STUDIES ON EXPERIMENTAL MODELS USED FOR NUTRITIONAL AND BIOLOGICAL RESEARCH: A TECHNIQUE OF PERMANENT INSTALLATION OF RUMEN CANNULAE IN THE NIGERIAN CATTLE

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ABSTRACT

The procedure found suitable for cannulating the rumen of some indigenous breeds of cattle in Nigeria for nutritional analysis and bioassays has been described. The viability of the technique relative to others suggested for exotic ruminants, is reviewed. The anatomical location for a successful implantation in order to reduce complications to the nearest minimum has been suggested. The maintenance of the implanted cannulae for the purpose of keeping the modified experimental model in perfect health is discussed.

Key Words: Experimental Models, Nutritional Biological Research, Rumen Cannulation Cattle.

INTRODUCTION

Most nutritional and biological research on the functional and digestive activities of the bovine alimentary tract particularly the rumen will necessitate being able to obtain samples of the digesta at regular intervals. However the development of techniques in cattle for quantitative and continuous sampling of the rumen digesta without upsetting the normal physiological processes of the animal has been very gradual. Colin (1886) was the first to use successfully the techniques of rumen fistulae in oxen (although he made no attempt to close the opening by any mechanical means) followed by Wester (1926), Schalk and Amadom (1928) and Diem Hofer in West Africa.

The purpose of this contribution is to describe the improved technique adapted for successful installation of permanent rumen cannulae in the Nigeria cattle that are used as experimental Models for nutritional and biological research.

MATERIAL AND METHODS

The Cannulae:-
The Cannulae used were essentially the same as those described by Mckenzie and Kay (1968) and Oladosu and Akpokodje (1975). They were also modified as earlier suggested by these workers in order that the cannulae could remain intact after implantation without un-
screwing the locking nut. These cannulae\(^1\) are with bore diameters of about 6.3cm, a collar and a locking nut. They are rigid and unbreakable. As supplied, the fitting comprises of a flanged cylindrical body with a standard pipe thread, through which the external flange and the locking nut could run easily (Plate 4). All cannulae used for cattle were about 10cm in length. Some of these cannulae were donated by the Department of Animal Science, University of Ibadan.

The Animals:

The fistulated animals consist of the White Fulani and crosses between the Bunaji and the Congo N’Dama. One of such animals used in describing this technique (Plate 1 – 4) was presented for rumen fistula implantation by the Department of Animal Science University of Ibadan. It was offered for fistulation as an experimental model for a ruminant nutritional research. The subject was admitted to the Large Animal Hospital for preoperative clinical surveillance four days before surgery. 24 hours before fistulation it received 15 ml Tonophosphan\(^1\) and 20 ml. combiotic\(^2\) using the intramuscular route. Coarse fodders were withdrawn 72 hours before surgery, concentrate ration 24 hours and water 12 hours before operation. The operative site around the left paralumbar fossa was also liberally clipped and shaved 24 hours before the operation.

On the day of cannula implantation and at about 30 minutes before surgery, the subject was sedated with acepromazine\(^3\) at a dose rate of 0.04mg/ body weight using the intramuscular route. The prepared operative site was moistened with 1% Savlon solution, scrubbed with brush, cleansed with water and allowed to drip dry. The area was wiped with lint soaked in mythlated spirit. The subject was kept standing and restrained in a squeeze metallic confinement preparatory to the operation as shown in Plate 1. Diernhofer (1928), also employed the same technique in cattle. He however in a very crude manner, closed the fistucae with a wooden cork. Diernhofer (1928) employed a cork block instead of wood together with rubber flaps held in place by string soaked in olive oil and iodine to prevent digestion by bacteria in the rumen. These methods reviewed by Phillips and Innes (1939) have the disadvantage that the whole stopping must be removed each time the animal is used for experiment.

Because of these limitations and disadvantages which exist in the various early techniques in bovine rumen fistulation, the evolution of new techniques or the improvement of existing techniques as a means of gaining insight into the rumen of cattle without serious complications, had been documented during the past years (Dougherty and Cello, 1952, Markowitz, 1954, Dougherty, 1955, Hill and Gregory, 1951, Downie, 1954, Topps, Kay and Goodall 1968). These procedures and their modifications have been established on exotic ruminants of temperate countries. These reports on the suitability and viability of the described techniques in the indigenous breeds of ruminants in West Africa.

Although there have been, in recent times a stream of publications derived

2. Tonophosphan – Fabweke Hoechst AG. Frankfurt (Main), Germany/Allengne.
3. The Boots Company Ltd. Nottingham England. 10mg/ml.
from digestibility studies on rumen fistulated West African ruminants Mba, 1971 and Olutunji, 1971, 1973, and Olubajo and Oyenuga 1970 to mention a few), there have been very few reports concerning the fistulation techniques found suitable for the highly nervous and significantly intractable breeds of cattle.

Regional anaesthesia of the operative site was induced with a paravertebral nerve blocks of the thirteenth thoracic, first second and third lumbar nerves using 2% lignocaine HCl. 7 ml. of the anaesthetic was injected at each injection site (Plate 2). This was augmented with lineal infiltration of the proposed line of incision to desensitise paracostal ramifications of teh ventral nerves.

