Effects of ethyl alcohol analgesia on pig behavior during castration

Emily Marsh Ferranti

Abstract

Newborn piglets born on commercial farms undergo various procedures in their first days of life. These procedures can include tail docking, various injections, and castration. One of the most common and invasive is castration. Boar piglets are castrated to prevent unwanted sexual behavior, aggression, and boar taint. Boar taint occurs when intact males that have reached sexual maturity are slaughtered, causing an offensive odor and taste (Sutherland, 2015). Castration invokes a pain response, but it is most often performed without any anesthesia or analgesia. This is mostly due to the lack of a readily available and inexpensive analgesia. Lidocaine is a common analgesic that is expensive and must be administered by a veterinarian. Castration without pain relievers raises welfare concerns and it would be beneficial to find an inexpensive and readily available alternative.

This study explores ethyl alcohol as a possible alternative. When injected into an area, ethyl alcohol performs alcohol neurolysis. This causes the demyelination of the neurons, leading to pain relief. In this experiment, boar piglets from 14 litters were assigned a treatment group. They were either injected with 1mL of saline solution (CON), injected with 1mL of ethyl alcohol (ETOH), or were injected with 1mL of lidocaine (LID). A gilt from each litter served as a handling control (SHAM). Each piglet was injected with their perspective treatment at 3 days of age. They were then subsequently castrated at 14 days of age. The SHAM was handled the same way as the boar piglets, but no incision was made.

The piglets were recorded for 24 hours/day beginning one day prior to treatment and ending 14 days post-castration. The videos were used to evaluate the behavior of each piglet. The frequency of certain behaviors listed in an ethogram were recorded. The averages of each behavior performed by each treatment were analyzed for statistical significance.

Overall, it was found that ethyl alcohol has similar effects as lidocaine. The ethyl alcohol and lidocaine appeared to cause some discomfort when injected as those treatments displayed higher incidences of rump scratching ($P < 0.05$) and stiffness. This is to be expected as the CON was only injected with saline and the SHAM was not injected at all.

The frequencies of behaviors performed by the ETOH and LID post-castration were very similar. Ethyl alcohol appears to have the same effect on pain as lidocaine. Both significantly decreased the instances of pain related behaviors compared to the CON.

More research needs to be conducted on ethyl alcohol as a possible analgesia for piglet castration. However, in this study, it does seem to reduce pain caused by castration and does so in a manner comparable to that of lidocaine. Based on this observation, ethyl alcohol is a good candidate for an inexpensive and effective analgesia.

Effects of ethyl alcohol analgesia on pig behavior and physiology during castration

Emily Marsh Ferranti

Introduction

There are many different procedures that baby piglets grown on commercial farms experience in the first few days of their lives. These procedures can include tail docking, vaccinations, and castration. All of these are done for a certain reason, but some of them can be considered invasive.

Castration is one of the more invasive procedures and is done on male piglets to prevent unwanted sexual behavior, aggression, and a phenomenon called boar taint. Boar taint occurs when intact boars are slaughtered at mature weight and their meat produces an offensive odor and taste (Sutherland, 2015). Castrating boars when they are young and are not sexually mature prevents dangerous behaviors and improves meat quality.

Surgical castration is commonly performed by slicing the skin of the scrotum to expose the testicle inside. The testicle is then removed from the piglet by pulling to break the spermatic cord or by directly cutting it. This procedure can vary in its methods from farm to farm. The wounds can be treated with an antibacterial solution to help prevent infection and the piglets are left to heal (Prunier et. al., 2006).

Surgical castration is known to invoke a pain response, however is most commonly performed without pain control (McGlone and Hellman 1988). This is due to the lack of an inexpensive anesthetic that can be easily used. Known analgesics such as Lidocaine are expensive and require administration by a veterinarian. They also lengthen the time it takes for each piglet to be castrated. This is not feasible for commercial pig farmers to implement because of the cost and extra time involved. However, performing this procedure without any type of pain management raises welfare concerns.

This study explores the use of ethyl alcohol as a possible remedy to this situation. When injected into an area, ethyl alcohol causes what is known as alcohol neurolysis. This means that the alcohol is disrupting the outer membrane of the nerves, which in turn, gives pain relief. Ethyl alcohol has been used in the medical field to alleviate pain. It is inexpensive and could be a cheap alternative to other products such as Lidocaine. If ethyl alcohol did seem to reduce the pain associated with castration, it could help ensure the best welfare possible for piglets raised in commercial settings.

