

Comparison of the Stunning and Non-Stunning Slaughtering Methods in the Light of the Current Knowledge

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Citation: Yardimci M (2019) Comparison of the Stunning and Non-Stunning Slaughtering Methods in the Light of the Current Knowledge. J Vet Ani Res 2: 302

Article history: Received: 11 September 2019, Accepted: 05 November 2019, Published: 08 November 2019

Abstract

Islam sets up strict dietary rules and prescribes its followers will what and how to drink and eat under the term “halal”. Living halal and avoiding haram are the main frames for a Muslim life. Since halal meat is obtained from halal slaughter, it is a prerequisite that the animal must be alive at the time of the slaughter and death must be realized with a sharp knife cut. Otherwise, it could be suggested to kill or strangle the animal in the quickest way before the cut, because it is an indisputable fact that dead animals do not feel any pain. Regarding stunned animals, when electrical energy travels through the body, it may result in muscle cramp, paralysis in body, respiratory muscles and vocal cords, which induces pain and stress for the paralyzed animal. This might be observed as if the animal is not suffering when actually it is. However, the immediate cutting of the vessels of the neck without pre-stunning causes cerebral ischemia with depriving the brain from oxygen and glucose and it acts as a painkiller that disables the sensory centre and causes the animal to become entirely insensitive to pain. This paper attempts to assess the perception of pain during stunning and non-stunning slaughtering methods and give an objective perspective for halal slaughter in animals.

Keywords: Beta-Endorphin; Halal; Pain; Slaughter; Stunning

Introduction

The source of animal food is important for Muslims because the animal must be halal and still be alive before slaughter [1]. Such meats must be obtained from poultry or two hooved animals slaughtered in accordance with requirements specified in the Islamic sources [2,3]. Additionally, Islam definitively does not allow any intentional torment of harm or injury to the animal before or after its slaughter. In this respect, the welfare of the animal includes the pre-slaughter phase, slaughter and post-mortem phases [4]. One of the things that is intended and achieved by halal slaughter is drained out the greatest amount of blood in the body as soon as possible, because as soon as the blood is removed from the body, the animal feels the least pain [5]. Moreover, since the intensity of the pain sensors on a blade-thin line in the throat region of the animal is negligible, it can be said that the animal might suffer less when cutting with a knife compared to other slaughtering methods such as stunning [6]. In this context, it can be said that stunning is mainly the process of rendering animals immobile to make the butcher's job easier but not a solution to help the animal feel less pain.

The Islamic principles of slaughtering without stunning

As a main principle of Islamic approach, the animal to-be-slaughtered must not suffer unnecessary pain when being killed [4]. Halal slaughter starts with pronouncing the Name of Allāh and followed by making a quick cut with a sharp knife on the front of the neck. The animal should be laid on its left flank, facing towards Kibla. Cutting off the oxygen-supply by cutting carotid arteries, jugular veins, windpipe and oesophagus, directly affect the functions of the heart and brain which are called “life-functional centres” of the body by instantly depriving the flow of oxygen and glucose to the brain, the heart enables an easy painless death in a few seconds. Ensuring rapid and maximum blood loss (75-80% of the total blood amount of an animal) is also crucially important during halal slaughter, since it causes a haemorrhagic shock, which relieves the animal. In terms of additional animal welfare concerns, animals should be healthy and relaxed. A proper relaxation provides muscle energy to decrease pH level and lower the chances of microbial growth as well as improving its taste [4,7-9]. The slaughtering method of animals is common to Judaism and Islam in terms of cutting the neck and avoiding cutting the spinal cord of animal at the beginning of slaughter [10]. The main reason for this ritual is that the brain continues to send it electrical impulses to the heart demanding blood. This provides an advantage to drain more blood.

The harsh reactions of the animal are from the natural muscular contractions not due to pain [11]. Moreover, no side or secondary effects are seen on the animal in traditional slaughtering.

Other methods of slaughtering

Mechanical or electrical techniques are used in other methods of slaughtering to produce a stunning effect in order to make the animal paralyzed. Electrical stunning, captive bolt stunning and gas stunning are some of the examples of these methods.

Stunning means any procedure which causes instantaneous loss of reversible or irreversible consciousness in animals [12]. In electric stunning, a low voltage is applied using two tongs placed on both side of brain with the third tong placed anywhere else on body (apart from sensitive areas). An electrode is placed under the chin and behind the ears in head-only stunning which is called as reversible stunning [9]. A reliable stun quality depends on efficacy of induction and maintenance of unconsciousness to avoid unnecessary suffering in the birds [13]. Bakhsh, *et al.* evaluated the effects of non-stunning and head-only electrical stunning slaughtering process on meat quality traits of longissimus lumborum muscle in Korean black goats and determined no negative effects in both methods in terms of the quality of the meat [14].

