

BEHAVIOURAL AND PHYSIOLOGICAL RESPONSES OF LAMBS OF TWO AGES IN THE FIRST THREE HOURS AFTER THREE METHODS OF CASTRATION

BY

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ABSTRACT

72 Fox lambs were divided into eight groups (n=9 each). The first four groups were subjected to early castration (21 day old) by surgical, Burdizzo or Burdizzo with local anaesthesia and one kept as control group. The other four groups were subjected to castration at later age (56 days old) by the same procedures as the first arrangement. Behaviour and plasma cortisol levels were recorded before and during the first three hours after castration while, the body weight was biweekly recorded during the next 22 weeks after castration.

Surgically castrated lambs spent significantly shorter time with lower frequencies in feeding and suckling and significantly longer lying and standing idle time with higher frequencies than Burdizzo, Burdizzo with local anaesthesia or control group. Moreover, highly significant decrease in movement activities for surgically castrated lambs was also observed.

The infiltration of local anaesthesia before application of Burdizzo castrator resulted in reducing pain and significantly increased the length and frequency of feeding and suckling bouts and the frequencies of movement activities than the use of Burdizzo alone.

All methods of castration resulted in significantly elevation in blood plasma cortisol concentration. The surgical castration resulted in significantly higher cortisol concentration than Burdizzo castration. Moreover, the preliminary treatment with local anaesthesia in Burdizzo castration resulted in low level of cortisol if compared with Burdizzo without anaesthesia in young lambs, while in older lambs it resulted in faster return to normal level after about 80 minutes.

The young lambs under treatments showed significantly higher blood plasma cortisol concentrations during the first three hours after castration and higher adjusted body weight than older lambs during the 22 weeks after castration. Moreover, surgical castration significantly decreased the body weight during this period, while, there were no significant differences between the Burdizzo castrated and control lambs.

INTRODUCTION

The behavioural and physiological changes associated with the method and age of lambs' castration could be minimized if rings were used instead of surgical castration

(Mellor and Murray 1989 and Lester *et. al.*, 1991 and Kent *et. al.*, 1993). Moreover, the castration by using rubber ring in combination with anaesthesia decreased the time spent in abnormal postures, restlessness and blood plasma cortisol concentration than the use of rubber ring alone (Molony *et. al.*, 1993 and Kent *et. al.*, 1995). Barrowman *et al.*, (1953) found that Burdizzo crushing method caused less distress as assessed by performance and qualitative observation of behaviour.

These behavioural and plasma cortisol changes indicated that the bloodless castration methods produce considerable acute pain and most of that pain occurs during and immediately after crushing of the skin and spermatic cord. Effective analgesic treatments are required to make these methods more humane and to help overcome aversion to use of such instruments by some practitioners (Clarke-Lewis, 1977).

Many attempts were done for choice of the less painful method of castration. Wood, *et al.*, (1991) have shown that the changes in behaviour and plasma cortisol after castration are closely related to estimates of pain in other ways and can be eliminated by local anesthesia. Moreover, reducing pain following castration by intratesticular injection of local anesthesia and intramuscular injection of Diclofenac analgesic resulted in significantly reduction in behavioural and physiological changes (Molony *et. al.*, 1997).

This study compared the behavioural and plasma cortisol responses of young lambs to three method of castration carried out at two different ages (21 and 56 days) in order to obtain evidence which could be used to help in assessment of pain produced by castration. Moreover, to investigate further growth performance of lambs after castration (22 weeks later).

MATERIALS AND METHODS

Experimental work:

The experimental design consisted of a 2 comparison. The first comprise 36 lambs at 21 days of age were allotted into 4 groups, (n=9). The 1st group was subjected to castration by the use of Burdizzo castrator fitted on the spermatic cord at the neck of scrotum involving the bilateral spermatic cords. The second group was subjected to Burdizzo castration proceeded by subcutaneous local infiltrated anaesthesia by the use of 1% procaine adrenaline. While, the third group was subjected to surgical castration. Moreover, the fourth group was handled and kept as control. The second comparison was run similar to the first one but on another 36 lambs with an average 56 days old.

The lambs were totally 72 Fox sheep lambs with their mothers. They were allotted into the eight group on the base of their age into two comparisons and within each comparison the animals were allotted on the base of their body weight and age. The lambs during the experiment were kept together with their mother in the same group till weaning then mothers were removed and the lambs kept alone.

During and after the suckling period a concentrate ration was offered two times daily, at early morning and evening. While, rice straw and silage were provided during the afternoon period. Moreover, water was supplied by using water trough *ad libitum*.

One veterinarian carried out the process of castration and another one collected the blood samples. The blood samples were collected by venepuncture in Menovit heparinized tubes. One sample was collected before treatment and six blood samples were collected after castration with half an hour interval till 180 min. Moreover, an extra sample was collected after 24 h. The blood plasma was separated by centrifugation then analysed by using ELISA technique for determination of the blood plasma cortisol concentration..

