 data is a little out-of-date at this time. The question of mechanical slaughter is an issue of its own in the Muslim community.]]

No data are available about the quality of the throat cut in ritual slaughter without stunning under practical conditions, in terms of whether all the veins and arteries in the neck area were completely severed.

6.4 Exsanguination

From an animal welfare viewpoint, the interval between the incision and loss of consciousness is the third point of interest in ritual slaughter without stunning, after correct restraint and a properly executed throat cut.[[But this needs to not be time but also quality of the transition from living to unconscious.]] Earlier studies have shown that ruminants lose one third of their total blood volume within thirty seconds of a shechita throat cut, with one half bleeding out after a minute (Levinger, 1976; Rosen, 2004).

The interval may be longer if the wound is not open - see Section 6.3.

The practice in some slaughterhouses in the Netherlands, of making the throat cut to only one side of the neck, so that bleeding out takes longer, has prompted calls for a ban on unilateral cutting (Waalkens and Zeijlemaker, 2007). This practice would not appear to be a point for attention in the international literature, where it is assumed that the religious rules prescribe cuts to both sides of the neck. [[Can you please describe the unique situation in Holland and why that might be happening? This again needs to be dealt with but first the reason needs to be determined.]

In ritual slaughter in New Zealand, the throat cut is combined with chest sticking in order to guarantee rapid exsanguination (Pleiter, 2005). This procedure is accepted by the Muslim authorities.[[Of certain countries and possibly not of the people eating the meat in those countries.]]

6.4.1 Exsanguination in cattle

It is important from an animal welfare point of view to know how soon an animal loses consciousness after the throat cut in slaughter without stunning. This interval depends on how quickly the blood supply to the brain stops. Many relevant summaries refer to a small-scale study by Blackmore from 1984, involving five calves and one young bull. The animals collapsed within ten to fifteen seconds of the throat cut, with one animal still attempting to stand after 47 seconds (Blackmore, 1984). However, Levinger, in his difficult-to-obtain, and therefore rarely cited book from 1976, describes many more extensive studies. For instance, he refers to a 1929 study by Sahlistedt, which showed that cattle bleed out almost completely within two to three minutes of a shechita throat cut. [[This is an important book – but it is also very out-of-date. Given the change in “handling”, these issues need to be reinvestigated.]]

Levinger investigated the effect of a throat cut in accordance with Jewish rules on the supply of blood to the brain, by injecting a pigment into the heart shortly before the incision and monitoring the presence of the pigment in various organs. Microscopic examination revealed pigment in the liver and kidneys, but little or none in the brain (Levinger, 1976). Blackman performed a similar experiment with calves, and found pigment in the cortex up to one hundred seconds after bilateral incision of the carotid arteries (Blackman et al., 1986). However, Rosen suggested in a discussion of these experiments that the throat cut in question was not performed in accordance
with shechita (Rosen, 2004). It is assumed that cattle can remain conscious for a relatively long time because their brains, unlike those of sheep and poultry, continue to receive blood through the unsevered vertebral artery (Figure 6.6) (Blackman et al., 1986; Gregory, 2005). Other factors in the time taken to lose consciousness are the speed of the incision and whether the animal was restrained in a way that keeps the wound open, allowing the blood to flow away freely. In cases of inadequate incision or fixation, the supplying blood vessels can be constricted by ballooning, slowing the blood pressure fall and keeping animals conscious for longer (Gregory et al., 2008). It is unclear to what extent factors of this kind were taken into account in earlier studies, which may explain the differences in the interval between throat cut and loss of consciousness reported by researchers (Rosen, 2004). Jewish laws require the wound caused by the cut to remain open, to allow rapid exsanguination and loss of consciousness. However, Table 6.3 shows that the kosher slaughter method gives no guarantee of rapid exsanguination. Blood may enter the lungs because the throat cut also severs the trachea (von Wenzlawowitzcz and von Holleben, 2007). Gregory found traces of blood in the trachea in 19 per cent of a group of animals slaughtered upright in accordance with shechita, and 36 per cent had blood in the bronchi. Since the spinal nerves remain intact, it is assumed that the animals will find this experience distressing (Gregory, 2008). Temple does believe that blood in the bronchi is a concern, but not in the trachea. And again the details of the slaughter need to be considered and possibly adjusted. No idea of which type of slaughter is being studied.]

