Papers

Description and evaluation of a right flank, mini-laparotomy approach to canine ovariohysterectomy

J. F. Reece, M. K. Nimesh, R. E. Wyllie, A. K. Jones, A. W. Dennison

Surgical ovariohysterectomy (OVH) using a right flank approach was performed in 114 bitches as part of the Animal Birth Control (ABC) Programme at Help in Suffering, Jaipur, India. Incision length, duration of surgery and postoperative pain scores were recorded for each animal. The mean weight of the bitches was 13.7 kg, and the mean body condition score was 4.5 on a 1–9 scale. Mean surgical incision length and time were 22 mm and 11 minutes 4 seconds, respectively. It was seen that 86.1 per cent of bitches required no additional postoperative analgesia. These findings compare favourably with other techniques for OVH, including laparoscopic techniques. The surgical approach described may be an alternative for canine OVH, particularly in a shelter setting.

Introduction

Canine ovariohysterectomy (OVH) is one of the commonest procedures in veterinary practice (Howe 2006). It is recommended by animal welfare groups to prevent overpopulation (Diesel and others 2010), and is recognised by the World Health Organization as a means of dog population control as a part of rabies control programmes in rabies-endemic areas (Anon 2004). The surgical approach to sterilisation of bitches has been the subject of numerous reports and debate over many years (Joshua 1965, Janssens and Janssens 1991, Culp and others 2009, Pukacz and others 2009). In recent years, there has been much interest in minimally invasive methods (Mayhew 2011), including laparoscopic techniques, since these are thought to be more appropriate for 'out-patient settings' common in small animal practice (Devitt and others 2005), because the smaller incisions used are less painful than those used in traditional approaches, and result in less surgical trauma and faster recovery (Hancock and others 2005). A disadvantage of laparoscopic surgery is the high cost of the equipment needed (Pukacz and others 2009). Alternative non-laparoscopic surgical methods with reduced tissue trauma have been suggested (Janssens and Janssens 1991, Pukacz, and others 2009), but are complicated by the need to reposition the patient during surgery and make multiple incisions. The sterilisation of cats through a flank incision is common in the UK. Although a flank approach for dogs has been described (McGrath and others 2004), these authors emphasise the limited use of the technique in dogs. A survey of 183 practices in the UK revealed only 1.7 per cent used a flank approach for OVH in the bitch (Hotston Moore and others 2005). A minimally invasive conventional surgical technique for effective, safe OVH in dogs of varied sizes and conditions is described and evaluated.

Veterinary Record (2012) doi: 10.1136/vr.100907

J. F. Reece, BSc, BVSc, MRCVS,
M. K. Nimesh, BVSc & AH
Maharani Farm,
Help in Suffering, Maharani Farm,
Durgapura, Jaipur 302018, Rajasthan,
India
R. E. Wyllie, BVSc, MRCVS,
Ribble Vets Ltd,
53 New Lane, Penwortham,
Preston, Lancashire PR1 9JJ, UK
A. K. Jones, BVSc, MRCVS,
Rufford Veterinary Group, 9, Holly Lane,
Rufford, Lancashire L40 1SH, UK

A. W. Dennison, BVSc, MRCVS,
Myerscough Veterinary Group,
Myerscough House, Longsight Road,
Clayton le Dale, Blackburn BB2 7LA,
Lancashire

E-mails for correspondence:
jack@his-india.in

Provenance: not commissioned;
externally peer reviewed

Accepted June 28, 2012

Methods

During a 23-day period in July 2010, 246 free-roaming street dogs entered the Animal Birth Control (ABC) programme (a street dog/rabies control programme) in Jaipur, India. Of these dogs, 80 were excluded from the current study (61 male dogs, nine bitches destroyed on welfare grounds, two died prior to surgery, and eight which had already been sterilised by the programme as denoted by an ear notch). Of the 166 healthy bitches, 114 were assigned at random to the current study (the remainder were sterilised by flank OVH by veterinary students under supervision). Each animal entering the programme was assigned a unique alpha-numeric identity code number and was kennelled individually or occasionally in pairs. Records were maintained to ensure continuous identification of dogs was possible. During hospitalisation, dogs were fed a mixed, good quality, homemade diet twice daily and had access to water *ad lib.* Food was withheld on the morning of surgery, but the dogs had access to water throughout.