The behavioural observation was recorded by Video camera hanged on the ceiling of each pen connected with a time lapse video cassette recorder. The data of the lambs' behaviour before, during and after castration was obtained from the video tapes by using a Microsoft computer program known as Observer v.3. A focal sampling method was used, where each lamb was observed during the first three hours after castration (continued recorded).

The estimation of the body weight during the experiment was carried out before the experimental work for classification of the animals then biweekly weighing till 22 weeks later.

Statistical analysis:

The data analysis was carried out by using SAS (1996). A Two-way analysis of variance (ANOVA) was performed on the behavioural and blood plasma cortisol data with the following model:

$$y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + e_{ijk}$$

Where:

y_{ijk} = An individual observation.; μ = Overall mean; A_i = Effect of i th treatment i.e. $i=1$ for surgical castration, $2=$ Burdizzo castration, $3=$ Burdizzo castration with local anesthesia and $4=$ Control group.; B_j = Effect due to j th age of lambs i.e. $j= 1$ young lamb (21 day) and 2 old lambs (56 day old). $(AB)_{ij}$ = Effect due to interaction of i th treatment with the j th age. and e_{ijk} = Random effect

The body weight data was analysed by SAS (1996) A two way analysis of covariance, as the initial weight between the two comparisons was differ, with the following model:

$$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + Cov + e_{ijk}$$

Where:

Y_{ijk} = An individual observation; μ = Overall mean; A_i = Effect of i th treatment i.e. $i=1$ for surgical castration, $2=$ Burdizzo castration, $3=$ Burdizzo castration with local anesthesia and $4=$ Control group; B_j = Effect due to j th age of lambs i.e. $j= 1$ young lamb (21 day) and 2 old lambs (56 day old). $(AB)_{ij}$ = Effect due to interaction of i th treatment with the j th age; Cov = Effect due to initial weight as covariance and e_{ijk} = Random effect

The Adjusted means of the body weight after castration was calculated by MSTAT (1984) with the following formula: $Adj Y_j = Unadj Y_j - b (X_j - X)$

Where:

Adj Y_j is the adjusted weight mean (2,4,6,8,22 wks weight), Unadj Y_j is the unadjusted weight mean, X_j is the initial weight mean for that treatment combination, X is the initial weight grand mean, and b is E_{xy}/E_{xx} (the slope of the data).

RESULTS

Lambs behaviour:

Surgically castrated lambs spent significantly shorter time and lower frequency of feeding and suckling than Burdizzo, Burdizzo with local anaesthesia or control group in both early and late castrates (Table, 1). On the other hand, the infiltration of local anaesthesia before application of Burdizzo castrator resulted in reducing pain and increased the length and frequency of suckling bouts.

Lambs castrated at early and late ages, ate and suckled shorter bouts with little frequencies than control lambs. However, young lambs castrated by Burdizzo preceded by local anaesthesia ate and sucked more frequent with prolonged bouts than those castrated with Burdizzo alone. On contrast older lambs behaved in a reverse manner since the Burdizzo castrated lambs exhibited longer feeding time with more frequency than those injected with local anaesthesia before Burdizzo (Table, 1). The Development of the digestive system of old lambs affect the ingestive behaviour where the older lambs showed significantly ($P<0.01$) more and longer feeding bouts (Table, 1), whereas, the young lambs showed significantly ($P<0.01$) more and longer suckling bouts.

Surgically castrated lambs exhibited significantly longer lying and standing idle time with higher frequencies than those in other groups. However, the control and Burdizzo with local anaesthesia groups had significantly shorter periods with little frequencies (Table, 2). This trend was common in young lambs. However, the surgically castrated older lambs showed the shortest lying time. Generally in young groups the lying time and frequency were significantly higher ($P<0.01$), moreover, running frequency was significantly higher as well. Whereas, in older lambs the standing idle, standing active and walking were significantly ($P<0.01$) longer with higher frequencies (Tables 1&2).

The changes in the movement activity after castration are summarised in table (3). There was highly significant decrease in movement activities for surgically castrated lambs, moreover, the application of local anaesthesia before Burdizzo castration resulted in more scratching and head turning than those castrated by Burdizzo alone. This general trend found to be experienced by the young lambs' groups. Moreover, lambs subjected to castration by Burdizzo in combination with local anaesthesia showed longer standing time and highest standing, running and walking frequencies if compared with Burdizzo alone or surgically castrated lambs. However, within the older age groups the animals intended to Burdizzo castration alone had a longer time and higher frequencies of most of these activities.

