

THE TECHNIQUE OF ADRENALECTOMY IN THE SHEEP

C. F. B. HOFMEYR,⁽¹⁾ Onderstepoort Laboratory and R. J. FITZPATRICK,⁽²⁾ Bristol

The literature on adrenalectomy is scanty in the case of ruminants. Strand, Anderson & Allcroft (1934) recorded a technique practised on sheep and consisting of "an oblique incision (about 8 inches long) made in the loin, stretching from the lower border of the 12th rib on the right side towards the umbilicus." The adrenal gland was exposed by retracting the viscera. Tapes were placed under the vena cava above and below the site of the gland, which was excised, the tape preventing haemorrhage, as the resection caused a slit, which was sutured, in the vena cava. The five sheep successfully adrenalectomised survived 34—60 hours after the second operation.

Cowie & Stewart (1949) operated on purebred British Saanen goats. Both adrenals were removed at one operation with cyclopropane as anaesthetic. The right side was operated upon first. An oblique incision about 17 cm. long was made from the vertebral end of the last rib on a line "extending to the umbilicus". This rib was resected at the vertebral end, and the viscera retracted to expose the adrenal. A local anaesthetic was injected into nerve plexuses in the vicinity of the gland. Specially designed forceps resembling cauponising forceps were placed over the gland after dissection so that the edges of the jaws were between the gland and the vein. A ligature was applied between the instrument and the vein. The adrenal was then resected by running a knife inside the jaws. The left side was operated upon in a similar manner except that the rib resection was found to be unnecessary. Cowie & Stewart (1949) further mention that, of the 20 goats, which were considered to have been operated upon satisfactorily, all died within seven days, except three, two of which lasted slightly more than a fortnight and one indefinitely. The latter was found at autopsy to have had some adrenal tissue left.

PROCEDURE

The sheep, which were all full-mouth Merinos, some aged, a few being ewes and the rest lambs (castrated males), were denied feed and water for at least 24 hours pre-operatively. The fleece over the loins and flanks was clipped very short and not shaved as the latter irritated the skin. Conventional aseptic and antiseptic techniques were used. Relatively poor condition facilitated operation, but appeared to be prejudicial to survival for an adequate time.

⁽¹⁾ Professor of Surgery, Faculty of Veterinary Science, University of Pretoria.

⁽²⁾ Department of Pharmacology, University of Bristol, England. Guest worker at Onderstepoort.

Anaesthesia

Sodium pentobarbitone solution (Sagatal: Maybaker) intravenously was used in all but the first two sheep. Chloral hydrate and beta-naphthoxy-ethanol (Anavenol K; I.C.I.) were used separately for the other two.

Site

An incision is made from the border of the last rib posteriorly, parallel to the lumbar transverse processes and 3 cm. or less below for a distance of 10 cm. or less (see Fig. 1). This is the site for both sides.