Despite the information above, there is enough literature to indicate that stunning does not cause loss of consciousness and an electrically stunned animal suffers more pain than a traditionally slaughtered one. Proponents of modern halal slaughter techniques argue that recoverable pre-slaughter stunning or mechanical slaughter is essential for today's slaughter process to protect animal welfare but opponents of these methods claim that such slaughter techniques do not fully comply with the halal slaughter rules [15].

The Effect of Electricity on Animals

The administration of a high electric current causes pain and burns, due to the effect on the sensory nerve endings in the skin. Low electrical stimulus causes muscles to contract, whereas stimulation causes spasm and paralysis. For example, a patient whose finger is anaesthetised locally can still flex it. The use of electrical energy can cause pain when travelling through the body and may result in thermal injury, cardiac and respiratory arrest as well as in the damage of the integrity of the tissues [16,17]. The lowest current level only for head stunning is of 1 amp for sheep and goats, 0.7 amp for lamb and 1.5 amp for cattle although generally higher levels are usually used in order to realize effective stunning. Regarding the used voltages, an interval between 350 to 400 V is generally preferred. The electrical stimulus is generally higher than 50 hertz in sheep and the frequency can range from 50 to 1500 Hz in chickens [18]. Low frequency stunning results in lower blood loss, higher hemoglobin and higher bacterial counts in meat compared to high frequency head-only electrical stunning as well as non-stunning slaughtering methods [19].

Lambooij, *et al.* compared the effects of captive bolt stunning using air pressure and electrical water bath stunning in broilers and they stated that more convulsions and less blood loss were seen in air pressure stunning with more tender meat [20]. Gezgin and Karakaya, examined the effects of the electrical water bath stunning on the meat quality of broilers and reported that the electrical stunning significantly decreased the percentage of the blood loss but resulted in higher pH muscle values, higher water holding capacity and greater toughness and firmness in meat [21].

Research examining the use of electricity to immobilize animals by several researches has shown that electrical immobilization is harmful and should not be preferred as a restraint device in terms of animal welfare concerns. Electro immobilization causes paralysis and is used to restrain conscious animals. Since animals are conscious and aware of the interventions, but unable to respond, it is thought that electro immobilization is a source of distress [22]. Researchers who are against the use of electro-immobilization for animals claim that it does not make the animal unconscious and insensible to pain due to the fact that when it is used, a very small current is passed through the body that paralyzes the muscles. The animal is paralyzed but remains conscious whereas in electric stunning the animal immediately becomes unconscious [23-26]. Considering the risks of the stunning process, Robins, *et al.* reported that pulse ultra-high current stun system may play an important role in developing the halal slaughter method and would reduce the risk of resumption of sensibility during exsanguination by thoracic sticking, as well as elimination of epilepsy and its negative consequences [27].

The pain caused by stunning itself

Most of the literature on stunning slaughter animals has focused on the effects after the stage of being paralyzed and interestingly, the effect of "stunning itself" is ignored. Researchers generally examine the perception of pain caused by knife after stunning. Claiming that an animal exposed to electric shock beforehand should not feel any pain caused by a knife means that the pain caused by the electric shock is missed. The animal experiences pain when being stunned. Claiming that the lost consciousness under the effect of an electric shock can be recovered means that the nervous system is engaged to eliminate this effect. It is clear that there is a critical time which includes possible pain and distress due to stunning itself during the time until the animal is being cut by a knife. The pain experienced at the time of stunning by the animal is not an insignificant thing to be ignored. Otherwise, it can be suggested to kill the animal by using a high current in order to guarantee that the animal will not have any pain while being cut by a knife because it is an indisputable fact that dead animals do not feel pain. Nevertheless, stunning has taken its place in animal slaughtering as a widely used method. In past, it was firstly adopted to enable immobility in animals rather than insensibility. In time it was switched to provide insensibility to pain as a priority. Given the fact that much energy

is transferred to the brain by the impact of electricity, this causes tissue damage and deformation between the cortex and the skull. It results in permanent loss of brain activity due to the inhibition of coronary circulation of the brain. As a researcher studying on the subject, Kmoonpuri, opposes the argument that stunning is less painful as compared to the traditional Islamic slaughtering [11]. He states that the paralyzed animal feels serious pain and fear but cannot express it since it is motionless. This gives the wrong impression that the animal is not suffering when actually it is.