The castration of lambs resulted in significantly lower ($P<0.01$) frequencies of scratching, rubbing and stretching. However, the preliminary treatment with local anaesthesia before castration resulted in higher frequency of scratching and head turning than the application of Burdizzo clamp alone or surgical castration (Table, 4). Furthermore, the older lambs showed higher rubbing, stretching and head turning but

lowered scratching frequencies. The interaction between age and method of castration showed significant effect only for head turning frequency where, the local anaesthesia resulted in higher frequency for the young lambs however, in the older lambs this interaction was not significant.

Plasma cortisol concentrations:

The data listed in tables (5&6) represents the effect of different castration method in two different ages of lambs on the blood plasma cortisol concentrations. It showed that all methods of castration resulted in significantly elevation in blood plasma cortisol concentration. The surgical castration resulted in significantly higher cortisol concentration than Burdizzo castration. Moreover, the preliminary treatment with local anaesthesia in Burdizzo castration resulted in lower level of cortisol if compared with Burdizzo without anaesthesia.

The young lambs under treatments showed significantly higher blood plasma cortisol concentrations than older ones. In addition within the same age group the cortisol level was higher in surgically castrated lambs followed by Burdizzo alone, while, those castrated by Burdizzo in combination with local anaesthesia showed a very low level of plasma cortisol.

Data presented in tables (5&6) illustrate the plasma cortisol responses to acute stress applied by castration with three different methods during the first three hours after treatment in two age groups. In both age groups, the peak plasma cortisol concentration was achieved after 30 minutes from castration. The surgical castration of lambs showed highest peak at 30 minutes in both age groups and showed another peak after 120 minutes in early castrated lambs. However, late castrated lambs showed the second peak after 90 minutes and extended in such high peak up to 120 minutes then falls to minimum level after 150 minutes. The preliminary application of local infiltrated anaesthesia to Burdizzo clamp application hindered the elevation of plasma cortisol level in young lambs after 30 minutes, while in older lambs it resulted in more elevation of cortisol level after 30 minutes than Burdizzo alone.

Body weight:

The analysis of covariance of the lamb's body weight increments from the time of castration till the slaughtering age (22 weeks later) presented in Table (7) and showed that young lambs had a higher adjusted body weight than older ones during this period. In spite of the surgical castration significantly decreased the body weight after 22 weeks, there was a non-significant difference between the Burdizzo castrated lambs and control group. Moreover, the interaction between the age and method of castration was not significant.

DISCUSSION

Lambs behaviour:

The effect of castration method and pre-treatment with local anaesthesia in Burdizzo castration on the behaviour, plasma cortisol concentration and progress in body weights of lambs showed that castrated lambs with surgery decreased the time and frequency of active behaviours such as feeding, suckling, walking, running and

standing accompanied by other activities, body care activities (scratching, rubbing, stretching and head turning) and increased the time lapse and frequency of other activities such as lying and standing idle behaviour or standing without any activity. This change in the lamb's behaviour either by increase or decrease in its activity is a mean of escaping or avoiding painful stimuli and as the more intense the pain the more vigorous are the attempts (Chapman, *et. al.*, 1985). Similarly Robertson, *et. al.*, (1994) stated that the changes in animal behaviour may be due to injury discharges produced by cutting tissues which releases inflammatory mediators and force the animal to increase resting behaviours and decreasing active behaviours (movements).

Lambs castrated by Burdizzo with preliminary local ring infiltration of anaesthesia exhibited more active behaviours including feeding, suckling, standing, walking, running, and body care behaviour, while, the frequency and duration of lying and standing idle were decreased. Moreover, the effect of different methods of castration within the same age as compared to their control group showed a similar trend where in young and old groups the surgical castration resulted in higher level of stress than Burdizzo castration and the local anaesthesia before castration resulted in lower stress than Burdizzo alone. This may be due to the inhibition of the sensation in the site of Burdizzo clamp application, which attained by the effect of local anaesthesia, consequently suppression the release of inflammatory mediators, while, in Burdizzo alone, the crushing of nerves of scrotal tissues, spermatic cord and skin is likely to produce injury discharges (Wall, *et. al.*, 1974). These results are in close accordance with Wood *et al.*, (1991) and Molony, *et. al.*, (1997), who stated that local anaesthetics pre-treatment before Burdizzo and rubber ring has been shown virtually to eliminate the restlessness and the time spent in abnormal postures after treatment..

The age of lambs was noted to affect their behaviour where the young ones showed higher frequency and longer bouts of sucking, lying, and frequency of standing, running, and scratching behaviours, while, the older ones showed higher frequency and duration of feeding, standing idle, rubbing and head turning. These differences between young and older lambs' behaviour may be due to the development of digestive and locomotory apparatus of the older animals as the play behaviour develops within one month after birth (Morgan and Wood, 1982). Similarly, Tanaka *et. al.*, (1992), stated that, running behaviour was developed by one month of age and viewed as a necessary behaviour pattern for the improvement of athletic ability in lambs. Moreover, the increased time spent in restless behaviour with age may in part explained by greater amount of tissue trapped by the rubber rings, not only providing the possibility of more afferent activity but also distributing the force exerted by the rings thus delaying any compression block of conduction in the nerves (Molony, *et al.*, 1993).

