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Effect of surgical and chemical castration on physiological parameters in Ghungroo male piglets

Asish Debbarma, Nilotpal Ghosh, Syamal Naskar, Menalsh Laishram, Sachin Tripura and Sujata Dey

Abstract
The present study was undertaken to compare the change in physiological parameters in Ghungroo male piglets after surgical and chemical castration. Twenty (n=20) healthy indigenous Ghungroo male piglets (*Sus domesticus*) weighing on an average 3.5±2 kg and aged around 2-3 months were selected for the experiment and randomly divided into four groups of five piglets each. In group 1(control), the piglets were castrated surgically whereas treatment groups (T1, T2 & T3) of each piglets were castrated by intra-testicular injection of chemical sterilant of varying concentrations. The mean rectal temperature for control group (99.59±0.150) in different time intervals were lowest when compared with all the treatment groups (T1=102.21±0.180; T2=101.67±0.270 and T3=101.31±0.170) ($p< 0.05$). However, there was no significance difference ($p< 0.05$) among the three treatment groups (T1, T2 & T3). The mean respiration rate for control group (30.37±0.130) was found lowered and highest in T1 group (36.06±0.123). However T1, T2 and T3 did not differ significantly from each other ($p< 0.05$). The overall means of pulse rate showed significant differences between treatment groups ($p< 0.05$). However there was no significant difference between control and T3. It can be concluded from the current experiment that there was no detrimental effects of chemicals on physiological variables in piglets and can be used as a substitute for surgical castration.

Keywords: Castration, chemical, Ghungroo, pig, surgical

1. Introduction
Pig rearing has been recognized as one of the most profitable ventures among the tribal community of India. Due to certain inherent traits such as high fecundity, improved feed conversion efficiency, prolificacy, early maturity, short generation interval, and higher dressing percentage (Talukdar *et al*., 2020) [9], pigs have a tremendous potential to give a faster economic return to farmers when compared to other livestock species. Pigs are twice as efficient as ruminants in terms of productivity (Mpofu and Makuza, 2003) [6]. Castration is one of the most important management activities of the farm in pig husbandry. Castration is practiced primarily to avoid boar taint to prevent skatole and androsterone accumulation in fat which is an unpleasant odour in the meat of an uncastrated male pig (Backus, 2014) [1] and is a carcass quality concern. Male pigs have been surgically castrated since 4000-3000 B.C. Surgical castration is now widely viewed as a stressful procedure that has detrimental consequences for animal health and welfare (Zamaratskaia and Rasmussen, 2015) [11]. Chemical castration has been proposed as a non-invasive castration technique in domestic animals. It has been used as a simple and low cost technique for castration in pig (Giri *et al*., 2002) [3]. Advantages of non-surgical chemical castration are apparent reduction in pain and stress, and relief from post-operative complications such as haemorrhage, hernia, infection, myiasis and other surgical sequelae (Koger, 1978) [5]. Physiological parameters are always correlated with physiological status of the animal, indicating the environment's positive or negative effect on that animal. The experiment was conducted with an objective to evaluate the changes in physiological parameters after surgical and chemical castration in Gunghroo male piglets.

2. Material and Methods
The present experiment was carried out in Pig unit of the composite livestock farm of ICAR-Indian Veterinary Research Institute, Eastern Regional Station, Kalyani, Nadia district, West Bengal located at 22° 56' 30" N latitude and 88° 32' 04" E longitude, and 9.75 meters above mean sea level altitude.

Twenty (n=20) healthy indigenous Ghungroo male piglets (Sus domesticus) weighing on an average 3.5 ± 2 kg and aged around 2-3 months were used for the current study. The piglets were maintained under standard feeding and management of the farm. The animals in the experiment were split into four groups at random. Each group contained five (n=5) clinically healthy piglets. In group 1 (control), each piglet were castrated by conventional surgical method. Every animal in each treatment group (T1, T2, T3) was administered a single bilateral intra-testicular injection of chemical sterilant solution of three different concentrations for a volume of 1ml per testis. A sterile 21 gauge needle was introduced from the caudo-ventral aspect of each testis approximately 1 cm from the epididymal tail and directed towards the dorso-cranial aspect of that testis for each intra-testicular injection. By linear infiltration from the proximal to the distal end, the solution was carefully deposited in a withdrawing fashion over the entire route. The small area to be injected at the bottom of each testis was cleaned with Betadine® solution 5% (Povidone-iodine) before every injection to maintain aseptic conditions. To avoid seepage of the solution from the injection site, necessary precautions were taken. Following injection, the animals were kept under normal routine observation. To evaluate the clinical parameters between surgically and chemically castrated male piglets, physiological variables such as body temperature, respiration rate and pulse rate were studied for the present study for all the groups (control and treatments). Body temperature was recorded with the help of a clinical thermometer inserted into the rectum and held for 2 minutes and expressed as degrees of Fahrenheit (ºF). The rectal temperature was recorded for seven consecutive days' post-injection and surgery during the experimental period. Respiration rate was recorded by counting the number of flank movements per minute. The recording was expressed as a number per minute. The respiration rate was recorded for seven days post-injection and surgery during the experiment. Pulse rate was measured by feeling the femoral artery on the medial aspect of the thigh. The measurements were expressed as beats per minute. The pulse rate was recorded for seven days post-injection and surgery during the period of experimentation.