Based on the approach that “electrical stunning results in unconsciousness because of the epileptiform activity induces in the brain”, Gregory and Wotton, stunned 12 sheep subjected to a flashing light to test whether epileptiform stage followed electrical stunning or not [28]. They observed apparent cortical responsiveness during the epileptiform phase and suggested that the brain can respond to external stimuli in that condition. They concluded that electrical stunning does not stop the visual cortex activity in a consistent manner. Zulkifli, *et al.* presented a contrary approach in terms of stress perception [29]. They reported that electrical stunning elevated adrenaline and corticosterone plasma levels significantly, but not noradrenaline in broilers whereas neck cut had negligible effect on the adrenaline and noradrenaline but significantly increased corticosterone in both no stunning and electrical stunning. The study concluded that, slaughter with or without stunning may not induce a physiological stress response in broilers.

Also, when stunning is applied, the blood cannot be taken out from the meat properly. Some animals die when the heart stops, which causes less bleeding out and more blood inside. Chemical changes in the meat make it less healthy and less nutritious. Britain and Europe has prohibited one type of stunning (pithing) because of the risk of BSE [30]. Similarly, electrical stunning used for poultry has been found to increase the frequency of small dark red areas in the meat and lowers the glycogen reserves of the muscle. Almost 5% of the electrically stunned animals die before an incision is made [7]. There are also opposing arguments claiming that bleed-out is not adversely affected by stunning, nor improved by a neck cut without stunning [31,32] or slaughtering animals without stunning do not improve bleed-out, but increase blood in the trachea and blood splash in the lungs [33].

Mis-stunning is also another cause for pain. Zivotofsky and Strous, stated that mis-stunning or stressful stunning process is unavoidable under the best of circumstances and conflicts with animal welfare because the slaughter method must not cause extreme stress, pain, damaging or harmful effects to the animal [18]. Barbosa, *et al.* assessed the Stunning Severity Index (SSI) as a quality indicator of stunning in poultry and they stated that using the proposed index, 5% of the birds, on average, presented inefficient stunning symptoms [34].

In electric shock treatment of some patients in psychiatry, the patient's brain is subjected to a controlled epileptic seizure by supplying electrical current to the brain in sufficient amount and time. During this shock treatment, patients reveal severe contraction, pain, and they cannot return to a proper condition for hours. Nowadays the shock procedure is very painful and is performed under general anesthesia. It wouldn't be necessary if the electric shock had made the patient suddenly unable to feel pain [6].

Unconsciousness and Feeling Pain during Slaughter

The use of Electroencephalography (EEG) to assess unconsciousness

The nervous system which is known to be the main physiological system to control the perception of pain, can be partially or completely blocked by interfering the sensory or motor neurons. For instance, when a local anaesthetic is administered to a part of the body, the patient cannot feel the suture but can move it freely since only the sensory system is blocked while the motor system works. Conversely, a patient who awakens during an operation may still be able to feel, although he or she may not be able to move due to the paralyzing drugs which block the motor system; however, the sensory system is functioning. In this context, it is normal not to observe signs like making loud noises or thrashing around after stunning of animals since when large electric currents are applied, the skin is burned and the muscles are stimulated. Stimulation results in muscle cramp due to the lack of oxygen and hampers the activity of the respiratory muscles and vocal cords [35]. This does not mean that there is no pain because visual observations only cannot reflect the real perception of pain by the animal during slaughter.

Regarding the assessment of pain perception based on unconsciousness, EEG recordings applied under experimental conditions are considered to be the most objective way. The European Food Safety Authority (EFSA) proposed that EEG recordings should be used in the research which evaluates the stunning interventions [36]. During one of the experiments conducted by Schultz and Hazim on sheep and calves, some animals were slaughtered using halal method and some others by a captive bolt. Brain and heart activities were measured by the EEG and ECG records during the process. Interestingly, no change was observed in the brain activity in the first 3 seconds in EEG records in halal slaughter, which indicates that the animal did not feel any pain during or just after the incision. Three seconds later the EEG recorded a condition of deep sleep or unconsciousness. The authors predicated the situation to the large quantity of blood loss from the body. Therefore, after six seconds of incision, the EEG recorded no brain activity, which means that the animal felt no pain, the heart was still beating to drive maximum blood from the body by the reflex action of the spinal cord.

