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SOFT TISSUE SURGERY

Update on Ovariohysterectomy

***Jacob M. Shivley**, DVM, MS*
***Philip A. Bushby**, DVM, MS, DACVS*
***Wilson Cooper Brookshire**, DVM, MS, DACVPM (Epidemiology)*
***Kimberly Woodruff**, DVM, MS, DACVPM (Epidemiology)*
Mississippi State University College of Veterinary Medicine

The most commonly performed surgical procedures in small animal practices in the United States are for reproductive sterilization (spay/neuter).[1] Surgical sterilization of the female dog and cat is commonly accomplished via ovariohysterectomy (OVH). In addition to sterilization, OVH significantly reduces the incidence of mammary gland tumors and is indicated for diseases such as pyometra, cysts, and ovarian/uterine neoplasia. An analysis of the veterinary medical literature reveals 4 commonly used sterilization techniques—traditional midline, laparoscopic, flank, and ovariectomy—which will be highlighted in this update. Often missing from surgical textbooks, student teaching, and scholarly articles are discussions on efficient techniques that can be used when performing OVH. The authors highlight several efficient techniques and other helpful methods that can be used during OVH.

REVIEW OF TRADITIONAL AND MODERN OVH TECHNIQUES

Traditional Midline Approach

Veterinary students are commonly taught, and many practicing veterinarians use, a traditional midline celiotomy approach for OVH.[2] The incision is often one-third to one-half the length of the distance between the umbilicus and pubis and can be extended in patients with ovaries or a uterine body that are difficult to exteriorize (e.g., obese or deep-chested dogs). Traditional OVH techniques include digital strumming of the suspensory ligament, triple clamping of the ovarian pedicle, and double ligation of the ovarian pedicles and uterine body. Closure is often depicted as a standard 3-layer closure.

Laparoscopic Approach

Laparoscopic OVH has been established as an alternative to the traditional midline approach and may have advantages (e.g., reduced postoperative pain, reduced infection rate, and improved visualization of anatomy). Potential disadvantages include the requirement for specialized equipment and training as well as the lengthy surgical times. Surgeons must also overcome the lack of depth perception when performing procedures while visualizing a 2-dimensional screen.[3]

THE VALUE OF TIME
Use of efficient surgical techniques during an ovariohysterectomy should prove beneficial for the patient, surgeon, and veterinary business alike.

A variety of specific techniques, which differ in number and location of ports, have been described. However, most commonly used is the 3 median-portal approach. Pedicle hemostasis can be accomplished by using bipolar/ultrasonic sealing devices, pre-tied ligature loops, extracorporeal sutures, hemoclips, and electrocautery. Vessel sealing devices are associated with less postoperative hemorrhage and shorter surgical times;[4] however, vessel sealing devices should not be used for uterine bodies ≥9 mm due to low uterine bursting pressure.[5] Laparoscopic OVH outcomes have yet to be compared (by randomized controlled trials) with outcomes of efficient surgical techniques that use short incisions and have succinct surgical times. The use of laparoscopic approaches should be carefully weighed against use of efficient techniques, in which an efficient open celiotomy can be performed with incision lengths of 1 to 4 cm, and total surgical times of 5 to 11 minutes, in cats and dogs respectively.[6,7]

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Flank OVH

In the United States, the standard approach for OVH of the cat is through a ventral midline incision; however, in other countries, veterinarians prefer a flank approach. The flank approach has been recommended for cats with mammary hyperplasia, nursing queens, and feral cats. One obvious advantage is that the incision avoids mammary tissue. Another advantage is that for feral cats, the risk for evisceration in the case of dehiscence is less and the surgical wound can be observed without handling the animal.[8] One disadvantage of flank OVH is that for Siamese and Burmese cats, the fur may grow back a different color.[9] Postoperative pain has been a matter of debate, but limited data have shown that pain scores for cats tend to be higher among those that underwent flank OVH than among those that underwent midline celiotomy.[10]