Other indicators of the speed of loss of consciousness and sensation, besides the rate of exsanguination, are brain activity and reflexes. To start with, it is known that cattle that enter the restrainer calmly lose consciousness more quickly after the incision than those that struggle. Grandin says that cattle already lose consciousness within 60 seconds of the throat cut (Grandin and Regenstein, 1994), which she bases on data from other researchers, having performed no brain activity measurements herself. Bager has measured spontaneous cortical activity in a slaughtering experiment with young calves (Bager et al., 1992). Calves that had been stunned electrically in advance took 54 seconds to lose electrocortical response to the throat cut. The average corresponding time for animals cut without stunning was 48 seconds. An exception was formed by one calf with a neck artery blocked by a clot that had formed, which lost electrocortical response only eleven minutes and twenty seconds after its throat was cut without stunning. Disregarding this exception, the results of slaughter without stunning and with electrical stunning differed little. The studies reveal the electrical stunning method used by the researchers to be unacceptable. A recommendation for cattle is therefore to combine stunning of the head with an electrical discharge to the heart (EFSA 2004).[[I am having trouble following the argument. The assumption seems to be that the brain activity should decrease more rapidly for electrical stunned animals? Is this stunning to stun or stunning to kill?]] Daly compared mature cattle that were slaughtered after stunning by pistol with others slaughtered ritually without stunning. A shot to the head followed within one minute by chest striking led to immediate loss of any evoked responses, which is to say that external stimuli produced no new electrical brain activity. Animals continued to respond after a throat cut without stunning for between twenty and 126 seconds. [[I think this is the difference between unconscious and insensitive. The issue of the state of the animal needs to be more carefully considered.]] Spontaneous electrocortical activity stopped within ten seconds in the stunned cattle, but persisted in cattle slaughtered without stunning for as long as 113 seconds (Daly et al., 1988). Measurable brain activity therefore persists longer in slaughter without prior stunning. However, it is invalid to equate loss of brain activity with the time at which animals lose sensibility. Unconscious or insensitive]] which may well have occurred earlier. Evoked responses are also detected in anaesthetized animals, and in poultry even in combination with a flat EEG (EFSA, 2004).[[This is the area where I need help keeping all the issues straight.]]

EG measurements of one-week-old calves slaughtered ritually [[need more information]] without stunning showed that the first signs of loss of sensibility occurred at between 65 and 85 seconds, after which brain activity could resume up to 323 seconds after the throat cut. The calves’ EEG became extinct after between 132 and 336 seconds (Newhook and Blackmore, 1982a). The corneal reflex, which is how animals respond when the cornea of an eye is touched, was used in the past to assess loss of consciousness [[is this consciousness or insensitivity] of cattle after shechita. Cattle showed no further demonstrable reflex 38.8 seconds after the throat cut, whereas the time for goats was as short as 3.4 seconds (Levinger, 1976). In the slaughter of cattle after stunning with a pistol, the corneal reflex disappears immediately in 99 per cent of the animals (Gregory et al., 2007).[[In the US, non-glatt animals are “stunned” with a non-penetrating stunner. There is current data from Temple on time to insensibility for cattle and sheep that seems to not be reported here. For a proper cut it is about 10 to 33 seconds with about 17 seconds being the average. But again the quality of this transition is as important as the time.]]

6.4.2 Exsanguination in sheep

Sheep lose ninety per cent of their blood volume within one minute of the throat cut. Prior stunning, either electrical or by pistol, has no influence on the speed of exsanguination in sheep (Anil et al., 2004). Observations of behaviour suggest that sheep lose consciousness two to fifteen seconds after the throat cut (Gregory and Wotton, 1984).[[This is in agreement with Temple’s data.]]