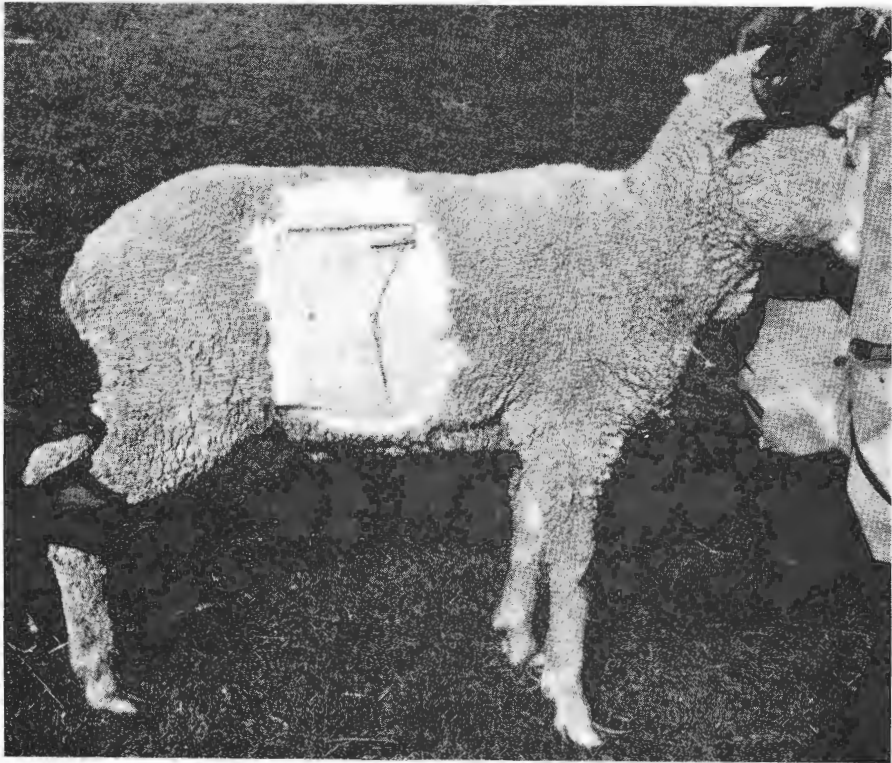


FIG. 1.—The site of the incision.

The Right Adrenal

The right adrenal being the more difficult to remove, this is the first side to be operated upon.

The right kidney is exposed as soon as the peritoneal cavity is entered. It is retracted posteriorly. Retractors are applied and, if necessary, the bowels packed out of the way. The slight traction on the kidney draws the adrenal backwards as it is situated in the crotch made by the Vena cava and the Vena renalis.

It is readily identified by palpation, being oblong, about 2-2.5 cm. long and flattened dorsoventrally. The whole of the parietal surface is firmly attached to the roof of the abdomen. There is a fairly large vein originating in the region of the vertebrae and traversing the visceral surface, giving tributaries to the V. cava and entering the V. renalis (Fig. 2.) Occasionally this vein runs caudal to the gland. Various small arteries and veins traverse the exposed surface of the gland, but form no fixed pattern. They are very friable and bleed readily, often obscuring the adrenal. It is preferable to divide them between mosquito forceps or between ligatures. By gently and carefully tearing the peritoneum and fascia attaching the gland to the lumbar region, using rat-toothed dissection forceps, the parietal surface is gradually freed until the adrenal is adherent solely by the tissues holding it to the two great veins. The usual relationship is for the