Plasma cortisol concentrations:

The cortisol responses of the surgically castrated lambs (Table 5&6) suggested that the overall noxious of the procedures was higher than that of Burdizzo castration. Although the surgical castration removes many of the nociceptors which contribute to the afferent input after castration by Burdizzo, however, cutting tissues produces injury discharges in the remaining afferent nerves, releases inflammatory mediators (Robertson *et al.*, 1994). Moreover, the preliminary treatment with local anaesthesia

reduces the noxiousness produced by Burdizzo. The overall reduction in acute pain, due to the prevention of the afferent neural activity by hindering their function in the damaged skin and crushed tissues by the use of local anaesthesia which make blockage to these receptors and prevent the feeling with pain. Similarly Molony *et al.*, (1997) reported that although local anaesthetic pre-treatment did not significantly decrease the time spent in abnormal postures, it did reduce the peak cortisol responses by one third .

The data presented in Table (5) showed also that the younger lambs after castration had greater increases in plasma cortisol concentration than that of older lambs. This result is in close accordance with that reported by Kent *et al.*, (1993). Moreover, At young age lamb group the plasma cortisol concentration showed a peak level after 30 minutes from castration with the highest level was for surgical castration followed by Burdizzo and the lowest was for Burdizzo castration with local anaesthesia (Table 6). On the other hand, older lambs castrated by Burdizzo with local anaesthesia showed a peak higher than that showed for Burdizzo alone after 30 minutes but later on (after 90 minutes) the level of blood plasma cortisol was lowered in this group than that of Burdizzo alone. This may be attributed to the longer time required for handling the older animal and their struggling during the local anaesthesia injection than the young ones.

Body weight:

The increments of the lambs body weight was observed to be of highly significant values in the Burdizzo castrated lambs either with or without local anaesthesia than that of control or surgically castrated group during the fattening period after castration (22 week) This may be due to higher level of aggression between males in control group and also due to presence of some testosterone hormones produced from the remaining tissue of testis after Burdizzo castration. (Molony, *et al.*, (1997) reported that the Burdizzo castrated lambs some time had testosterone hormone level till 8 weeks after castration. Moreover, Burdizzo crushing method caused less distress as assessed by performance and qualitative observation of behaviour (Barrowman, *et al.*, 1953).

Conclusion:

The behavioural and plasma cortisol changes indicated that castration accompanied by a considerable acute pain and most of the pain occurs during and immediately after crushing or cutting the skin and spermatic cord. However, the Burdizzo castration method has a lower pain than surgical castration and Burdizzo improved by the local infiltration anaesthesia resulted in lowered cortisol level and reduced the feeling of pain.

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Table (1) Effect of method and age of castration on the ingestive behaviour of lambs.

Item	No	Mean \pm Standard error			
		Feeding freq.	Feeding time	Suckling freq.	Suckling time
Treatment:					
Control	18	4.65 \pm 0.48 ^A	11.87 \pm 1.44 ^A	2.78 \pm 0.41 ^A	1.99 \pm 0.45 ^A
Burdizzo	18	3.73 \pm 0.50 ^{AB}	7.87 \pm 0.92 ^B	0.94 \pm 0.14 ^B	0.51 \pm 0.10 ^B
Burdizzo + anaesth.	18	4.19 \pm 0.39 ^A	7.44 \pm 0.85 ^B	1.04 \pm 0.15 ^B	0.98 \pm 0.23 ^B
Surgical	18	2.63 \pm 0.30 ^B	4.44 \pm 0.63 ^C	0.54 \pm 0.13 ^B	0.31 \pm 0.12 ^B
Age of castration					
21 day	36	3.25 \pm 0.27 ^B	5.87 \pm 0.58 ^B	2.07 \pm 0.23 ^A	1.67 \pm 0.26 ^A
56 day	36	4.34 \pm 0.33 ^A	9.94 \pm 0.84 ^A	0.57 \pm 0.07 ^B	0.22 \pm 0.03 ^B
Treatment x age					
Young					
control	9	4.41 \pm 0.69 ^B	8.23 \pm 1.44 ^A	4.59 \pm 0.64 ^A	3.63 \pm 0.78 ^A
Burdizzo	9	2.33 \pm 0.34 ^B	4.95 \pm 0.94 ^{AB}	1.26 \pm 0.20 ^B	0.79 \pm 0.17 ^B
Burdizzo + anaesth.	9	4.33 \pm 0.52 ^A	7.62 \pm 1.18 ^A	1.63 \pm 0.23 ^B	1.75 \pm 0.41 ^{AB}
Surgical	9	1.93 \pm 0.37 ^B	2.69 \pm 0.69 ^B	0.82 \pm 0.24 ^B	0.52 \pm 0.24 ^B
Old					
control	9	4.89 \pm 0.69 ^{AB}	15.51 \pm 2.30 ^A	0.96 \pm 0.16 ^A	0.35 \pm 0.07 ^A
Burdizzo	9	5.11 \pm 0.80 ^A	10.80 \pm 1.38 ^B	0.63 \pm 0.16 ^A	0.24 \pm 0.07 ^A
Burdizzo + anaesth.	9	4.04 \pm 0.60 ^B	7.27 \pm 1.24 ^{BC}	0.44 \pm 0.12 ^A	0.21 \pm 0.06 ^A
Surgical	9	3.33 \pm 0.43 ^B	6.19 \pm 0.95 ^C	0.26 \pm 0.09 ^A	0.09 \pm 0.04 ^A
Treatment	3	41.864 ^{**}	502.826 ^{**}	53.265 ^{**}	30.324 ^{**}
Age	1	93.352 ^{**}	892.633 ^{**}	121.278 ^{**}	113.511 ^{**}
Age x treat.	3	39.735 ^{**}	150.205 [*]	28.278 ^{**}	23.401 ^{**}
Exp. Error	64	8.885	48.768	2.160	2.965