Materials and Methods

Experimental Design

This procedure included boar piglets that were chosen from 14 different litters. Four piglets from each litter were randomly chosen and then assigned a treatment. These treatments included: sham handled (SHAM), lidocaine injection (LID), saline injection (CON), and ethyl alcohol injection (ETOH). A gilt from each litter was randomly chosen and used for the SHAM treatment. The SHAM served as a control for the effects of handling the piglets. The saline injection piglets served as the control and were handled the same as well as given an injection of saline and castrated. One mL of saline, ethyl alcohol, and lidocaine were injected directly into the piglet's testicles by the collaborating veterinarian. This was performed at 3 days of age. When the piglets were given their initial injections, the SHAM was picked up and handled as to mimic the handling of the other piglets.

When the piglets reached 14 days of age, they were each castrated. The LID piglets had to be re-injected to ensure analgesic effects were present. This was done with 1mL of lidocaine injected directly into each testicle. The LID piglets were then allowed to sit for 10 minutes before they were castrated to allow the lidocaine sufficient time to take effect. Each piglet was picked up and removed from the sow. They were subsequently walked over to a trained technician who made an incision on each side of the scrotum and then pulled on the testicle to break it free. A handler restrained the piglets upside down with the testicular area facing the castrator. Once castration was complete, each piglet was returned to its litter.

The SHAM piglet was handled the same as the other piglets. She was removed from the litter, walked to the castrator, and restrained the same as other treatments. No incision was made and she was walked back to her litter.

Behavioral Data Collection

When each piglet was randomly selected and assigned a treatment, they were marked with a livestock crayon. Each treatment had a specific color, allowing each piglet to be easily identified. The marks were redone as needed so the color never faded and each piglet was always identifiable.

Behavioral observations can be useful to determine the consequences of surgical castration (Moya et. al., 2008). Therefore, the piglets were recorded by camcorders beginning 1 day prior to treatment injection until 14 days post-castration. The recordings were continuous 24 hours per day. Each video was then watched and the piglet's behaviors observed. Behaviors were scored based on a behavioral ethogram. The ethogram was adapted from Hays et. al. (2003) and was split into three categories including: non-specific behaviors (Table 1.1), pain-castration related behaviors (Table 2.1), and social cohesion behaviors (Table 3.1). Anytime a piglet performed one of the behaviors listed, it was recorded. This allowed the frequency of each behavior performed by each piglet to be recorded.

Results

All data was collected and analyzed for statistical significance. It was broken into averages for each behavior shown by each treatment after injection and after castration. All data for the post-injection period started on day 3 and continued to day 13. Data for post-castration began on day 14 and ended on day 24.

Post-Injection

The ETOH and LID treatments showed significantly more instances of being awake inactive from day 3 to day 5 than the CON and SHAM ($P < 0.05$) (Figure 1.1). There were no significant differences among treatments for aggression (Table 2.1).

There were significantly more instances of prostration in the ETOH treatment on days 3 and 4 than the CON, SHAM, and LID ($P < 0.05$). The LID treatment exhibited more prostration than the SHAM and CON, but these differences were not significant (Figure 1.2). No significant differences among the four treatments existed for the huddled behavior ($P > 0.05$) (Table 2.2). The frequency of stiffness was higher in the ETOH piglets than the others; LID was higher than the SHAM and CON; and the CON was higher than the SHAM (Figure 1.3). However, none of these differences were significant ($P > 0.05$). None of the differences in the frequency of spasms were significant ($P > 0.05$), but the ETOH and SHAM exhibited more of this behavior on day 7 than the CON and LID. The ETOH and SHAM treatment were then the same until day 13. The LID treatments had the least amount of spasms after day 4

(Figure 1.4). The ETOH treatments had significantly more rump scratching than the LID, CON, and SHAM on days 3 to 5 (P<0.001). The LID treatment had significantly more rump scratching that the CON and SHAM on days 3 and 4 (P<0.05). The CON and SHAM treatments were similar beginning on day 3 and all of the treatments were similar from day 6 to day 13 (Figure 1.5).

On day 3 LID was significantly more isolated than the rest (P<0.05). The other treatments were similar from day 3 to day 13. Beginning on day 4, the LID treatment was similar to all others (Figure 1.6). ETOH, LID, CON, and SHAM treatments were similar in the instances of desynchronization from day 3 to day 13 (Table 2.3).

Post-Castration

For the awake inactive behavior (Figure 2.1), the SHAM was awake inactive significantly less from day 14 to day 16 than the other treatments (P<0.001). On day 15, the CON was awake inactive significantly more than ETOH, LID, and SHAM (P<0.05). All the treatments were similar beginning on day 17. There were no significant differences between treatments in the instances of aggression observed (P > 0.05) (Table 3.1).