Immediately prior to induction of anaesthesia, each dog was weighed on domestic scales while carried by a technician of known weight. The result was calculated by subtraction to the nearest 0.5 kg.

The Body Condition Score (BCS) of each dog was assessed independently by two observers using the nine-point scale of Laflamme (Laflamme and others 1994). The assessment was made before surgery on kennelled dogs prior to the administration of any medication.

An estimate of the age of each dog was made. Puppies were defined as dogs without the presence of permanent canine teeth, and were thus under 5–7 months of age (Dyce and others 1987). The distinction between yearling and adult was more subjective, and was based on experience of morphology, dentition and condition.

Surgical time for each operation was measured from the first incision to the cutting of the last suture. Timings were measured with a stopwatch and recorded to the nearest second.

Incision length was measured using a sterile, metal, engineer's rule. The measurement was made immediately after the skin incision was made, and on skin which was not tensed. Incisions which were extended during surgery were not re-measured.

Every dog was assessed for pain after surgery using the Short Form Glasgow Composite Pain Score (GCPS) (Reid and others 2007). The same two observers made an assessment of each dog independently twice daily for three days postoperatively. Assessments were made at the intervals shown in Table 1.

Additional analgesia (meloxicam (Melonex 5 mg/ml Intas Pharmaceuticals)) was available if the GCPS was six or more.

Every dog received a veterinary examination once daily after surgery, the results of which were recorded. Dogs were released after surgery when, in the opinion of a veterinary surgeon, the surgical wound was sufficiently healed to ensure that the animal's welfare was not compromised. The veterinary surgeon undertaking this examination was one of the surgeons undertaking the study's surgery, but differed randomly every day. The period in days from surgery to release was recorded with the day of surgery being day 0.

In view of the small number of dogs in the current study, a retrospective study of records of bitches spayed earlier using the same surgical, analgesic and husbandry protocols as described here was undertaken. From the records of the Jaipur ABC Programme, the 1246 bitches spayed in alternate months from August 2006 to June 2007 were identified, and the postoperative complication rate was calculated (defined as any abnormality of the surgical wound which, in the opinion of the examining veterinary surgeons, required treatment postoperatively, whether or not this treatment delayed the release of the animal.) Alternate months were chosen because breeding in street dogs is seasonal in Jaipur (Chawla and Reece 2002), and the programme sterilises dogs both pregnant and in oestrus.

Surgical method

Each bitch was premedicated with triflupromazine HCl injection, I.P. (10 mg/ml, Jackson Laboratories) at 2 mg/kg intramuscularly between 30 and 120 minutes prior to surgery. The dog was anaesthetised using xylazine 0.01 mg/kg (Xylaxin, 20 mg/ml, Indian Immunologicals) and ketamine hydrochloride injection, IP, 7 mg/kg (Ketamine Hydrochloride 50 mg/ml, Jackson Laboratories) intravenously through an indwelling catheter usually placed in the right cephalic vein. Additional doses of the anaesthetic mixture were administered as necessary at any time during preparation and surgery.

Immediately after induction of anaesthesia, the animal received meloxicam (Melonex 5 mg/ml, Intas Pharmaceuticals), 0.2 mg/kg intravenously, and was positioned in left lateral recumbency. Rabies vaccine (Defensor, Pfizer) and 400,000 International Units of fortified procaine penicillin injection IP (Zydus Animal Health) were administered intramuscularly into different locations on the right anterior thigh. An area extending cranio-caudally from the 10th rib to the femur, and dorso-ventrally from the transverse spinal processes to the midline was shaved using a safety razor (from which the lateral bars had been removed) and chlorhexidine solution (Cadlon 0.3% w/v Chlorhexidine and 0.6%w/v Cetrimide solution, Zydus Cadila). The site was then prepared for surgery with povidine-iodine solution (Intadine, 5% w/v povidine-iodine solution, Intas Pharmaceuticals) in a conventional manner. A notch was placed in the cranial edge of the left pinna, and the dog's identity number tattooed in the inner surface of the right pinna.