Means within the same column carry different capital superscripts are significantly differ at P<0.01

Means within the same column carry different small superscripts are significantly differ at P<0.05

Table (2) Effect of method and age of castration on the comfort behaviour of lambs.

Item	No.	Mean \pm Standard error			
		Standing idle		Lying	
		Frequency	Time	Frequency.	Time
Treatment:					
Control	18	0.52 \pm 0.16 ^D	1.21 \pm 0.48 ^D	1.89 \pm 0.21	11.18 \pm 1.34 ^B
Burdizzo	18	3.20 \pm 0.30 ^B	7.06 \pm 0.73 ^B	3.72 \pm 1.15	14.14 \pm 1.78 ^{AB}
Burdizzo + anaesth.	18	2.30 \pm 0.34 ^C	4.63 \pm 0.78 ^C	2.83 \pm 0.28	11.66 \pm 1.37 ^B
Surgical	18	5.09 \pm 0.47 ^A	13.00 \pm 1.51 ^A	3.57 \pm 0.37	17.46 \pm 2.36 ^A
Age of castration					
21 day	36	2.09 \pm 0.19 ^B	4.291 \pm 0.46 ^B	3.76 \pm 0.21 ^A	21.050 \pm 1.29 ^A
56 day	36	3.46 \pm 0.34 ^A	8.660 \pm 0.98 ^A	2.25 \pm 0.59 ^B	6.165 \pm 0.70 ^B
Treatment x age					
Young					
control	9	1.04 \pm 0.30 ^B	2.43 \pm 0.91 ^B	2.26 \pm 0.32 ^b	12.75 \pm 1.95 ^C
Burdizzo	9	2.30 \pm 0.34 ^A	4.73 \pm 0.77 ^{AB}	3.48 \pm 0.29 ^{ab}	22.64 \pm 2.43 ^B
Burdizzo + anaesth.	9	2.04 \pm 0.39 ^{AB}	4.29 \pm 1.03 ^{AB}	3.52 \pm 0.41 ^{ab}	16.30 \pm 2.02 ^C
Surgical	9	3.00 \pm 0.45 ^A	5.72 \pm 0.86 ^A	5.78 \pm 0.32 ^a	32.52 \pm 2.22 ^A
Old					
control	9	0.00 \pm 0.00 ^D	0.00 \pm 0.00 ^D	1.52 \pm 0.27 ^a	9.60 \pm 1.81 ^A
Burdizzo	9	4.11 \pm 0.43 ^B	9.39 \pm 1.08 ^B	3.96 \pm 2.29 ^a	5.64 \pm 1.20 ^{AB}
Burdizzo + anaesth.	9	2.56 \pm 0.56 ^C	4.97 \pm 1.20 ^C	2.15 \pm 0.35 ^a	7.02 \pm 1.37 ^{AB}
Surgical	9	7.19 \pm 0.60 ^A	20.28 \pm 2.12 ^A	1.37 \pm 0.26 ^a	2.40 \pm 0.61 ^B
Treatment	3	195.765**	133.814**	38.042	447.125**
Age	1	101.407**	1030.461**	123.005**	11965.952**
Age x treat.	3	65.889**	736.859**	58.375*	1825.094**
Exp. Error	64	4.710	20.177	20.177	86.515

Means within the same column carry different capital superscripts are significantly differ at P<0.01

Means within the same column carry different small superscripts are significantly differ at P<0.05

Table (3) Effect of method and age of castration on the movement activities of lambs.