Shaw and Tume measured the same cortisol levels with and without stunning, which may have been because the blood samples were taken within fifteen seconds of the throat cut, while cortisol release from the adrenal gland begins only after several minutes (Shaw and Tume, 1992).[[So is this a meaningful measurement?]] Brain activity measurements in sheep after a throat cut without stunning showed that they stopped responding to stimuli within seven seconds, with EEG extinction after between ten and 43 seconds (Newhook and Blackmore, 1982b). The
difference with cattle (see Section 6.4.1) is attributed to differences in the anatomy of the brain blood supply (Blackmore, 1984). Unlike cattle (Figure 6.6), the vertebral artery of sheep does not reach the brain (Blackman et al., 1986).

6.4.3 Exsanguination in poultry

Australian researchers have timed the interval to loss of consciousness after a shechita throat cut [[by a shochet or by a scientist?]] by putting the birds (n=41) on the ground and measuring how long they remained on their feet (Barnett et al., 2007). [[Does this itself affect the results – puts the head in a different position.]] The average interval was fourteen seconds, with a minimum of eight and a maximum of 26 seconds. Some chickens were still capable of coordinated movement almost half a minute after the throat cut. Electrical activity can be aroused in the brains of broiler chickens for an average of 136 seconds after decapitation, whereas the corresponding time after a throat cut is 163 seconds (Gregory and Wotton, 1986). The animals will probably have lost consciousness earlier, but the exact time is hard to ascertain. Gregory’s estimate is about twenty-five seconds (EFSA, 2004). If broiler chickens are electrically stunned in a water bath less than ten seconds before exsanguination, they lose consciousness twenty seconds [[that’s worse than the shechita cut if I read this right?]] after stunning (Raj et al., 2006).
7 Ritual slaughter with stunning

Halal slaughter occurs with stunning in several countries. Kosher slaughter occurs with stunning in one country, Austria, immediately after the throat cut.

Many Muslim authorities accept as halal the reversible variant of electrical stunning. Irreversible electrical stunning is achieved by passing current through both brain and heart. The release of neurotransmitters in the brain combined with heart failure results in a brain oxygen deficiency, which prevents the animal regaining consciousness. Reversible stunning is achieved by a brain-only electrical discharge. In both cases, large quantities of neurotransmitters are released in the brain, so that the animal loses consciousness within 200 milliseconds. Reversibly stunned animals subsequently exhibit epilepsy-like convulsions, which occur rarely with irreversible stunning. The released neurotransmitters ensure that the animal is insensible to pain stimuli for between five and fifteen minutes. If the throat of a reversibly stunned animal is not cut immediately, it may regain consciousness and resume normal behaviour. Reversible stunning requires accurate electrode placement. If attached too far to the back of the head, the stun will be ineffective. Although the animal will be temporarily paralysed it will not lose consciousness. [[What are the implications for animal welfare if this is the case?]]

Furthermore, the strength and duration of the electric shock are important factors in complete stunning. Under practical conditions, a current of between 1.5 and 3.0 amps for two to four seconds is recommended for cows. For calves, 1 - 1.5 amps for two to three seconds will suffice, and 0.7 - 1.0 amps for 0.8 to two seconds for sheep and lambs.[[Is this for reversible or irreversible stunning?]]

The stun equipment delivers a preconfigured current, taking into account the resistance of the animal’s skin. Stunned cattle in New Zealand are laid on an electrically live slaughtering table to suppress epileptic convulsions, which workers do not then have to contend with. Then the throat cut is made, followed immediately by chest sticking to accelerate bleeding. The interval between the electrical discharge and chest sticking is less than twenty seconds. Sheep in New Zealand are slaughtered in this way on a large scale in a largely automated procedure. See Pleiter (2005) for a comprehensive description of the above. Wege states that the German Muslim authorities have also accepted as halal the stunning of cattle with a pistol. Animals must be positioned with their heads pointing towards Mecca, with exsanguination achieved by a throat cut. The halal meat is exported to various Arab countries (Wege, 2005). [[which are a minority of the Muslim world, actually about 20% and it is not clear that the people in these countries approve – this is done by the official agencies and the meat importers.]] Cattle in Austria have their throats cut after fixation while conscious. They are then stunned immediately with a shot to the head. This method is accepted by both the Muslim and Jewish communities. [[Freely or under duress?]]
Animal welfare consequences of the main systems of stunning and killing farm animals destined for consumption are discussed comprehensively in an EFSA report drawn up by prominent researchers in the field (EFSA, 2004). We summarize the findings briefly below.