3. Results and Discussion

3.1 Effect on rectal temperature

The details of mean body temperature at different time intervals in various groups are presented in Table 1 and also shown in graphical presentation in Fig.1. The average body temperature (^{0}F) of piglets of control group at day 1 to day 7 were 99.8±0.025, 99.0±0.200, 99.2±0.200, 100.00±0.215, 100.00±0.200, 99.60±0.300 and 99.50±0.400 respectively. The corresponding values for T1 group were recorded as 102.6±0.410, 102.08±0.736, 102.76±0.448, 102.44±0.768, 102.4±0.160, 101.60±0.255 and 101.56±0.325 respectively. Similarly for the T2 group animals were recorded as 102.32±0.256, 101.68±0.784, 102.32±0.304, 101.76±0.592, 101.92±0.256, 101.50±0.230 and 100.20±0.310 respectively. The corresponding values in T3 group were recorded as 101.84±0.208, 100.92±0.944, 101.88±0.368, 101.28±0.544, 101.48±.544, 100.85±0.345 and 100.90±0.315 respectively. The study revealed that there was significant effect of chemical sterilant on the body temperature of piglets at different days after giving injection. In day 1, the lowest mean body temperature was observed in control group and highest was observed in T1 followed by T2 and T3. There was significant difference in body temperature between control group and other treatment groups. However, there was no significance difference ($p< 0.05$) among the three treatment groups I, II and III. Similar trend was observed in subsequent day's viz., day 2, day 3, day 4, day 5 and day 6. However, in day 7, slight variation was observed in the above mentioned trend of result. There was significant difference between control group and T1 & T3.

Table 1: Body temperature (^{0}F) of piglets of different groups at different time intervals (Mean ± SE)

Group	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Average
C	99.80 ± 0.025^{aC}	99.00 ± 0.200^{aA}	99.20 ± 0.200^{aAB}	100.00 ± 0.215^{aC}	100.00 ± 0.200^{aC}	99.60 ± 0.300^{aBC}	99.50 ± 0.400^{aABC}	99.59 ± 0.150^{a}
T1	102.60 ± 0.410^{bC}	102.08 ± 0.736^{bABC}	102.76 ± 0.448^{bC}	102.44 ± 0.768^{bC}	102.40 ± 0.160^{bC}	101.60 ± 0.255^{bAB}	101.56 ± 0.325^{cA}	102.21 ± 0.180^{c}
T2	102.32 ± 0.256^{bC}	101.68 ± 0.784^{bBC}	102.32 ± 0.304^{bC}	101.76 ± 0.592^{bBC}	101.92 ± 0.256^{bBC}	101.50 ± 0.230^{bB}	100.20 ± 0.310^{abA}	101.67 ± 0.270^{bc}
T3	101.84 ± 0.208^{bB}	100.92 ± 0.944^{bAB}	101.88 ± 0.368^{bB}	101.28 ± 0.544^{bAB}	101.48 ± 0.544^{bAB}	100.85 ± 0.345^{bA}	100.90 ± 0.315^{bcA}	101.31 ± 0.170^{b}

($p< 0.05$)

The superscripts in capital letters indicate significant differences in mean values between days in a row.

Superscripts in small letters indicate significant differences in mean values between treatments in a column.

In control group, there was significant difference ($p< 0.05$) among mean body temperature at different days starting from the day of operation. The highest mean body temperature was observed on day 4 & 5 and lowest on day 2. In T1, the highest mean body temperature was observed on day 2 and lowest on day 7. In T3, the highest mean body temperature was observed on day 1 and lowest on day 7 respectively.