Item	No.	Mean \pm Standard error			
		Standing		Walking	Running
		Frequency	Time	Frequency	Frequency
Treatment:					
Control	18	19.43 \pm 0.93 ^A	47.55 \pm 1.27 ^A	32.17 \pm 1.84 ^A	1.63 \pm 0.29 ^A
Burdizzo	18	16.67 \pm 0.41 ^{BC}	41.23 \pm 2.61 ^B	31.11 \pm 1.90 ^A	0.98 \pm 0.18 ^{BC}
Burdizzo + anaesth.	18	17.22 \pm 0.61 ^B	41.28 \pm 1.23 ^B	32.82 \pm 1.19 ^A	1.43 \pm 0.23 ^{AB}
Surgical	18	15.17 \pm 0.39 ^C	29.54 \pm 2.30 ^C	23.76 \pm 1.22 ^B	0.54 \pm 0.11 ^C
Age of castration					
21 day	36	17.32 \pm 0.59	34.63 \pm 1.69 ^B	27.80 \pm 1.13 ^B	1.39 \pm 0.18 ^a
56 day	36	16.92 \pm 0.40	45.18 \pm 1.30 ^A	32.13 \pm 1.15 ^A	0.90 \pm 0.12 ^b
Treatment x age					
Young					
control	9	21.00 \pm 1.47 ^A	44.70 \pm 1.46 ^A	36.37 \pm 3.02 ^A	1.37 \pm 0.50 ^{AB}
Burdizzo	9	15.59 \pm 0.54 ^C	33.07 \pm 2.69 ^C	23.63 \pm 1.44 ^C	1.67 \pm 0.30 ^A
Burdizzo + anaesth.	9	17.96 \pm 0.70 ^B	38.96 \pm 1.54 ^B	29.82 \pm 1.40 ^B	1.96 \pm 0.38 ^A
Surgical	9	14.74 \pm 0.44 ^C	21.767 \pm 1.47 ^D	21.37 \pm 1.64 ^C	0.56 \pm 0.18 ^B
Old					
control	9	17.85 \pm 0.85 ^A	50.40 \pm 1.63 ^A	27.96 \pm 1.80 ^B	1.89 \pm 0.30 ^A
Burdizzo	9	17.74 \pm 0.98 ^{AB}	49.39 \pm 2.27 ^A	38.59 \pm 2.88 ^A	0.30 \pm 0.10 ^B
Burdizzo + anaesth.	9	16.48 \pm 0.98 ^{AB}	43.60 \pm 1.65 ^B	35.82 \pm 1.76 ^A	0.89 \pm 0.25 ^B
Surgical	9	15.59 \pm 0.64 ^B	37.317 \pm 2.28 ^C	26.15 \pm 1.70 ^B	0.52 \pm 0.15 ^B
Treatment	3	56.094**	1016.93**	950.284**	12.782**
Age	1	2.989	2003.07**	1014.000**	13.005*
Age x treat.	3	25.170*	157.383**	1252.309**	10.523**
Exp. Error	64	6.207	33.318	112.692	2.344

Means within the same column carry different capital superscripts are significantly differ at $P < 0.01$

Means within the same column carry different small superscripts are significantly differ at $P < 0.05$

Table (4) Effect of method and age of castration on the body care behaviour of lambs.

Item	No.	Mean + Standard error			
		Scratching	Rubbing	Stretching	Head turning
Treatment:					
Control	18	2.46±0.56 ^A	0.35±0.12 ^a	0.09±0.04	22.02±1.12 ^a
Burdizzo	18	0.98±0.16 ^B	0.13±0.07 ^b	0.11±0.06	20.12±1.36 ^{ab}
Burdizzo + anaesth.	18	1.07±0.23 ^B	0.09±0.06 ^b	0.04±0.03	22.91±1.25 ^a
Surgical	18	0.22±0.08 ^B	0.00±0.00 ^b	0.00±0.00	14.40±0.98 ^b
Age of castration					
21 day	36	1.35±0.19 ^a	0.09±0.04	0.05±0.02	18.32±0.86
56 day	36	1.02±0.28 ^b	0.19±0.07	0.07±0.03	21.59±0.84
Treatment x age					
Young					
control	9	2.41±0.50	0.22±0.12	0.04±0.04	22.60±1.84 ^{ab}
Burdizzo	9	1.11±0.25	0.07±0.07	0.07±0.05	14.53±1.10 ^{bc}
Burdizzo + anaesth.	9	1.52±0.41	0.07±0.07	0.07±0.05	24.54±1.82 ^a
Surgical	9	0.37±0.13	0.00±0.00	0.00±0.00	11.60±1.25 ^c
Old					
control	9	2.52±1.02	0.48±0.22	0.15±0.07	21.37±1.31 ^a
Burdizzo	9	0.85±0.20	0.19±0.12	0.15±0.12	26.33±1.92 ^a
Burdizzo + anaesth.	9	0.63±0.19	0.11±0.08	0.00±0.00	21.11±1.69 ^a
Surgical	9	0.07±0.07	0.00±0.00	0.00±0.00	17.52±1.31 ^a
Treatment	3	47.049**	1.202*	0.140	263.400*
Age	1	6.000*	0.560	0.042	202.216
Age x treat.	3	2.309	0.177	0.091	228.659*
Exp. Error	64	5.483	0.317	0.084	112.79

Means within the same column carry different capital superscripts are significantly differ at $P < 0.01$

Means within the same column carry different small superscripts are significantly differ at $P < 0.05$

Table (5) Effect of castration method on the plasma cortisol concentration in young lambs.