The CON was significantly more prostrated on days 14 and 15 (P<0.001) as well as on day 16 and 17 (P<0.05). The SHAM treatment was significantly less prostrated on days 14 to 16 (P<0.05) and on day 17 (P<0.001). The LID and ETOH were similar in their instances of prostration throughout the entire observation period (Figure 2.2). Huddled behavior was similar for all treatments (Table 3.2). The CON had significantly more stiffness on days 14 and 15 (P<0.05). The other treatments were similar throughout (Figure 2.3). On day 18, the ETOH treatment had more spasms than the LID, CON, and SHAM; The LID had more than the CON and SHAM; and the CON had more than the SHAM

(Figure 2.4). None of these differences were significant ($P>0.05$) and all the treatments were similar for the rest of the time period. The SHAM did significantly less rump scratching on days 14 and 15 ($P<0.001$) and on day 16 ($P<0.05$). The CON had significantly more on days 14 to 16 ($P<0.05$). All treatments were similar beginning on day 17 (Figure 2.5).

On days 14 and 15, the CON was significantly more isolated than the others ($P<0.001$). The LID, ETOH, and SHAM were all similar throughout the entire observation time. The CON was similar beginning on day 17 (Figure 2.6). The CON was significantly more desynchronized on days 14 and 15 than the others ($P<0.05$). The ETOH, SHAM, and LID were similar throughout with the CON being similar starting on day 16 (Figure 2.7).

Discussion and Conclusions

Based on the results above, probable conclusions can be drawn. Ethyl alcohol and lidocaine both appeared to have an affect on the piglets after injection. Both the LID and ETOH treatments were awake inactive significantly more than the rest of the piglets. This suggests a similarity between ethyl alcohol and lidocaine in the way they affect non-specific behaviors. There were no significant differences between the treatments in aggression.

The ethyl alcohol did seem to cause more pain and discomfort for the piglets as they were prostrated and performed rump scratching significantly more during the post-injection period. They also exhibited more stiffness, but this difference was not significant. This suggests that the injection of ethyl alcohol into the piglets may cause more pain than the injection of lidocaine.

The LID treatment was significantly more isolated on day 3 than any of the other treatments. This could be a possible result of the lidocaine injection itself. Ethyl alcohol did not seem to have an effect on this particular social cohesion behavior.

Following castration, the CON exhibited significantly more frequency of awake inactive behavior, prostrated behavior, stiffness, rump scratching, isolation, and desynchronization. This was true for a number of days following castration for each behavior. This is consistent with results found in Moya et. al. (2008), where they found that castrated piglets exhibited significantly more pain related behaviors. A study performed by Hay et. al. (2003) also showed increases in awake inactive behavior, isolation, and desynchronization post-castration. For the first part of the observation period, the gilt showed significantly less frequency of awake inactive behavior, prostrated behavior, and rump scratching. This can be attributed to the fact that she was not actually castrated, just handled. She should not have undergone any pain related experience.

The ETOH and LID treatments showed very similar frequencies for awake inactive behavior, prostrated behavior, stiffness, rump scratching, isolation, and desynchronization. A separate study showed that lidocaine significantly reduces the pain resulting from castration compared to castration performed without local anesthesia (Haga and Ranheim, 2005). Our study also demonstrates this as LID significantly lowered the frequency of pain related behaviors compared to the CON. The ETOH treatment appears to also lower the instances of pain-related behaviors compared to the CON. There were also no significant differences between the ETOH, LID, and SHAM for stiffness, isolation, and desynchronization. The instances of aggression and spasms did not differ significantly between treatments, suggesting they may be effects of handling.

Overall, injecting ethyl alcohol appears to cause some pain and discomfort for a period of time. However, this period of time is fairly short and then the piglets are back to normal. Ethyl alcohol seems to function very similarly to lidocaine. They were similar for every behavior observed post-castration. The CON showed signs of being in more pain due to being castrated without any analgesic. This is consistent with Haga and Ranheim (2005). The ethyl alcohol seems to reduce pain caused by castration similarly to lidocaine. The ETOH and LID exhibited similar frequencies of stiffness, isolation, and desynchronization to the SHAM.

Based on this data and the information collected from this experiment, ethyl alcohol is a promising alternative to lidocaine as an analgesic in piglets being castrated. It appeared to have all of the same pain reducing benefits in the post-castration period. It did seem to cause slightly more discomfort after injection, but not for more than 3 days. More research needs to be conducted to determine other effects of ethyl alcohol on piglets being castrated. However, this may be a novel avenue of pain relief that is both affordable and economical for use in commercial production settings.

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Figures and Tables

Table 1. 1 Description of non-specific behaviors.

Behavior	Definition
Aggression	Forceful fighting, pushing with the side of head with the lower jaw or jowl in a violent manner.
Awake Inactive	No special activity but awake. Lying, sitting, or standing.