TABLE 1: Timing of pain score assessment periods

Assessment	Time after surgery (hours)
1A	2 to 4
1B	7 to 9
2A	20 to 22
2B	31 to 33
3A	44 to 46
3B	55 to 57

Each dog was then assigned randomly to one of three veterinary surgeons (JR, MN and SC) all of whom had considerable experience in the technique. Each veterinary surgeon was assisted by a highly experienced trained technician. Surgeons and assistants prepared for surgery in a conventional manner, and wore sterile gloves.

The bitch was positioned on the operating table in left lateral recumbency. The right hind limb was tied to the table and the dog stretched in a cranio-caudal direction. The left stifle was extended caudally and hooked behind the right hock. Isopropyl alcohol was applied to the surgical site. A 0.9 per cent sodium chloride injection IP (Shree Krishna Keshav Laboratories) was administered intravenously throughout the operation.

The site was draped first with a fenestrated plastic sheet to prevent wicking, and then with a conventional sterile fenestrated cloth drape.

A cranio-caudal incision was made at a position ventral to the iliac crest, and at the level of the fold of skin connecting the stifle to the abdominal wall, the stifle fold. In young dogs, the incision was placed slightly more caudally. For this study, the incision length was measured (Fig 1).

The external oblique muscle, or its aponeurosis, was exposed by blunt dissection through the fascia. The muscle was grasped by the assistant using Allis clamps, incised using scissors, and then split along the fibres by blunt dissection. The internal oblique muscle was grasped and cut in a similar fashion, and the incision edges were isolated with Allis clamps. The rectus abdominis muscle was thus revealed. This was elevated and incised in a similar fashion. A very small incision was made through this layer initially, to avoid the possibility of unintentional injury to underlying abdominal tissues. The incision edges of the rectus abdominis and peritoneum were isolated with Allis clamps.

Using a spay hook, the right uterine body was exteriorised. By gentle manual tension on the uterus broad and round ligament, the ovary was also exteriorised. A small hole was made in the broad ligament and mesometrium. The ovary and ovarian bursa were isolated using the standard triple-clamp method across the ovarian pedicle. An encircling ligature of 6 metric (2 USP) chromic cat gut (Trugut, Sutures India) was placed around the ovarian pedicle. Rarely, at the surgeon's discretion, a second or transfixing ligature was placed. The ovarian stump was checked for haemorrhage, and the excised structure examined to ensure complete excision of ovarian tissue. The ligated pedicle was then returned to the abdominal cavity.

The dependent ovary was then located by following the right uterine horn caudally to the uterine bifurcation which was drawn into the incision site. From the uterine bifurcation, the left uterine horn was exteriorised, and the left ovary exteriorised and removed in a similar manner to that of the right. In young bitches, the bifurcation is more caudal, which necessitated more caudally placed incisions in younger animals.

Following removal of both ovaries, the whole reproductive tract was exteriorised. A window was made in each mesometrium. This was extended, by controlled tearing and breaking, from the free ovarian edge, caudally along the reproductive tract close to the uterine vasculature to the level of the cervix. The support and fatty

FIG 1: The site of incision for a right flank ovariohysterectomy

structures were returned to the abdominal cavity. The freed uterine body and vasculature were isolated just cranial to the cervix using the triple-clamp method. The uterine body was ligated using 6 metric (2 USP) chromic cat gut, and the uterine body then excised. A second, or transfixing ligature, was placed at the surgeon's discretion before excision. The uterine stump was examined for haemorrhage and returned to the abdomen. If at any point in the procedure it was felt necessary to extend the incision this was done at the surgeon's discretion in a cranio-caudal direction to facilitate the safe removal of the sexual organs. (The extended incision was not re-measured).

The incision was closed using 5 metric (1 USP) chromic cat gut (Trugut, Sutures India). Horizontal mattress sutures were placed in each of the three muscle layers. The peritoneum was incorporated into the closure of the rectus abdominis. In pups and young dogs, the peritoneum, rectus abdominis and internal oblique muscles were closed together at the discretion of the surgeon. The subcutaneous fat and fascia were closed with 3 metric (3/0 USP) chromic cat gut (Trugut, Sutures India). The skin was closed using 3 metric (3/0 USP) braided coated polyglycolide-co-L lactide (Solus 910, Lotus Surgicals) in a continuous intradermal pattern terminated with a buried Aberdeen knot.