Time after castration	Control	Burdizzo	Burdizzo plus anaesthesia	Surgical	F-value
0	1.66±0.38	1.52±0.30	1.35±0.23	0.89±0.18	1.386
30	1.25±0.48 ^B	10.35±1.01 ^B	8.44±0.81 ^B	12.21±1.72 ^A	18.938**
60	2.68±0.68 ^B	5.09±0.63 ^{AB}	3.36±0.43 ^B	9.42±1.08 ^A	16.605**
90	2.05±0.39 ^B	2.94±0.36 ^B	2.72±0.39 ^{AB}	8.05±0.68 ^A	33.875**
120	2.53±0.51 ^B	4.91±0.73 ^B	4.36±0.62 ^B	9.77±1.35 ^A	12.743**
150	2.10±0.54 ^B	3.35±0.35 ^B	2.36±0.49 ^B	8.04±0.90 ^A	21.087**
180	3.00±0.59 ^B	4.84±0.43 ^B	4.24±0.61 ^B	7.65±0.96 ^A	8.433**
24 hr	4.30±0.37	4.37±0.29	3.57±0.24	3.99±0.39	2.005
Total	2.45±0.19 ^C	4.67±0.29 ^B	3.80±0.25 ^B	7.38±0.47 ^A	404.44**

Table (6) Effect of castration method on the plasma cortisol concentration in old lambs.

Time after castration	Control	Burdizzo	Burdizzo plus anaesthesia	Surgical	F-value
0	2.76±0.31	1.95±0.13	1.40±0.07	2.40±0.23	2.05
30	2.65±0.24 ^C	5.35±0.52 ^C	8.40±0.55 ^B	11.15±1.22 ^A	25.764**
60	1.08±0.08 ^C	1.79±0.16 ^C	3.90±0.40 ^B	5.25±0.45 ^A	37.760**
90	2.55±0.30 ^B	3.59±0.46 ^B	2.50±0.22 ^B	8.86±0.57 ^A	54.229**
120	2.97±0.26 ^C	6.20±0.64 ^B	4.33±0.40 ^{BC}	8.39±0.79 ^A	17.662**
150	2.06±0.09 ^B	3.32±0.25 ^A	3.13±0.21 ^A	3.36±0.13 ^A	11.269**
180	3.43±0.49 ^{AB}	3.23±0.27 ^{AB}	2.30±0.15 ^B	4.09±0.40 ^A	4.397**
24 hr	1.59±0.13 ^B	2.15±0.31 ^B	2.11±0.24 ^B	3.64±0.39 ^A	9.796**
Total	2.39±0.11 ^B	3.45±0.19 ^B	3.51±0.21 ^B	5.98±0.34 ^A	402.21**

Means within the same row carry different superscripts are significantly differ at level $P < 0.01$

Table (7) Analysis of covariance of the effect of age and method of castration on the body weight of lambs.