Table-1.2 Description of pain-related behaviors

Behavior	Definition
Prostrated	Awake, sitting or standing motionless, with the head down, lower than shoulder level.
Huddled Up	Lying with at least three legs tucked under the body.
Stiffness	Lying with extended and tensed legs.
Spasms	Quick involuntary contractions of the muscles under the skin.
Rump-Scratching	Scratching the rump by rubbing it against the floor, pen, walls, or mother.

Table 1.3- Description of social cohesion behaviors

Behavior	Definition
Isolated	Aside from other piglets, alone or with one pen-mate at the most. A distance of at least 40cm (about the width of two piglets) separates the animal from the closest group of littermates.
Desynchronized	Activity different from that of most (at least 75%) littermates (e.g. sleeps while most other littermates suckle).

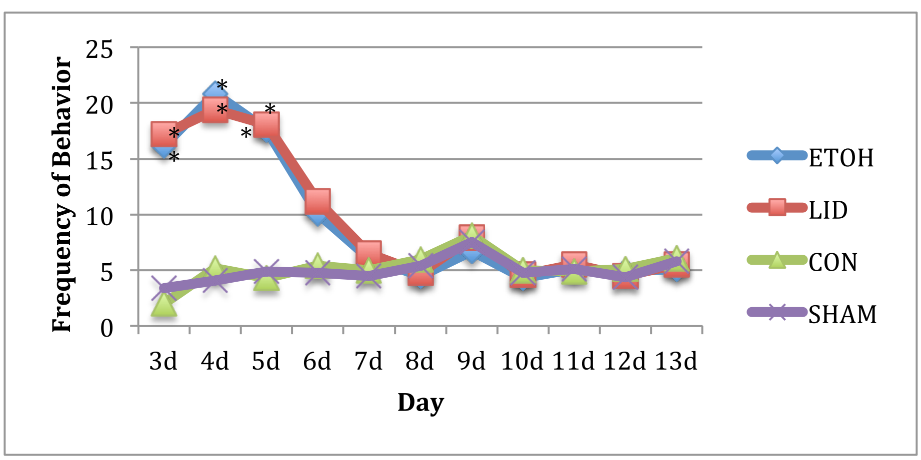

Figure 1.1- Average frequency of awake inactive behavior following injection. (*P < 0.05, **P < 0.001: significant difference)

TRT	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d
ETOH	11.2	8.3	9.6	8.9	7.1	8.2	6.0	7.2	5.5	7.1	8.1
LID	11.0	9.1	8.8	8.0	7.6	9.1	7.1	8.1	4.9	7.2	7.1
CON	10.9	8.8	7.9	7.6	6.9	9.2	7.5	7.6	4.5	8.9	7.6
SHAM	10.8	9.6	8.9	7.8	6.8	9.5	6.9	7.7	5.0	7.8	8.4

Table 2.1- Average frequency of aggression following injection.

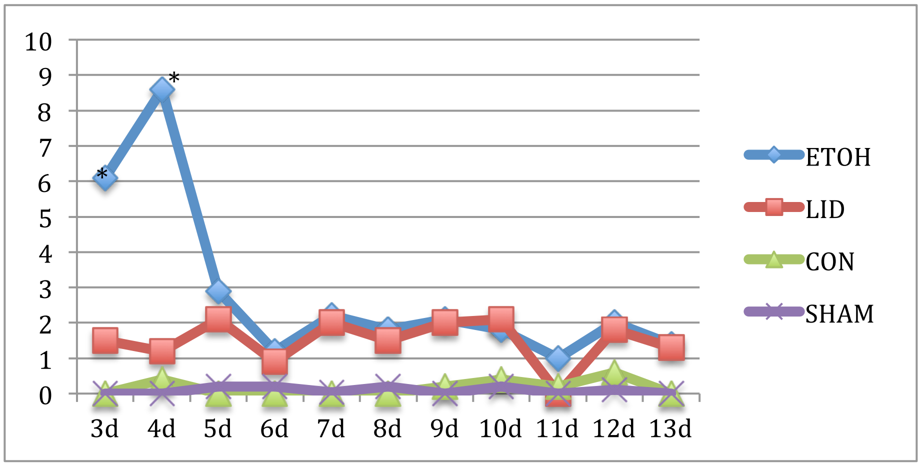

Figure 1.2- Average frequency of prostrated behavior following injection. (*P < 0.05, **P < 0.001: significant difference)

TRT	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d
ETOH	22.2	25.5	24.5	26.4	23.1	22.9	24.5	23.5	24.5	22.1	20.2
LID	20.1	26.1	26.3	26.0	21.5	22.7	22.9	24.5	23.6	22.6	19.6
CON	18.9	24.5	24.5	25.6	22.4	23.1	23.1	24.1	24.0	22.4	18.9
SHAM	19.6	24.9	23.9	25.9	23.4	22.1	22.5	23.9	23.9	23.3	19.4

Table 2.2- Average frequency of huddled behavior following injection.