The purpose of stunning animals to be slaughtered is to induce unconsciousness and insensibility, so that they can be spared avoidable fear, anxiety, pain, suffering and distress. Some stunning methods have only temporary effect, so that the animals have to be bled promptly for a satisfactory result and to cause death. If exsanguination is not rapid enough, an animal may regain consciousness, with all the attendant consequences.

Bleeding is facilitated by what is known as sticking, which severs the major blood vessels in the neck or chest. Stunning and killing may occur simultaneously or sequentially.

The stunning methods are set down in the Directive (European Community, 1993) and the Health and Welfare of Animals Act (GWWD, 1992), and fall into three categories: mechanical, electrical, and gas.

### 8.1 Mechanical methods
Mechanical stunning works by propelling a captive bolt into the brain of cattle or sheep, which inflicts sufficient damage to stun the animal without causing pain or anxiety (Lambooy & Spanjaard, 1981). A disadvantage of this method is that it cannot be automated, and the result depends on the training and skill of the operator. EFSA recommends harmonization of the various bolt guns on the market, especially with respect to firing force. All equipment should be inspected regularly for conformance with the original specifications. Regular maintenance is also needed.

Field studies indicate that up to ten per cent of executed stuns are ineffective. A field study in the United States found the proportion of bad stuns to be less than two per cent in three-quarters of the slaughterhouses, with only one in ten slaughterhouses rising above five per cent. These substantially lower percentages were achieved with the help of annual audits (Grandin, 2001). [[This suggests that there are problems with stunning – and these need attention – rather than banning because some folks don’t do it right!]]

### 8.2 Electrical methods
An electric shock can induce immediate unconsciousness and render an animal insensible to the subsequent exsanguination (Lambooy, 1982; Lambooy & Spanjaard, 1982; EFSA, 2004). Electrical stunning puts high demands on equipment and operators. Satisfactory performance requires monitoring of the voltage, current and frequency of the discharge. Head-only stunning with electrodes placed on both sides is the method applied for most animals. This method sometimes stuns mature cattle for too short a time to keep them unconsciousness during exsanguination. This problem can be solved by electrical stunning of the heart (Lambooy & Spanjaard, 1982). Furthermore, better fixation of the animals can reduce the stun-stick interval enough for them to remain unconscious until death, without shocking the heart. Poultry is usually stunned electrically in a water bath, after being hung upside down by the legs, which causes pain and distress. [[So we need to work on the shackles – agreed rather than write legislation banning shackling of chickens? Or is this some people’s goal?]] There is currently public debate about the strength of the conventional electrical shock used in the Netherlands for stunning poultry. Researchers[vague and likely misleading] are of the opinion that a discharge that is too weak merely immobilizes but does not stun. Although the animals will show no sign of this situation, it is a fact that they are still conscious and will feel pain (EFSA, 2004). A problem is that discharges that are powerful enough for complete stunning could cause haemorrhaging, and render the quality of the carcass unacceptable. Account must be taken of the thick fleece of sheep in electrical stunning. Fitting pins to the electrical stunning tongs is advisable, as is wetting the fleece to lower its electrical resistance. If animals are not properly restrained, the result of stunning may be unsatisfactory. [[So all is not well here either.]]

### 8.3 Methods based on gas
Animal welfare improvement was one of the main reasons for developing and introducing poultry stunning methods based on CO₂ gas. Most of the reduction in suffering is attributable to avoiding the need to hang the birds on slaughtering hooks while still conscious. Instead, they are carried on a conveyor belt, either after being tipped out of the transport crate, or still inside the crate. In either case, no manual handling is involved. The conveyor belt then takes them to the stunning tunnel.