The Cannula Installation Procedure.

The rumen was approached through a sub lumbar paracostal laparotomy which was about 2 inches caudal and parallel to the costal arch of the last rib (Plate 3). The rumen was partly outpouched through this incision and held out with two intestinal forceps at the dorsal and ventral commissures of the laparotomy incision.

A continuos purse string suture of about 20 cm in diameter was made on the outpouched part of the intact rumen using size 3 monofilament nylon. An incision capable of accommodating the internal flange of the cannula to be implanted was made across the dorsolateral aspect of the rumen wall. The cannula flange was inserted into the rumen and the rumen wall drawn up the purse string. The lips of the rumen wall incision were invaginated against the barrel of the cannula and the purse string suture tightened—with four surgeon’s knots. A plastic internal collar was sutured unto the rumen between the serosal surface of the rumen and the abdominal wall as described by Ash (1962) to enable the development of adhesions between these layers and reduce the chances of leakage. The exteriorization of the cannula barrel was through a secondary stab incision of the abdominal wall at about 6.3 cm from the transverse processes of the lumbar vertebrae (Plate 4). After intraperitoneal administration of 4 megaunits of procaine penicillin G the laparotomy incision was closed routinely using chromic gut No. 1 for the soft internal tissues and size 3 nylon sutures for the skin. The external flange of the cannula and the locking screw were fixed, the gauze plug was removed and the cannula opening covered with the bung (Plate 4). The operation lasted for about 60 minutes and the subject was released from the confinement and admitted into the hospital for post operative recovery.

The Post Operative Care:

This consisted of administration of combiotic daily for the first 5 days and the cleaning with 1% savlon solution and application of aureomycin violet spray 48 hours after the operation and daily for one week to the sutured left incision. The patient was maintained on good quality grass and ad lib water during the period of hospitalisation. Strict hygiene of the recovery pen was maintained throughout the period of hospitalization. A block of rock salt (mineral lick) was provided for the animal during the period of hospitalization. This together with appropriate vitamin injection ensured good appetite and quickened recovery.

RESULTS AND DISCUSSION

The operative wounds (laparotomy and stab) healed within two weeks of
operation after which the stitches were
removed. The patients' appetite in most
cases appeared back to normal around
the third or fourth day of operation. The
subject was discharged 3-4 weeks after
surgery. After complete healing the
external flange of the implanted cannula
was tightened close to the abdominal
wall. Sulphenilamide powder was applied
round the area of contact of the abdo-
minal wall and the cannula barrel at re-
gular intervals as need arose. The post
operative maintenance of the fistulated
cattle was essentially the same as pre-
viously described, (Oladosu and Akpo-
kodje, 1975). Daily inspection of the
animal is desirable and regular cleaning
of the sites around the cannulae with a
15 x 20cm lint soaked in 1% Savlon solu-
tion prior to application of antibiotic
powder is essential.

Experiences gained in cannulating the
Nigerian cattle at the University of
Ibadan shows that considerable care is
needed in the siting of the cannulae. The
exteriorization of the implanted rumen
cannulae should be very close to the
transverse process of the lumbar verte-
brae at about 1/3rd up the vertebral
border of the paralumbar fossa. This
should be so because the trunk of the
Bunaji cattle in general appears relatively
narrower than those of temperate breeds
of cattle with more prominent but
smaller paralumbar fossa. This would
enable the implanted cannula to gravi-
tate at an angle of about 70° within the
rumen and reduce the chances of leakage
during rumination movements.

The vulcanite type 504 waste-drain
cannula fitting appeared to be better
retained when implanted with very
minimal leakages compared with the
Ebonite or even pliable rubber cannulae.
The latter together with the pressure
plug cannulae or the pneumatic plug
type as described by Dougherty (1955),
and Ash (1957), seemed to be often con-
spicuously attended with excessive leak-
age when used on the Nigerian breeds of
cattle.

Although the perspec type cannulae
have proved satisfactory in many ways
and had been used with cattle in Nigeria
by Akerejola at Zaria and the early
visiting experts at Ibadan, they have
been found in this study to have the
disadvantages of being too heavy for the
abdominal wall of local breeds of cattle.
They are characterised with excessive
leakage and are prone to dehiscence and
total rejection of the implanted cannulae.

The brass cone used for cannulae
eexteriorization was patterned after the
type used and described by Brown,
Armstrong and Macrae (1968). It was
designed by the author at Ibadan and
prepared at the University's Mechanical
work shop using a 6 long cylindrical
rod of 25cm diameter. The use of this
brass cone has quickened the operation
time and reduced the stress on the sub-
ject and the surgeon.

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Plate 1
Preoperative restraint of cattle within an adjustable metallic confinement.

Plate 2
Paravertebral nerve blocks of thirteenth thoracic, first, second and third lumbar nerves.

Plate 3
Paracostal incision technique. Note the relative position from the vertebral column and the hook bone.

Plate 4
The fistulated cattle showing the relative position of the sutured incision and the exteriorized cannula.
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