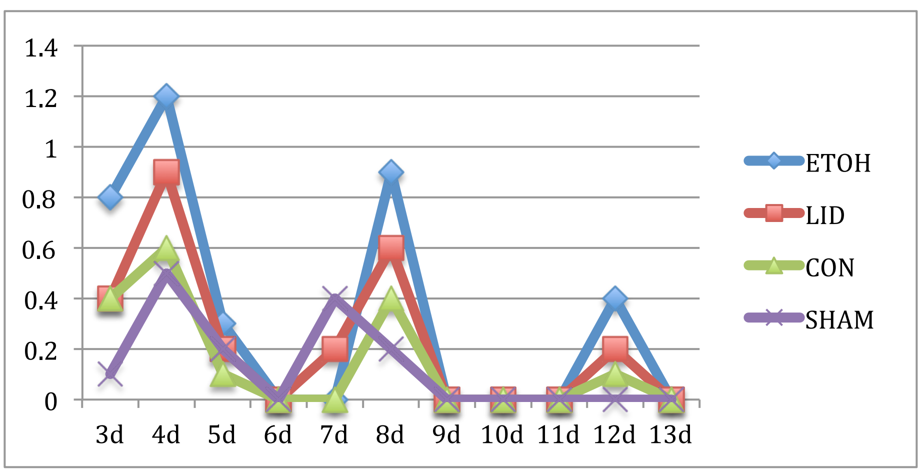

Figure 1.3- Average frequency of stiffness following injection.

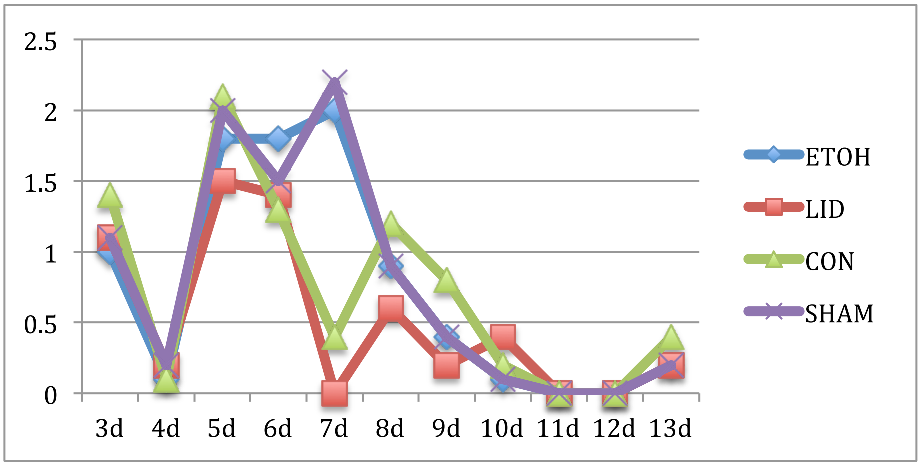

Figure 1.4- Average frequency of spasms following injection.

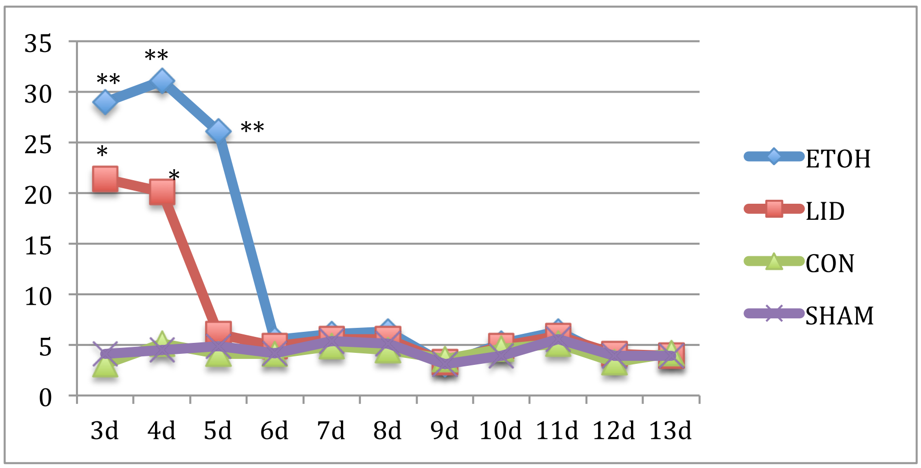

Figure 1.5- Average frequency of rump scratching following injection. (*P < 0.05, **P < 0.001: significant difference)