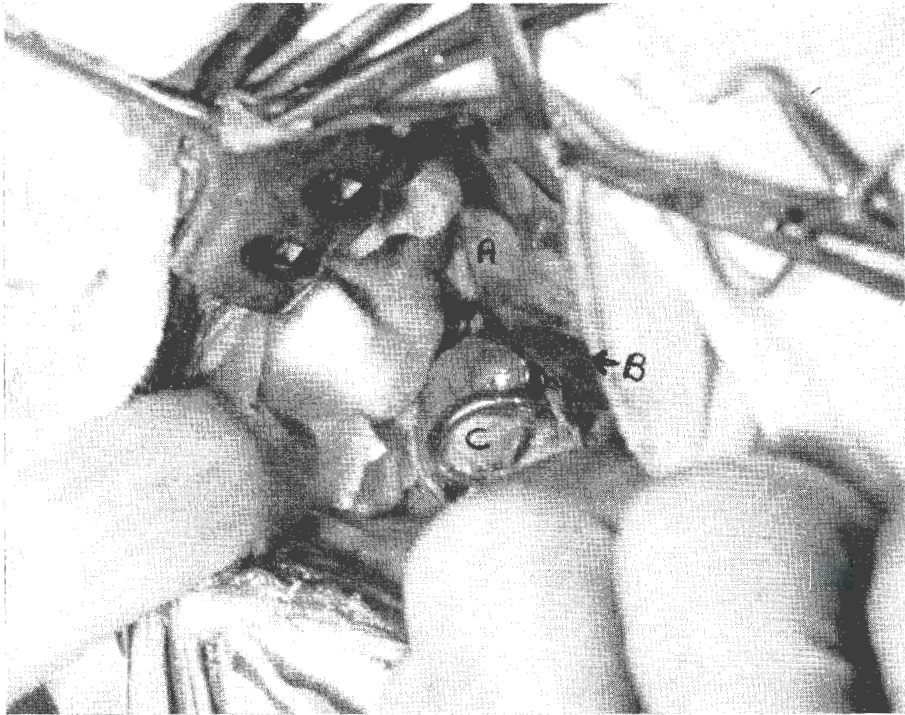


FIG. 2.—A. Vena cava caudalis. B. Vena renalis. C. Right adrenal showing the large vein traversing the visceral surface

caudal pole of the gland to be almost in contact with the renal vein and for its edge to lie over the ventral surface of the V. cava. Occasionally this position is reversed. In one case the adrenal was inserted between the V. cava and the dorsal muscles. In another case the gland was double the one lying well forward of the usual position and the other firmly attached to the ventral surface of the two large veins mentioned, so that the angle of confluence was obscured.

Tongue-holding forceps are applied in such a manner that part of the jaws are interposed between the adrenal and the adjacent blood vessels. (Fig. 3.)



FIG. 3.—The tongue-holding forceps in position A, B and C as in FIG 2

In as much as the pedicle holding the gland is too wide to be ligated safely with one ligature, curved mosquito forceps, or an aneurism needle is passed against and outside the jaws of the forceps and roughly at the point of junction of the renal vein with the V. cava. The needle carries a thick (No. 4) silk suture doubled so that one half is securely tied around the cranial portion of the pedicle and the other half caudally. By means of a No. 12 Bard-Parker blade the adrenal is dissected away inside the ring formed by the jaws. The forceps are then gradually released. Subcutaneous fascia, muscle and peritoneum are then closed by one continuous silk suture and the skin with silk Halsted sutures.

It must be emphasised that the disposition of the adrenal vein is very variable. It may enter the V. cava — sometimes it joins the renal vein and often there is an adrenal vein to each of the other two veins. The various points of entry are also variable. It is, therefore, impossible to predict this location with any degree of certainty.

The Left Adrenal

The left side is operated upon with the following differences: As the left kidney is further back, it is scarcely necessary to push it out of the way. The left adrenal is much more mobile than the right one in that its parietal surface is free and covered with peritoneum. It is held in close proximity (but not as close as on the right side) to the large blood vessels by a very strong and fan-shaped pedicle. The blood vessels on the visceral surface are also not prominent.

The tongue-holding forceps are applied without previous dissection. As the pedicle is too wide to be safely encompassed by two ligatures, the edges are carefully nibbled away with rat-toothed forceps before being tied off in the manner already described.

RESULTS

Table 1 gives details of the post-operative survival periods of our sheep and the cause of death if other than adrenal insufficiency. Of seven untreated adrenalectomised sheep (with a mean survival time of 20 hours) four died within 30 hours and the remainder survived for periods up to four days. In the group of six adrenalectomised sheep given adrenal cortical hormones at operation, or within 24 hours thereof, survival times ranged from 24 hours to 11 days (mean 4.23 days).

TABLE I.—Details of post-operative survival periods of experimental sheep.