The relationship between the rapid falls in blood pressure and loss of consciousness

According to Aidaros, the sudden neck cut during halal slaughter induces the animal with insensitivity to pain due to the ischemia of the brain and causes maximum drain of blood [37]. In the same line, Muhammad, reported that the halal slaughtering is humane because it initiates a great deal of haemorrhaging and anoxia [38]. Thus, it acts as a powerful painkiller, which disables the sensory centre

and causes the animal to become entirely insensitive to pain. In another study, by comparing the different methods of slaughtering, a maximum blood lost was determined for the kosher method of slaughtering, which is similar to the Islamic method [39]. The shortest time for being unconscious in an animal was reported to be of 3 seconds for neck cut with the longest periods of 60 seconds. The ranges in sheep, goats and cattle are of 5-22 seconds (most sheep 5-7 seconds), 3-7 sec and 5-60 sec, respectively [40,41].

According to animal welfare point of view, the expected stage after unconsciousness is insensibility. In this context, Newhook and Blackmore, examined the consistent insensibility time after the cut of the neck in sixteen sheep and five lambs [42]. They determined the insensibility by electroencephalograms (EEG) and recorded EEG traces. The results showed that both the sheep and lambs were conscious at the time of slaughter, where insensibility occurred within 2 to 7 seconds and the EEG traces became isoelectric between 10 and 43 seconds. In sheep, which were lightly anaesthetised at the time of slaughter, the EEG traces became isoelectric between 18 and 70 seconds after incision of the major blood vessels of the neck. In one sheep, which was slaughtered by severance of the carotid artery and jugular vein on one side of the neck only, the onset of insensibility was delayed for 29 seconds. In the majority of animals, the electrocardiogram (ECG) continued to show a normal pattern for more than 10 min after slaughter. There was an initial rise in blood pressure in the first 5 to 7 seconds and it remained elevated for a further 10 to 20 seconds.

Similar results were obtained in several other studies. For example, Rosen [43] discussed the behavioural and neurophysiological responses of animals to Shechita in order to evaluate the perception of pain and concluded that Shechita was a painless and humane method of animal slaughter. In his study, he reported that blood loss was extremely rapid after the Shechita incision which caused rapid falls in blood pressure and resulted in the loss of consciousness within a few seconds. Moreover, as soon as the animal's major blood vessel in the neck is cut-off, it produces an immediate stunning effect [11]. Some similar points of Shechita and Halal slaughter can be summarized as the animal is conscious before slaughtering process, the brain becomes inactive due to the rapid cerebral blood flow and an instant loss of consciousness occurs just after the neck incision [9]. It means that the stunning effect and loss of consciousness follow each other in seconds in Shechita and Halal slaughtering methods. As an alternative argument, Shahdan and Rahman [44] reported that the time for the chickens to become insensible after neck cutting was not affected by stunning.

Pain relieving property of beta-endorphin

Apart from the issues mentioned above, the body of the animal has some protective systems to reduce the pain during slaughter. Beta-endorphin is one of the components of those systems which act as central pain-killer. It has an almost 30 times greater pain relief effect than that of the morphine. It also plays an important physiological role in terms of animal welfare as a sign of health condition which provides advantage in reducing pain as a response to harsh environmental conditions or management systems [45-47]. In a recent study, Aksoy, *et al.* [45] determined the blood serum beta-endorphin levels in cows 20 minutes before, during and 3 minutes after the slaughter considering its pain relieving properties. They stated that a rise in beta-endorphin levels was observed during cutting, and beta-endorphin level increased 2-fold after 3 minutes from slaughter (157.0 ± 23.1 , 262.0 ± 35.8 , 574.3 ± 95.4 pg/mL), which indicates relief rather than pain by halal cutting.

In order to clear fully the blood in the circulating and whole muscle tissue, the animal must be awake, able to order contraction of its striated muscles, and the muscles must be able to take and apply this order without experiencing any stroke. Electroshock stunned animals cannot do any of them and the muscles cannot be cleared of blood tissues [5].

Animal welfare implications and conclusion

It is crucial to balance the welfare of the animals with the prerequisites of halal slaughtering process. Main commitment by everyone is that the animals should be treated humanely at the time of slaughtering. From this point of view, pain technologies may enable us to develop better practices on animals in terms of finding solutions for the welfare problems and understand the physiology of the animal as well as the hidden causes of the religious rules. Therefore, the correct and proper slaughter methods, which would provide the least pain, should be applied in halal slaughtering in order to allow the rapid and full drain of blood resulting after the death of the animal.

Animal Welfare Statement

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. No ethical approval was required as this is a review article with no original research data.

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