Immediately after surgery, the incision site was treated with Himax Skin Ointment (an Ayurvedic fly repellent ointment, Natural Remedies), and the animal returned to kennels for recovery.

The dogs were examined daily by a veterinary surgeon, and independently by two observers conducting the pain score observations. The veterinary examination noted animals which required further wound dressing, antibiosis or pain relief. These were then administered. The examining veterinary surgeon also determined when each animal was ready for release back to the address whence it was caught. These details were noted.

Results

The data collected in this study was entered into Microsoft Excel, and were analysed using Minitab 16. Of the 114 operations in the study, 62 were performed by JR, 47 by MN and 6 by SC. There were 19 puppies, 21 yearlings and 75 adults. The mean weight of bitches neutered was 13.7 kg (range 3.5–24 kg). The mean BCS of bitches in the study was 4.5 on a 1–9 scale.

Of the 114 bitches in the study, three (2.6 per cent) had identifiable problems prior to surgery; one each with diarrhoea, mange and a transmissible venereal tumour. During surgery, 12 bitches (10.43 per cent) were found to be in oestrus, one bitch had cystic ovaries, and seven (6.07 per cent) dogs were pregnant. These animals were, nevertheless, neutered.

Incision length and duration of surgery

The mean flank incision length for all spays was 22 mm (range 10 mm–53 mm). If the results of pregnant bitches are excluded, the mean was 21 mm.

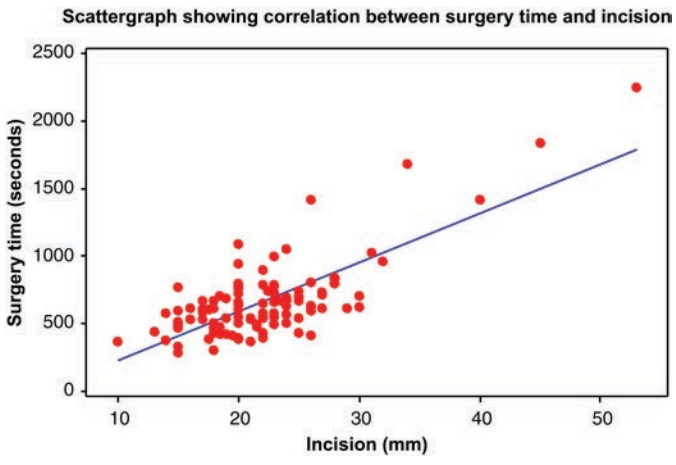

FIG 2: Graph showing a positive correlation between incision length and duration of operation for bitches spayed in this study

The mean duration of surgery was 11 minutes and 4 seconds (range 4 minutes 40 seconds to 37 minutes 25 seconds – this latter bitch was in the last trimester of pregnancy). The mean surgical time for non-gravid bitches (n=108) was 10 minutes 18 seconds. The mean surgical time for bitches in anoestrus (n=96) was 10 minutes 7 seconds, suggesting that there is not much more difficulty neutering a bitch in oestrus with the flank approach.

Figure 2 shows that there is a positive correlation between incision length and surgery time (Pearson correlation 0.753), showing that smaller incisions can lead to reduced operating times.

Postoperative pain

The postoperative pain scoring was performed independently by two observers using the GCPS. The observers' scores were found to be not significantly different (paired *t* test, P=0.05) apart from those from pain assessment 1A (see Table 1). The difference in means for the first pain assessment (2–4 hours postoperatively) may be due to the fact that some animals were still under the effect of anaesthesia at this time.

The proportion of animals requiring additional analgesia was greatest on day 2 when a maximum of 13.9 per cent of bitches were found to have a pain score of 6 or above.

The mean postoperative pain scores were under 3. This score decreased over the three days of assessment until release (Fig 3).

For each bitch, an average pain score was calculated for the entire assessment. This was compared with the bitch's bodyweight to ascertain if flank OVH is more painful in larger dogs. No correlation (Pearson correlation=0) was found between the weight of the bitch and postoperative pain scores.