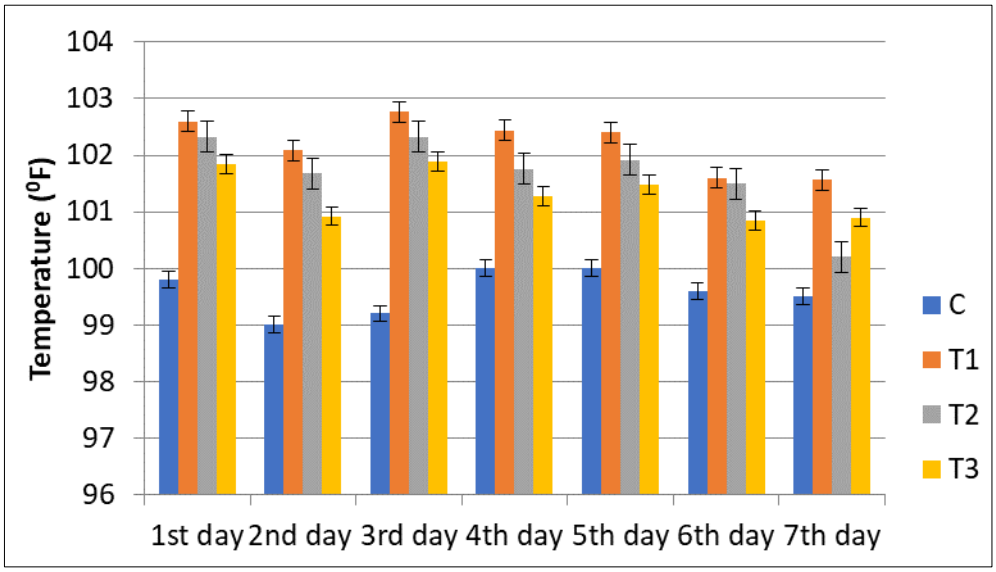

Fig 1: Graphical representation of body temperature (^{0}F) of piglets of different groups at different time intervals

The initial rise in mean body temperature values might be due to stress experienced by the animal of different groups due to injection of chemical agents and accompanied inflammation. These results were in accordance with Pineda *et al*. (1977) [7], King *et al*. (1991) [4], Fahim *et al*. (1993) [2] and Giri *et al*. (2002) [3]. As the days advancing there was decrease in the body temperature in all groups with control group being the lowest followed by T3, T2 and T1. Similar findings were reported by Tepsumethanon *et al*. (2005)[10] in dog. There were minor temperature changes in the control group in comparison to the treatment groups which is in agreement with the work done by Silva *et al.* (2018) [8]. It may be noted from the result that though there was variation in body temperature in various groups, it was within the normal physiological range which sought to non-detrimental effect of chemical sterilant on this physiological norm of the piglets.

3.2 Effect on respiration rate

The details of mean respiration rate at different time intervals in various groups are presented in Table 2 and graphical presentation is shown in Fig 2 respectively. The mean respiration rate (breathe/minute) of piglets of control group at day 1 to day 7 were 30.5±2.60, 30.2±1.80, 30.0±1.60, 31.0±2.10, 30.5±1.50, 30.4±1.70 and 30.0±1.80 respectively. The corresponding values for T1 group were recorded as 37.2±3.84, 37.2±5.44, 30.8±3.36, 37.6±3.68, 36.0±2.40, 32.2±2.35 and 31.4±3.20 respectively. Similarly for the T2 group the corresponding figures were recorded as 35.2±4.16, 34.4±3.68, 34.4±4.48, 36.8±1.44, 32.8±3.36, 31.2±3.25 and 31.0±2.15 respectively. The corresponding values in T3 group were recorded as 31.2±4.16, 30.0±3.20, 31.2±4.96, 32.8±2.56, 39.2±4.64, 30.2±3.75 and 30.0±2.56 respectively. From the result it was revealed that the lowest overall mean (30.37±0.13) respiration rate was observed in control group and highest (36.06±1.23) in T1. In day 1, day 2, day 5, day 6 and day 7 the effect of treatment on respiration rate was found to be non-significant among the various groups. In day 3 significant difference was observed between control and T1 group with lowest observation in control group (30.0±1.60) and highest in T1 group (30.8±3.36). In day 4 significant differences were observed between control group when compared to T1 and T2. However T1, T2 and T3 did not differ significantly from each other. The fluctuations in the mean respiration rate among the groups may be due to the effect of injecting chemical sterilant.