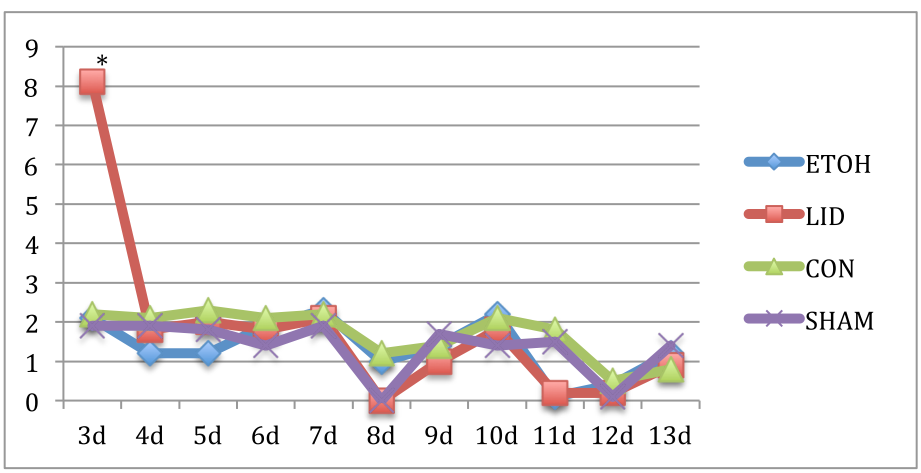

Figure 1.6- Average frequency of isolation following injection. (*P < 0.05, **P < 0.001: significant difference)

TRT	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d
ETOH	2.9	1.8	3.1	1.3	1.2	0.3	1.4	1.3	0.1	0.0	0.0
LID	2.1	2.1	3.3	1.8	2.9	0.2	1.1	1.6	0.4	0.0	0.0
CON	2.2	2.0	3.9	2.1	2.1	0.4	1.0	1.4	0.9	0.0	0.0
SHAM	2.0	1.8	3.9	1.6	2.5	0.0	1.1	1.5	0.6	0.0	0.0

Table 2.3- Average frequency of desynchronization following injection.

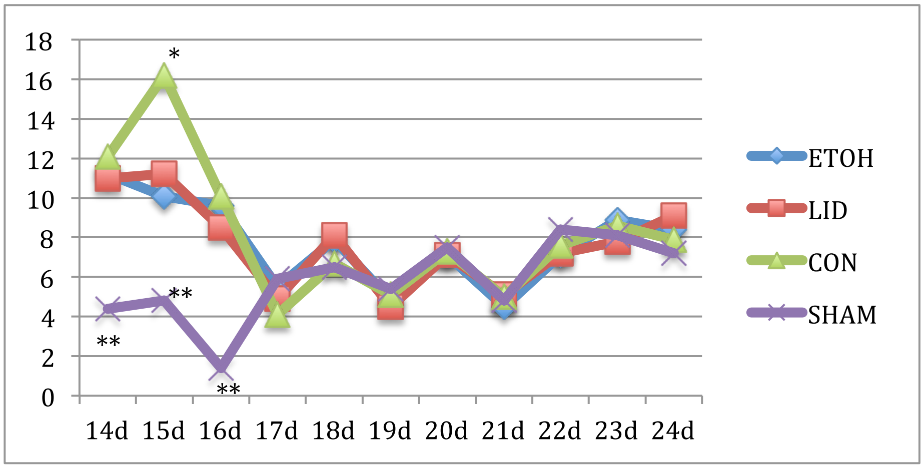

Figure 2.1- Average frequency of awake inactive behavior following castration. (*P < 0.05, **P < 0.001: significant difference)

TRT	14d	15d	16d	17d	18d	19d	20d	21d	22d	23d	24d
ETOH	9.2	8.3	7.6	9.9	7.4	9.9	6.9	8.1	4.1	4.2	4.5
LID	10.5	8.0	8.8	8.6	7.6	9.1	7.1	8.1	3.9	3.9	5.1
CON	11.0	9.2	7.9	8.1	7.9	9.8	7.1	7.1	4.9	4.1	6.1
SHAM	11.1	9.6	8.9	7.9	6.8	9.5	6.8	7.6	4.5	3.9	4.9

Table 3.1- Average frequency of aggression following castration.