Sheep No.	Post operative survival time.	
1,364	3½ days.....	Chloral hydrate anaesthesia
1,708	4 days.....	—
2,343	48 hours.....	—
X	24 hours.....	Anavenol K. anaesthesia
3,476	24 hours.....	—
1,732	30 hours.....	—
1,356	30 hours.....	—
87,071	24 hours.....	—
1,432	Indefinite.....	Sham operation (1)
2,469	Indefinite.....	Incomplete adrenalectomy (2)
3,003	24 hours.....	Hydro-cortisone acetate 125 mg. at operation. (3)
3,012	50 hours.....	Hydrocortisone acetate 125 mg. at operation
2,323	75 hours.....	Hydrocortisone acetate 125 mg. at operation
2,338	11 days.....	Hydrocortisone acetate 125 mg. at operation
		Hydrocortisone acetate 125 mg. 48 hr. after operation (4)
3,046	6 days.....	Prednisone 100 mg. 20 hr. after operation
3,091	45 hours.....	Prednisone 100 mg. 24 hr. after operation
2,853	18 hours.....	Thrombosis of left renal vein
2,419	24 hours.....	Thrombosis of right renal vein
1,334	Nil.....	Transfusion reaction
82,103	Nil.....	Aspiration of rumen contents
88,671	18 hours.....	Aspiration of rumen contents

(1) The sham operation comprised the double laparotomy, exposure and manipulation of each gland but without removal of either gland.

(2) The incomplete adrenalectomy was effected in a sheep in which the right adrenal gland was present in two portions, only one of which (in the normal position) was removed. The other so closely invested the Vena cava that dissection was impracticable and it was left intact. The left adrenal was removed.

(3) Hydrocortisone was given by intramuscular injection as "Cortril" suspension (Pfizer).

(4) Prednisone was given by intramuscular injection as Meticortin suspension (Scherag).

DISCUSSION

Strand *et al.* (1934) successfully adrenalectomised five sheep by a two-stage operation and all deaths occurred between 34 and 60 hours. The authors' figures of survival time for non-treated animals show a wider spread, with a higher incidence of deaths apparently due to surgical shock, which is not unexpected for a single stage operation. Cowie *et al.* (1949) noted a similar high early death rate after single-stage double-adrenalectomies in goats, and the authors' survival times in sheep are not inconsistent with his figures for goats.

For the purposes of biochemical investigation, survival for more than 24 hours is usually necessary. It is probable that our high early mortality is partly attributable to the absence of the adrenals coincident with the shock of a major operative procedure. The authors' results suggest that survival is prolonged, as would be expected, by the post-operative administration of adrenal cortex hormones and it is thought probable that the early mortality rate would be decreased if the two adrenals are removed at separate operations, the right adrenalectomy as the more severe operation being made first, followed perhaps two weeks later by removal of the left gland. As one of the authors (R.J.F.) was very severely restricted to the time available for this preliminary investigation, this method was not adopted.

Some deaths were not solely due to adrenal deficiency or to surgical shock, but to surgical mishaps which are worth recording.

Two animals died of thrombosis of the renal vein within 24 hours of operation (No. 5 and 6). This occurred due to interference with venous drainage of the kidney by ligatures applied to control profuse haemorrhage. This haemorrhage was caused by inadvertent severance of inconstant hidden veins draining from the adrenal gland into the renal vein and which were present in addition to more obvious veins draining the gland to the Vena cava. It was these mishaps which first emphasised to us the inconstancy of the venous drainage of this area and the respect which must be accorded this feature. Strand, Anderson & Allcroft (1934) record a somewhat similar cause of death, involving the Vena cava, in one of their sheep.

Two other sheep died of inhalation pneumonia attributed to failure to implement instructions restricting food and water prior to operation. One further animal died from a blood transfusion reaction.

CONCLUSIONS

A technique for removal of the adrenal glands in the sheep is described; the difficulties associated with the anatomy of the right adrenal gland are emphasised.

ACKNOWLEDGEMENTS

It is a pleasure to record our appreciation of the facilities made available by Professor R. A. Alexander (Director of Veterinary Services) and of the enthusiasm and co-operation of Professor R. Clark and Dr. M. M. Brown of the Department of Physiology, Onderstepoort. We are grateful to Mr. D. de Vos, Department of Surgery, for skilful anaesthesia.

REFERENCES

- COWIE & STEWART. (1949). *J. Endocrinol.* Vol. 6, p. 197.
STRAND, ANDERSON & ALLCROFT. (1934). *Biochem. J.* Vol. 28, p. 642.