Table 2: Respiration rate (breathe/minute) of piglets of different groups at different time intervals (Mean ± SE)

Group	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Average
C	30.50±2.600	30.20±1.800	30.00±1.600^{a}	31.00±2.100^{a}	30.50±1.500	30.40±1.700	30.00±1.800	30.37±0.130^{a}
T1	37.20±3.840	37.20±5.440	30.80±3.360^{b}	37.60±3.680^{b}	36.00±2.400	32.20±2.350	31.40±3.200	36.06±1.230^{b}
T2	35.20±4.160^{AB}	34.40±3.680^{AB}	34.40±4.480^{abAB}	36.80±1.440^{bB}	32.80±3.360^{AB}	31.20±3.250^{AB}	31.00±2.150^{A}	33.69±0.800^{b}
T3	31.20±4.160	30.00±3.200	31.20±4.960^{ab}	32.80±2.560^{ab}	39.20±4.640	30.20±3.750	30.00±2.560	30.66±0.450^{a}

($p< 0.05$)
The superscripts in capital letters indicate significant differences in mean values between days in a row.
Superscripts in small letters indicate significant differences in mean values between treatments in a column.
The values without any superscript in a row/column did not differ significantly.

In control group, T1 and T3 there were no significant differences in mean respiration rate among different days. In T2 significant differences were observed in mean respiration rate among different days. Significant difference was observed in mean respiration rate on day 4 and day 7. However there was no significant difference between day 4 as compared to means of day 1, 2, 3 and 6. Similarly mean of day 7 had no significant difference as compared to means of day 1, 2, 3, 5 and 6. However, though there were differences in respiration rate among the groups as well as among the days after injecting chemical sterilant, the respiration rate values were within the normal physiological range in piglets indicating no adverse effect of chemical sterilant on the piglet's physiology. No report was found in the available literatures to compare this result.

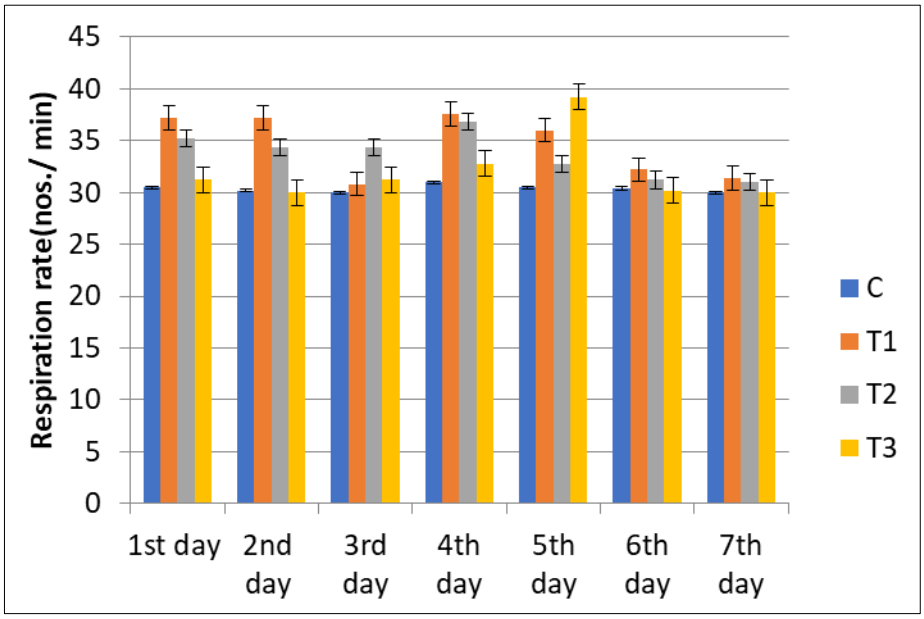

Fig 2: Graphical representation of respiration rate (numbers/minute) of piglets of different groups at different time interval

3.3 Effect on pulse rate

The details of mean pulse rate at different time intervals in various groups are presented in Table 4.3 and graphical presentation is shown in Fig 4.3 respectively. The average pulse rate (beats/minute) of control group animals at day 1 to day 7 were 84.00±1.20, 82.01±1.50, 88.00±1.80, 90.00±1.60, 84.00±1.50, 87.00±1.60 and 89.00±1.40 respectively. The corresponding values for T1 group animals were recorded as 99.2±3.36, 101.2±2.56, 101.2±7.84, 100.0±4.00, 99.6±5.28, 98.0±2.78 and 97.0±2.95 respectively**.** Similarly for the T2 group animals were recorded as 92.8±1.76, 89.2±2.24, 91.0±2.72, 94.0±2.50, 93.2±4.96, 91.0±2.55 and 90.0±1.84 respectively. The corresponding values in T3 group animals were recorded as 86.0±1.40, 85.2±2.56, 86.0±1.60, 87.2±1.76, 85.6±4.32, 85.4±3.52 and 86.0±2.75 respectively.