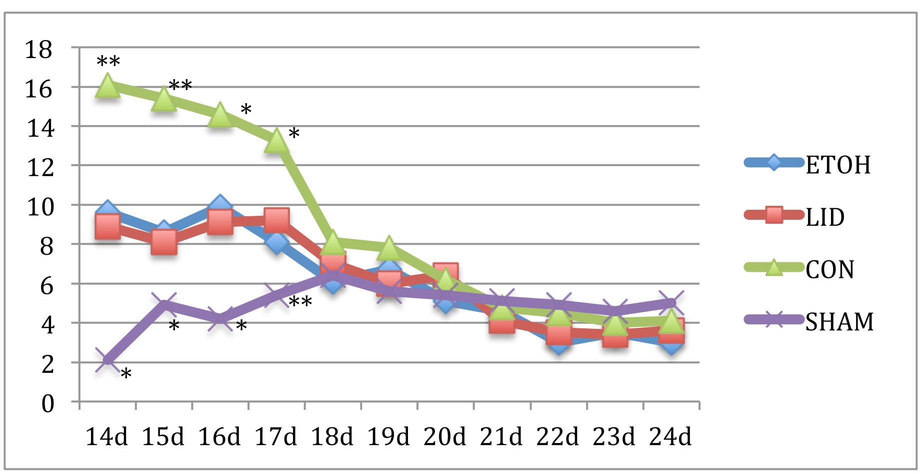

Figure 2.2-Average frequency of prostrated behavior following castration. (*P < 0.05, **P < 0.001: significant difference)

TRT	14d	15d	16d	17d	18d	19d	20d	21d	22d	23d	24d
ETOH	26.3	25.6	25.5	24.5	23.6	22.9	26.5	23.6	22.1	22.4	21.2
LID	24.5	25.9	26.3	22.9	24.0	22.7	22.9	24.0	23.6	22.6	20.0
CON	24.5	26.4	24.1	24.5	23.9	24.1	22.9	24.5	23.2	23.6	19.4
SHAM	19.6	26.0	25.9	24.1	24.5	22.1	22.5	23.9	23.8	23.2	19.6

Table 3.2- Average frequency of huddled behavior following castration.

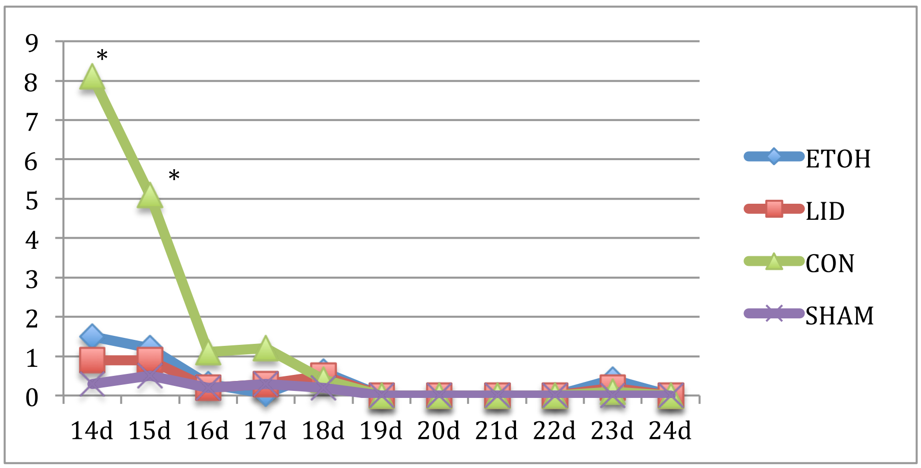

Figure 2.3- Average frequency of stiffness following castration. (*P < 0.05, **P < 0.001: significant difference)

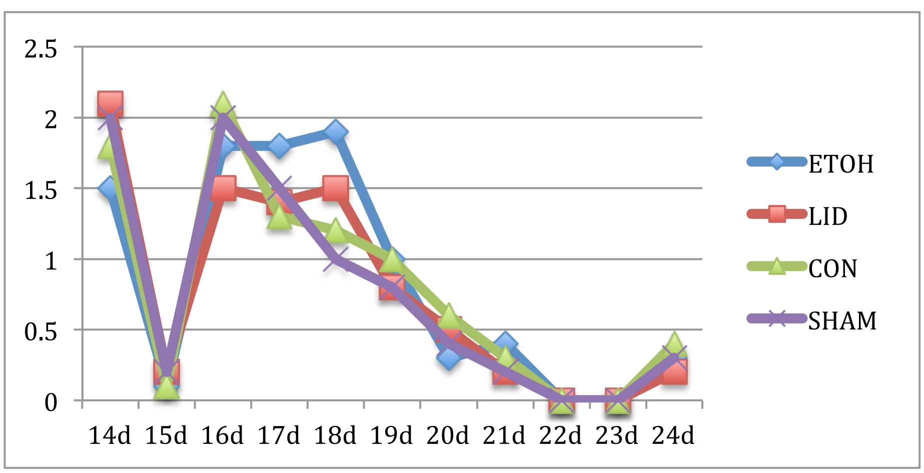

Figure 2.4- Average frequency of spasms following castration.