Postoperative complications

There were nine (7.82 per cent) bitches with postoperative complications. Of these cases, six (5.22 per cent) were related to OVH, (five partial wound dehiscences, one surgical site infection). One of these cases was pregnant at the time of surgery, the others were in anoestrus. The mean BCS of these bitches was 4.78/9, and the mean weight was 14 kg.

In the retrospective analysis of 1246 ovariohysterectomies (performed by veterinary surgeons experienced in the right flank approach at Help in Suffering between August 2006 and June 2007), the postoperative complication rate was 4.57 per cent where infection rate has been defined as any abnormality of the surgical wound which, in the opinion of the veterinary surgeons, required treatment postoperatively, whether or not this treatment delayed the release of the animal.

Recovery times

No bitch was released until the examining veterinary surgeon was satisfied that the animal had recovered satisfactorily and could be released into the streets with no risk to the welfare of the animal. The average recovery time from operation to release was 3.7 days, range 2–20 days (n=105), excluding those bitches whose release was

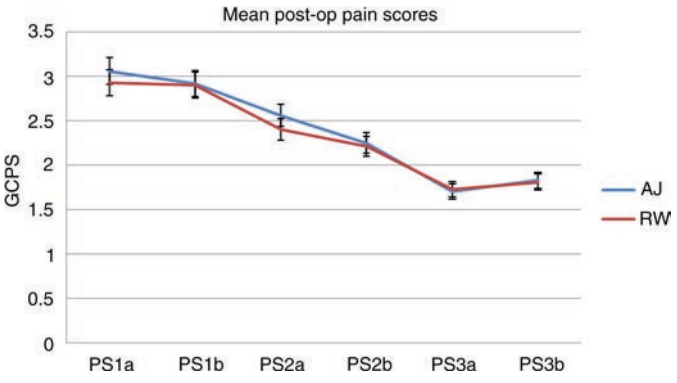

FIG 3: Mean pain scores plotted against assessment period (time after surgery) for the two pain score observers illustrating that pain scores decline with time and that there was close correlation between the observers. Error bars at 95 per cent CIs

delayed for reasons other than complications arising from the surgical intervention.

Discussion

The mean body weight of the dogs spayed in this survey (13.7 kg) was similar to the mean weights of the bitches spayed in other surveys; 15 kg (Burrow and others 2005) and 12.1 kg (Davidson and others 2004). The mean BCS, 4.5 (1 emaciated; 9 obese) of the dogs in this survey indicates that they were not emaciated strays.

Mean surgical time in the current study was 11 minutes 4 seconds (range 4 minutes 40 seconds–37 minutes 25 seconds). The mean time for a median approach by experienced university surgeons was 31.7 minutes (Hancock and others 2005). Davidson and others (2004) give a mean surgical time of 69 minutes (range 25–140 minutes) for a traditional midline approach performed by experienced students assisted by qualified surgeons, and considered it 'unlikely that student surgeons played a role in overall surgery time'. Shorter surgical times lead to shorter anaesthetic times, which are associated with a reduced risk of anaesthetic-related deaths (Brodbelt 2009, Jones 2009). Shorter anaesthesia also reduces consumption of anaesthetic agents, thus reducing costs which may be an important consideration in a high-throughput canine sterilisation programme.

The surgical incision length of 22 mm compared favourably with that given for a midline approach of 60 mm (Hancock and others 2005). British veterinary school surgical teachers advise that incision length for a midline spay should be 'from the umbilicus halfway to the pubis or as long as necessary' (Hotston Moore and others 2005). This distance was measured on all dogs neutered in the Jaipur ABC programme on August 1, 2011, and the mean length was 167 mm (n = 11, including two puppies). Thus, surgeons following this advice would make a midline incision of 83.5 mm. Incision lengths for laparoscopic OVH techniques are often described as stab incisions. Two or three such incisions are usually required, depending on the laparoscopic method used. In the current study, incisions which were extended during surgery were not re-measured. Incision extension was done in a few but unspecified cases. This experimental omission will have led to an underestimation of the mean incision length. The correlation found between incision length and surgical time was unsurprising. There is a correlation between surgical time and postoperative complication rate (Cimino-Brown and others 1997). Shorter incisions should lead to fewer postoperative complications. The short incision used in the flank approach arises, in part, from the use of a spay hook to exteriorise the uterus.