Table 3: Pulse rate (beats/minute) of piglets of different groups at different time intervals (Mean±SE)

Group	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Average
C	84.00±1.20^{aB}	82.01±1.50^{aA}	88.00±1.80^{BC}	90.00±1.60^{abC}	84.00±1.50^{aB}	87.00±1.60^{aBC}	89.00±1.40^{aC}	86.29±1.13^{a}
T1	99.2±3.36^{b}	101.2±2.56^{c}	101.2±7.84	100.0±4.00^{c}	99.6±5.28^{b}	98.0±2.78^{b}	97.0±2.95^{b}	99.46±0.59^{c}
T2	92.8±1.76^{b}	89.2±2.24^{b}	91.0±2.72	94.0±2.50^{bc}	93.2±4.96^{ab}	91.0±2.55^{ab}	90.0±1.84^{a}	91.6±0.67^{b}
T3	86.0± 1.40^{a}	85.2±2.56^{ab}	86.0±1.60	87.2±1.76^{a}	85.6±4.32^{a}	85.4±3.52^{a}	86.0±2.75^{a}	85.91±0.25^{a}

(p< 0.05)

The superscripts in capital letters indicate significant differences in mean values between days in a row. Superscripts in small letters indicate significant differences in mean values between treatments in a column. The values without any superscript in a row/column did not differ significantly.

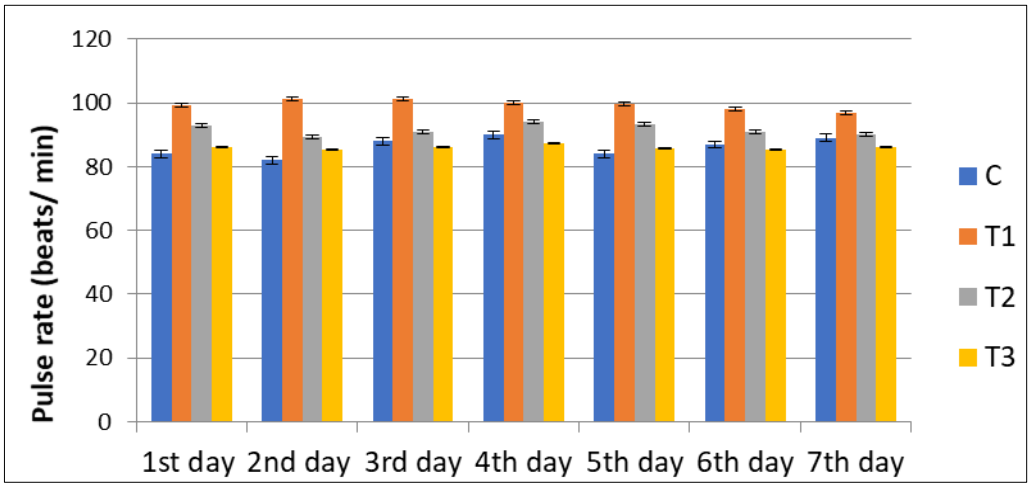

Fig 3: Graphical representation of pulse rate (beats/minute) of piglets of different groups at different time intervals

It was revealed from the result that in day 1, there was significant difference in pulse rate between control group and T1 & T2 groups. However there were no significant differences between control group and T3 and between T2 and T3. In day 2, control group differed significantly as compared to T1 and T2. There was also significant difference

between T1 and T2. However T3 did not significantly differ from control and T2. In day 3, the effect of treatment was not significant on pulse rate. In day 4, there was significant difference between mean pulse rate of control group and T1. There was also significant difference between T1 and T3. In day 5, significant differences were observed between control and T1 and between T1 and T3. In day 6, control and T3 differed significantly as compared to T1 and T2. However, there was no significant difference between control and T3 and between T1 and T2. In day 7, T1 differed significantly as compared to control, T2 and T3. However, there was no significant difference between control, T2 and T3. Overall means showed significant differences between treatment groups. There was significant difference between control, T1 and T2. However there was no significant difference between control and T3.

4. Conclusion

From the present study it was observed that there were initial rise of body temperature, respiration rate and pulse rate of piglets subjected to surgical castration as well as chemical castration with intra-testicular injection of potassium permanganate solutions, which is expected from any such study. Though there was variation in body temperature in various groups, it was within the normal physiological range which sought to non-detrimental effect of chemical sterilant on the common physiological norms of the piglets. Hence, chemical castration may be taken into consideration for castration in Ghungroo piglet.

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