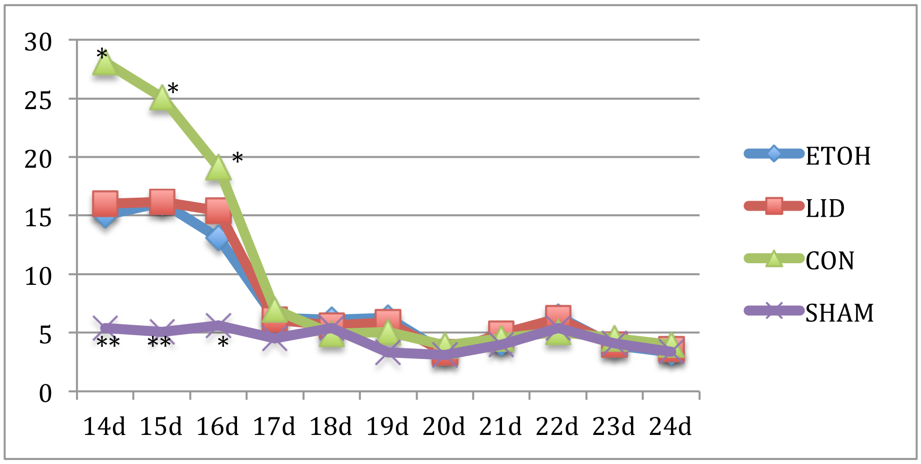

Figure 2.5-Average frequency of rump scratching following castration.
(*P<0.05,**P<0.001:significant difference)

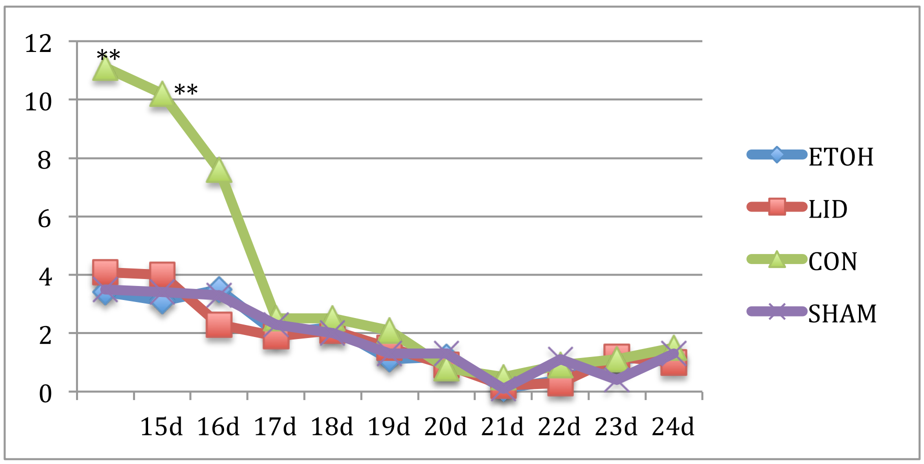

Figure 2.6- Average frequency of isolation following castration.
(*P<0.05,**P<0.001:significant difference)

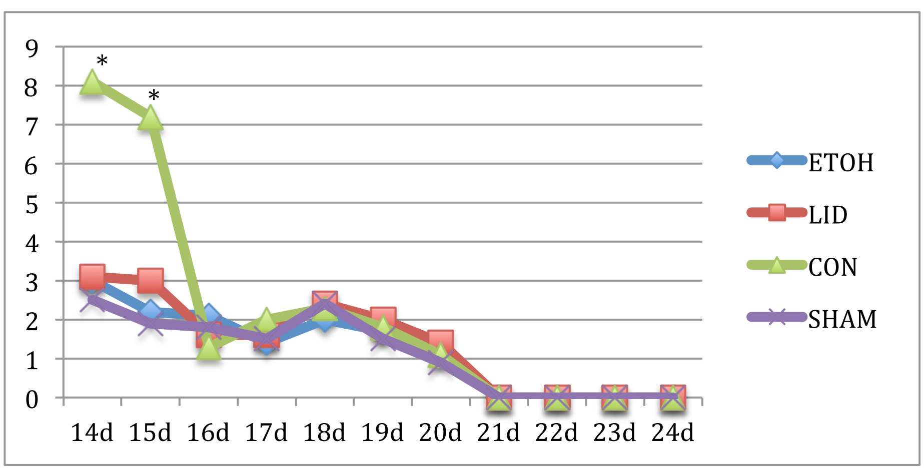

Figure 2.7- Average frequency of desynchronization following castration.
(*P<0.05,**P,0.001:signiciant difference)

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