The anaesthetic and analgesic protocol used in this study used a multimodal analgesic regime as is considered best practice. Opiates are considered as the 'gold standard' analgesics but, unfortunately, no convenient opiate is available in India. The pain scores recorded here did not reach zero, as may have been expected. The nature of the dogs involved in the current study may be different from that used to devise the GCPS, which were drawn from patients at veterinary schools in Glasgow, North Carolina and Dublin (Reid and others 2007). The current study was performed on Indian free-roaming street dogs which lack familiarity with close human contact or confinement. Many street dogs will vocalise on kennelling, and may flinch, growl and snap when touched. They may be nervous, fearful and restless when restrained. These behaviours, which may not be related to pain, could give falsely high pain scores. No preoperative pain score assessment was undertaken; had this been done, an adjustment for the behaviour of the dogs may have been possible. The highest proportion (13.9 per cent) of bitches was found to require additional analgesia on the day following surgery.

The proportion of postoperative complications in the study (5.22 per cent) may be due to the climate in Jaipur at the time of this study. July is the start of the monsoon season, where the relative humidity in the air rises (often 80 per cent) and temperatures can remain high (average maximum 33.9°C), causing an environment that can impede wound healing. In the retrospective study, of 1246 bitches spayed by the flank method described in a 12 month period, a 4.57 per cent complication rate was observed. Wound complications increased towards the peak of the breeding season. Jaipur street dogs exhibit a seasonal breeding pattern (Chawla and Reece 2002), and wound complications increased towards the peak of the breeding season due to the additional challenges of performing OVH on oestrus or pregnant bitches. The current study was conducted throughout July when reproductive activity begins to increase. The six dogs in the current study which had postoperative complications had a slightly higher mean weight and BCS than the average but, overall, there was no correlation between postoperative pain scores and body weight. This would suggest that dissecting through a thicker body wall is no more painful than doing so in thinner animals, and that a right flank approach is appropriate for dogs of all sizes. McGrath and others (2004) note the lateral flank approach is often used in large animal surgery where body weights involved are much higher.

Many surgeons would not use cat gut for OVH surgery. The choice of suture material in this study (and the wider ABC project of which the study was a part) is a compromise based on the local availability and cost of alternatives.

Traditional midline approach to OVH does enable easier management of intraoperation complications by extending the incision. The right flank approach does allow for some incision extension should difficulties be encountered, but visualisation can remain difficult, and the management of complications is considered less easy with this approach.

There are multiple alternatives to the traditional midline spay technique available to the practitioner, each with their own advantages and disadvantages. Laparoscopic OVH is minimally invasive (Devitt and others 2005) and believed to be less painful than conventional surgery but takes longer (Hancock and others 2005) though the evidence on pain for these two approaches is far from clear. Expensive equipment is required for laparoscopic OVH (Pukacz and others 2009) limiting its use, especially in the charity sector where much sterilisation surgery is undertaken. Multiple (two or three) small incisions, often of about 12 mm each, are generally made for laparoscopic OVH techniques compared with one incision of an average 22 mm in the current study. A distinct advantage of laparoscopic surgery over conventional incisions, even where very small incisions are used, as in the right flank technique described here, is the better visualisation of anatomical structures that a laparoscope may allow (Mayhew 2011).

The method described in this paper is considered a viable option for the surgical OVH of most dogs. The technique requires no additional surgical equipment over a midline OVH. It may be of particular interest to rescue charities and large-scale neutering projects since it is less invasive than traditional midline approaches, can be performed quickly and easily by experienced veterinary surgeons, allowing for a high throughput of animals which experience low postoperative pain levels and rapid return to function.

Acknowledgements

The ABC programme at Help in Suffering, and MN's position is funded by the Animal Welfare Board of India. JR is supported by grants from the Humane Society International, USA, and from Help in Suffering (UK). AJ's travel was funded by the Community Foundation for Merseyside. AD was supported in part by the Knowlson Trust. The authors thank all these bodies for their support. The authors thank Dr SK Chawla for neutering six bitches, and Messrs Ajeet, Mukesh, Shyamlal, Ramashankar and Ramcheran for their excellent technical help.