If birds inhale high CO₂ concentrations, the CO₂ content (pCO₂) of their blood rises, and the oxygen tension (pO₂) falls, together with oxygen saturation. The rising pCO₂ causes both the blood and cerebrospinal fluid pH to fall (Martoft 2003; Gerritzen, 2006). The normal pH of cerebrospinal fluid is 7.4. A state of analgesia and anaesthesia are induced at a pH of about 7.0. The pCO₂ stimulates breathing, so that in a CO₂-rich environment more CO₂ will be inhaled than exhaled. As a consequence, the CO₂ concentration in the blood rises even more, the pH falls, and the oxygen percentage in blood, brain and the rest of the body continues to fall until the onset of death. With gas, stunning and killing are therefore two stages of the same process.

An important point is that, unlike mechanical or electrical methods, the animals do not lose consciousness immediately, but gradually. While this is happening, the animals may show aversion to the gas, and suffer a biting
or pricking sensation and breathlessness. It has been shown that several types of animal lose consciousness when inhaling air with a CO₂ content of between seventeen and twenty per cent (Danneman 1997; Gerritzen, 2006). However, the higher CO₂ concentration that is needed to kill animals in less than a few minutes causes pain and breathlessness. [[Thank you for noting the pain! And a slow kill – so time has to be reconsidered – so the idea that a good death may take time is acceptable to those who favour gas?]]

These negative aspects of CO₂ can be greatly reduced by adding O₂, but the process then takes much longer. Therefore a two-phase system has been devised, in which animals first lose consciousness in a low CO₂ concentration before being exposed to a lethally high concentration. A system of this kind considerably reduces distress in the animals. [[This is a complex system to do right over a long time period? And how long does the low CO₂ stunning take?]]
9 Conclusions and recommendations

The literature shows that ritual slaughter without stunning is worse [[actually the case for making such a decision is actually pretty weak given the issues that need to be raised?]] for animal welfare than slaughter with prior stunning. This already follows from the need to restrain animals that are to be slaughtered without stunning, to hold them in full consciousness while their throats are cut. The fixation can cause much distress, in particular to cattle that are laid on their backs. [[But that is a small amount of the total kill?!]] Furthermore, it cannot be ruled out [[this is not science – haven’t we figured out how to determine consciousness versus unconsciousness? Maybe the veterinarians really need some help from the medical profession!]] that cattle remain conscious for a relatively long time because their brains, unlike those of sheep and poultry, continue to receive blood through the unsevered vertebral artery.

In view of the large number of pain receptors in the neck region, animals slaughtered without stunning will experience a severe pain stimulus when their throats are cut. [[This is inconsistent with the behaviour information.]] A state of shock may possibly suppress the pain sensation in some animals.

The time it takes for an animal to lose consciousness after a throat cut without stunning depends significantly on the quality of the throat cut. The literature shows that much is wrong in this area, so that animals suffer even more severely. [[And so improvements are needed. If these numbers were bad for a really good set up – then we have a problem that might not be solvable. But given the lack of details, we have no idea what a good system’s numbers would be. Interestingly, the last time Dr. Grandin made a full review of European kosher slaughter houses she found none that were excellent. In Canada we have TWO plants that are excellent, yet no one has ever done measurements there!]]

Blood may enter the trachea and lungs during exsanguination. Animals that are still conscious must then experience severe discomfort, producing a sense of suffocation. [[This is overstated here.]]

Various Muslim and Jewish organizations appear to accept certain forms of ritual slaughter with stunning. [[Very misleading in the broad context which no one in this paper or DialRel ever tried to understand properly.]]

The discomfort involved in ritual slaughter can be reduced by attending to details of the restraining methods, altering the design of slaughterhouses, using trained personnel, and performing regular slaughterhouse audits. [[This is the most important statement in the conclusion – we have serious work to do and the religious community and the scientific community need to work together to address these issues.]]

The data reported in this study are based on research conducted in other countries. No data about the situation in Dutch slaughterhouses that perform ritual slaughter are currently available. [[But the government is ready to take action with no knowledge!]]