Item	No.	Adjusted lamb weight means every 2 week after castration																		
		2 wk	4 wk	6 wk	8 wk	10 wk	12 wk	14 wk	16 wk	18 wk	20 wk	22 wk								
Age																				
Young (21 day)	36	16.30 ^A	17.86 ^A	20.84	25.66 ^A	28.89 ^A	31.15 ^A	32.76 ^A	34.87 ^A	36.91 ^A	37.68 ^A	38.95 ^A								
Old (56 day)	36	15.07 ^B	17.08 ^B	21.17	22.35 ^B	23.89 ^B	26.46 ^B	28.81 ^B	30.89 ^B	32.32 ^B	33.31 ^B	34.15 ^B								
S.E.		0.168	0.170	0.294	0.404	0.480	0.531	0.570	0.648	0.693	0.693	0.650								
Treatment																				
Control	18	15.53	17.42	20.84	23.57	26.17	28.41	30.82	33.35 ^A	35.65 ^A	36.14	36.97 ^A								
Burdizzo	18	15.86	17.78	21.47	24.67	26.99	28.97	31.29	34.30 ^A	35.93 ^A	36.01	37.75 ^A								
Burdizzo+anaesth.	18	15.89	17.42	20.85	23.77	26.48	29.26	31.46	33.50 ^A	35.08 ^A	36.36	37.30 ^A								
Surgical	18	15.46	17.25	20.84	24.01	25.92	28.59	29.57	30.37 ^B	31.80 ^B	33.47	34.17 ^B								
S.E.	18	0.238	0.340	0.416	0.571	0.678	0.751	0.805	0.917	0.981	0.979	0.919								
Age x Treatment																				
Young																				
Control	9	16.04	17.30	20.58	24.65	28.06	30.07	31.85	34.47	37.00	37.97	39.08								
Burdizzo	9	16.53	18.22	20.93	26.17	29.36	31.59	33.69	36.94	38.71	38.73	39.40								
Burdizzo+anaesth.	9	16.40	18.02	20.87	25.69	29.75	32.57	34.52	36.52	38.37	40.10	40.90								
Surgical	9	16.22	17.92	20.97	26.10	28.39	30.37	30.98	31.54	33.56	33.92	36.41								
Old																				
Control	9	15.02	17.55	21.11	22.49	24.28	26.75	29.80	32.24	34.31	34.30	34.86								
Burdizzo	9	15.18	17.34	22.02	23.16	24.62	26.35	28.88	31.65	33.15	33.30	36.09								
Burdizzo+anaesth.	9	15.39	16.83	20.82	21.85	23.21	25.95	28.41	30.47	31.79	32.62	33.71								
Surgical	9	14.70	16.58	20.72	21.91	23.44	26.81	28.16	29.19	30.04	33.02	31.93								
S.E.		0.337	0.339	0.588	0.807	0.959	1.062	1.139	1.296	1.387	1.385	1.300								
S.O.V.	D.F.	Mean square errors																		
Age	1	13.86**	5.736*	1.018	100.80**	+231.41**	203.23**	144.13**	146.56**	194.92**	176.52**	213.12**								
Treatment	3	0.889	0.896	1.782	4.071	3.829	2.612	13.11	53.533*	65.600*	33.057	47.011*								
Age*Treatment	3	0.281	2.303	1.656	3.696	5.841	10.766	15.408	17.489	14.408	34.916	12.554								
Covariance	1	715.8	814.9	1035.77	1309.4	1380.2	1396.26	1325.74	1187.82	1298.99	1229.23	1288.19								

الملخص العربى

التغيرات السلوكية والفسيوولوجية خلال الثلاث ساعات الأولى
بعد الخصى بثلاث طرق فى الحملان

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أجريت الدراره على عدد ٧٢ حمل من سلاله الفوكس تم تقسيمها الى ثمانيه مجموعات قوام كل منها تسع حيوانات . تعرضت أربع منها للخصى عند عمر ٢١ يوم بالجراحه ، الهرس ، الهرس المبوق بالتخدير الموضعى وتم أستبقاء المجموعه الرابعه كمجموعه ضابطه . وبالنسبه للمجموعات الأربعه الثانيه تم معاملتها كالسابقه ولكن عند عمر ٥٦ يوم . تم دراسه التغيرات فى كل من سلوكيات الحملان ومستوى هرمون الكورتيزول فى دماؤها بينما تم دراسه معدلات النمو بالوزن كل اسبوعين حتى عمر ٢٢ اسبوع بعد الخصى .

أظهرت النتائج أن خصى الحملان بالجراحه أدى الى زياده وقت الرقاد مع أنخفاض فى معدل الرضاعه وتناول الطعام وزياده مده الوقوف ساكناً و أنخفاض سلوكيات الحركه أنخفاضاً معنويآ عن الخصى بالهرس سوءاً كان مسبقاً أو غير مسبقه بالتخدير الموضعى وكذلك عن المجموعه الضابطه . أستعمال التخدير الموضعى قبل الخصى بالهرس أدى الى تقليل الألم والى زياده معدل تناول الطعام والرضاعه ومعدلات الحركه عن الحملان المخصيه بالهرس بدون تخدير موضعى .

أدت طرق الخصى المختلفه الى زياده معنويه فى مستوى هرمون الكورتيزول وكان أعلاها فى الحملان المخصيه بالجراحه تلتها التى بالهرس بدون تخدير موضعى ثم التى بالهرس المسبوق بالتخدير الموضعى فى الحملان الصغيره بينما فى الحملان الكبيره أدى استعمال التخدير الموضعى الى أنخفاض مستوى هرمون الكورتيزول الى معدلته الطبيعى خلال ٨٠ دقيقه بعد الخصى .

كانت مستوى هرمون الكورتيزول مرتفع ووزن الجسم أعلى فى الحيوانات المخصيه فى العمر الصغير عن المخصيه فى عمر متأخر بينما أدى الخصى بالجراحه الى أنخفاض الوزن عن المخصيه بالهرس ولم يلاحظ هذا الفرق بين المجموعات المخصيه بالهرس المسبوق أو الغير مسبوق بالتخدير الموضعى أو المجموعه الضابطه