References

ANON (2004) WHO Technical Report Series 931 WHO Expert Consultation on Rabies. Geneva, Switzerland: WHO. p 54

BRODBELT, D. (2009) Perioperative mortality in small animal anaesthesia. *The Veterinary Journal* **182**, 152–161

BURROW, R., BATCHELOR, D. & CRIPPS, P. (2005) Complications observed during and after ovariohysterectomy of 142 bitches at a veterinary teaching hospital. *Veterinary Record* **157**, 829–833

CHAWLA, S. C. & REECE, J. F. (2002) Timing of oestrus and reproductive behaviour in Indian street dogs. *Veterinary Record* **150**, 450–451

CIMINO-BROWN, D., CONZEMIUS, M. G., SCHOFER, F., & SWANN, H. (1997) Epidemiologic evaluation of post-op wound infections in dogs and cats. *Journal of the American Veterinary Medical Association* **210**, 1302–1306

CULP, W. T. N., MAYHEW, P. D. & BROWN, D. C. (2009) The effect of laparoscopic versus open ovariotomy on post surgical activity in small dogs. *Veterinary Surgery* **38**, 811–817

DAVIDSON, E. B., MOLL, H. D. & PAYTON, M. E. (2004) Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. *Veterinary Surgery* **33**, 62–69

DEVITT, C. M., COX, R. E. & HAILEY, J. J. (2005) Duration, complications, stress and pain of open ovariohysterectomy versus a simple method of laparoscopic assisted ovariohysterectomy in dogs. *Journal of the American Veterinary Medical Association* **227**, 921–927

DIESEL, G., BRODBELT, D. & LAURENCE, C. (2010) Survey of veterinary practice policies and opinions on neutering in dogs. *Veterinary Record* **166**, 455–458

DYCE, K. M., SACK, W. O. & WENSING, C. J. B. (1987) The Head and Ventral Neck of the Carnivores in Textbook of Veterinary Anatomy. Chapter 11. Philadelphia: WB Saunders Company. pp 370–389

HANCOCK, R. B., LANZ, O. I., WALDRON, D. R., DUNCAN, R. B., BROADSTONE, R. V. & HENDRIX, P. K. (2005) Comparison of post-operative pain after ovariohysterectomy by harmonic scalpel assisted laparoscopy compared with median celiotomy and ligation in dogs. *Vet Surgery* **34**, 273–282

HOTSTON MOORE, A., TIVERS, M. S., TRAVIS, T. R. D. & WINDSOR, R. V. (2005) Questionnaire study of canine neutering techniques taught in UK veterinary schools and those used in practice. *Journal of Small Animal Practice* **46**, 430–435

HOWE, L. M. (2006) Surgical Methods of contraception and sterilization. *Theriogenology* **66**, 500–509

JANSSENS, L. A. A. & JANSSENS, G. H. R. R. (1991) Bilateral flank ovariectomy in the dog; surgical technique and sequelae in 72 animals. *Journal of Small Animal Practice* **32**, 249–252

JONES, R. S. (2009) Death in small animal anaesthesia. *The Veterinary Journal* **182**, 375–376

JOSHUA, J. O. (1965) The spaying of bitches. *Veterinary Record* **77**, 642–647

LAFLAMME, D. P., KEALLY, R. D. & SCHMIDT, D. A. (1994) Body condition scoring and weight maintenance. Proceedings of the North American Veterinary Conference. Orlando, USA, January 16–21, 1993. pp 290–291

MAYHEW, P. (2011) Developing minimally invasive surgery in companion animals. *Veterinary Record* **169**, 177–178

MCGRATH, H., HARDIE, R. J. & DAVIS, E. (2004) Lateral flank approach for ovariohysterectomy in small animals. *Compendium,* **26**, 922–931, Dec

PUKACZ, M., KIENZLE, B. & BRAUN, J. (2009) Simple, minimally invasive technique for ovariohysterectomy in the dog. *Veterinary Record* **165**, 688–690

REID, J., NOLAN, A. M., HUGHES, J. M. L., LASCELLES, D., PAWSON, P. & SCOTT, E. M. (2007) Development of the short-form Glasgow Composite Measure Pain Scale (CMPS-SF) and derivation of an analgesic intervention score. *Animal Welfare* **16(S)**, 97–104