- The slaughter of animals without stunning has the following disadvantages compared with slaughter with prior stunning:
  - o a different method of restraint must be used for performing the throat cut, which causes considerable additional distress, depending on the method, but in particular to cattle;
  - o [[Only if it is not designed right – the key is that religious slaughter does require an investment in equipment.]]
  - o animals have their throats cut while fully conscious, which evokes, depending on the (variable) quality of the throat cut, a severe pain response; [[This is not consistent with the actual data. This is anthropomorphism.]]
  - o it cannot be ruled out that cattle remain conscious for a relatively long time because their brains, unlike those of sheep and poultry, continue to receive blood through the unsevered vertebral artery;
  - o **[[Consciousness is not about blood being available, it requires a high enough blood pressure and even then I can be made unconscious without lowering my blood pressure.]]
  - o blood that is able to enter the trachea can cause a sensation of suffocation;
  - o [[No. It probably happens at the bronchii level – again the data needs to be much better done.]]
  - o the fact that some forms of stunning are accepted in ritual slaughter in several countries is a powerful argument to be used in discussions with religious organizations in the Netherlands, with a view to reviewing the feasibility of solutions of this kind. [[This is imposing religious standards inappropriately and is an inappropriate statement for a scientist/veterinarian to make.]]

- If animals must be slaughtered without stunning, they should be:
  - o stunned immediately after the throat cut;[[You haven’t made a compelling case for this.]]
  - o slaughtered under the direct supervision of the competent authority, in the person of a vet; [[Job creation but not sure it actually accomplishes anything.]]
  - o handled by properly trained and certified personnel; [[Absolutely agree – and this is again what really needs to be done.]]
  - o handled in a slaughterhouse where holding pens and chutes to the restraining device are designed to avoid causing fear and distress; [[Another totally right on suggestion.]]
  - o (for cattle) restrained on a supporting restrainer with a head restraint at one end, unlike the common rotary fixation practice in the Netherlands. An alternative would to develop an improved restraint method with partial rotation to the side for easier performance of the throat cut; [[The details of what actually works needs to be worked out and Dr. Grandin or someone trained by her needs to be
• Better monitoring is required of the correct application of stunning criteria in the water bath method for poultry. [[Agreed]]

• Since relaxation of the ritual slaughter notification obligation, there is no longer a clear picture of the number of animals ritually slaughtered (without stunning) in the Netherlands. The supervisor, the Food and Consumer Product Safety Authority (VWA), must record the number of animals and the types of animal per slaughterhouse that are ritually slaughtered (without stunning). Clarity is also required as to the number of slaughterhouses that perform ritual slaughter exclusively, and of those with a mix of ritual and conventional slaughter. [[The government ought to know what is going on – if there is regular inspection, why cannot a lot more information be collected by the inspectors on the premises. Good for their job security.]]

• Much more information is required about the domestic and foreign markets for meat from animals slaughtered without stunning in the Netherlands. [[This is misleading – market information is needed, but this ought to be collected for all meat into and out of the Netherlands.]]

• Imported meat from animals ritually slaughtered without stunning must comply with the same requirements on slaughter methods as apply to slaughter in the Netherlands. [[Not if the Netherland rules are punitive. If they truly reflect an agreement with the religious community, then it makes sense to do this.]]

• The slaughter method must be visible to the consumer on the packaging, so that people can avoid inadvertently or unwillingly buying the meat of animals slaughtered ritually without stunning. [[This is a political not a scientific conclusion. If so then all forms of slaughter need to be noted on the package and certainly animals provided by hunting need to be identified.]]

• EU rules must be drawn up for the halal mark, by analogy with the Dutch EKO eco-label. [[Why? This is again an invasion of religious space. Again how does this derive from your scientific review of the literature?]]
Appendix

Summary of observed animal welfare differences between slaughter with stunning and ritual slaughter without stunning

The following three tables present observations from the scientific literature to date, on the differences that are relevant to animal welfare between slaughter with and without stunning prior to the throat cut. Various other differences between slaughter methods are also included. The tables are for cattle, sheep and poultry, respectively. [[These tables are bogus because they don’t tell you in most cases how the animals were killed – selecting a bad kill guarantees damaging data but that only shows the operation needs improvement and may not address the issues of un-stunned slaughter!]]

<table>
<thead>
<tr>
<th>Table</th>
<th>Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Difference</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Without stunning less calm during fixation [[what equipment?]].</td>
</tr>
<tr>
<td>Number of animals that slip or fall over</td>
<td>Not related to slaughter method.</td>
</tr>
<tr>
<td>Use of electrical prods</td>
<td>Not related to slaughter method.</td>
</tr>
<tr>
<td>Substances in blood or tissues</td>
<td>Cortisol higher in inclined [[vague]] ritual slaughter.</td>
</tr>
<tr>
<td>Brain activity (EEG) and/or heart function (ECG)</td>
<td>Measurable brain activity persists for longer without stunning. [[What slaughter system – I believe all of Daly’s is on the horrible Weinberg pen]]</td>
</tr>
<tr>
<td>Corneal reflex</td>
<td>Without stunning demonstrable for longer.</td>
</tr>
<tr>
<td>Quality of the throat cut</td>
<td>Not performed well in 5 - 10% of cases in both halal and kosher slaughter. [[Needs training]] Aspiration of blood into the lungs in kosher slaughter. [[What types of systems were actually studied?]]</td>
</tr>
<tr>
<td>Incidence of incomplete stunning</td>
<td>Not relevant to slaughter without stunning; commonly occurs in conventional slaughter.</td>
</tr>
<tr>
<td>Time to loss of consciousness</td>
<td>Longer in slaughter without stunning.</td>
</tr>
<tr>
<td>Total duration of slaughtering process</td>
<td>Longer without stunning. [[Absolutely – so what?!]]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table</th>
<th>Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Difference</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Fixation and laying on the back more stressful than in conventional slaughter.</td>
</tr>
<tr>
<td>Number of animals that slip or fall over</td>
<td>No data.</td>
</tr>
<tr>
<td>Use of electrical prods</td>
<td>No data.</td>
</tr>
<tr>
<td>Substances in blood or tissues</td>
<td>Cortisol levels do not differ.</td>
</tr>
<tr>
<td>Brain activity (EEG) and/or heart function (ECG)</td>
<td>Measurable brain activity persists for longer without stunning. [[So??]]</td>
</tr>
<tr>
<td>Corneal reflex</td>
<td>No data.</td>
</tr>
<tr>
<td>Quality of the throat cut</td>
<td>Throat cut unsatisfactory in 4% of cases.</td>
</tr>
</tbody>
</table>
Quality of knife used in halal slaughter insufficient. Grandin and Regenstein, 1994

| Incidence of incomplete stunning | No data. |
| Time to loss of consciousness | No data. |
| Total duration of slaughtering process | No data. |

### Table: Poultry

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Difference</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour</td>
<td>Wing flapping after suspension causes fractures in slaughter with stunning.</td>
<td>EFSA, 2004</td>
</tr>
<tr>
<td>Substances in blood or tissues</td>
<td>No data.</td>
<td></td>
</tr>
<tr>
<td>Brain activity (EEG) and/or heart function (ECG)</td>
<td>No data.</td>
<td></td>
</tr>
<tr>
<td>Comb reflex (instead of corneal reflex)</td>
<td>No data.</td>
<td></td>
</tr>
<tr>
<td>Quality of the throat cut</td>
<td>Incomplete incisions common in shechita. [[Which system – more than one plant? More than one country?]]</td>
<td>Gregory &amp; Wotton, 1986</td>
</tr>
<tr>
<td>Incidence of incomplete stunning</td>
<td>No data.</td>
<td></td>
</tr>
<tr>
<td>Time to loss of consciousness</td>
<td>No data.</td>
<td></td>
</tr>
<tr>
<td>Total duration of slaughtering process</td>
<td>No data.</td>
<td></td>
</tr>
</tbody>
</table>
Acknowledgments

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