For flank OVH, the patient is positioned in left lateral recumbency, a dorsal-ventral incision is made in the right flank, subcutaneous tissue is excised, and muscle fibers of the external abdominal oblique and internal abdominal oblique muscles are bluntly separated. The peritoneum is incised or bluntly punctured. After the abdominal cavity has been entered, the right uterine horn is located and the OVH is performed in a manner identical to that of a ventral midline OVH. Apposition of the internal abdominal oblique muscle, the external abdominal oblique muscle, subcutaneous tissue, and skin is recommended. The flank spay technique in dogs is reportedly similar to that in cats, but its use in dogs is uncommon.[11]

Ovariectomy

Ovariectomy is the surgical removal of both ovaries while leaving the uterine tissue intact. When performed properly, both ovariectomy and OVH result in permanent sterilization. The data vary with regard to length of surgical incision, surgical time, and potential for postoperative complications.[12,13] In terms of risk, several recent articles have indicated that risk for pyometra after ovariectomy or OVH is near zero if all of the ovarian tissue is removed. Because pyometra is hormonally dependent, removing the ovaries almost completely removes the chance of postoperative pyometra.[14,15]

Also, uterine neoplasia after ovariectomy has been reported, albeit rarely.[16] Given conflicting evidence that one procedure is easier or better for the patient than the other, and given the existence of rare reports of neoplasia, surgeons should use their best judgment when deciding if an ovariectomy is indicated.

EFFICIENT OVH TECHNIQUES

Use of efficient surgical techniques benefits the patient and the veterinary business alike. In both human and veterinary medicine, increased surgical times have been associated with increased risk for anesthetic complications and surgical wound infections.[17-19]

Decreased surgical times should lead to faster recovery and return to function for the patient. Therefore, keeping duration of surgery and anesthesia to a

minimum is imperative. Techniques to accomplish this can include creating shorter incisions, adopting efficient ovarian pedicle disruption and ligation techniques, and using more efficient suture patterns.

From a business standpoint, more-efficient surgeries should decrease costs. A recent study found that use of the pedicle tie procedure in cats decreased surgical time by 2 minutes compared with double-ligation of the ovarian pedicles with suture ligature.[6] Another study argued that sharply transecting the suspensory ligament reduces time by 1.1 minutes per animal and could add up to a substantial savings of time and resources (anesthetic drug costs and surgeon compensation).[7] Were a clinic to perform 4000 OVHs in a year and simply apply the 2 efficient techniques mentioned here, 206 hours could be saved, enabling the surgeon to complete more surgeries or see more appointments.

Patient Positioning

OVH is typically performed with the patient in dorsal recumbency. Exceptions include flank spays (left lateral recumbency) and laparoscopic OVH (tilted table). Traditionally, the patient's forelimbs are secured by pulling them as far cranially as possible. In the authors' experience (approximately 80,000 spay/neuter surgeries performed over the past 15 years), positioning the patient's forelimbs caudally, lateral to the patient's thorax, is advantageous (**FIGURE 1**). There are several ways to accomplish this positioning, but using a simple device created from bending aluminum splint rods enables efficient placement and ease of disinfection (**FIGURE 2**). This position improves efficiency by minimizing abdominal body wall tension, improving suspensory ligament exposure, and allowing for shorter incisions and reduced tissue handling.

FIGURE 1. Caudally positioned forelimbs for OVH in a puppy.

Incision Length and Placement

OVH is more efficient when performed through an appropriately placed small incision. In general, the longer the spay incision, the more time it takes to close. The proper location of the spay incision is predicated on which reproductive structures are more difficult to exteriorize and should vary accordingly. In cats, the uterine body is more caudally situated in the abdomen than it is in dogs; therefore, the abdominal midline incision in cats should be situated more caudally. It has been the authors' experience that in dogs, the ovaries are the most difficult structure to exteriorize, and it was found that a more cranial incision in dogs facilitates exteriorizing the ovaries and disrupting the suspensory ligaments. The incision for puppies (5 months or younger) is located midway between that of a cat and an adult dog.

FIGURE 2. Various sizes of bent splint rods used to position patients' forelimbs in a caudal and lateral position, thereby relaxing the abdominal body wall and easing the sharp transection of suspensory ligaments.

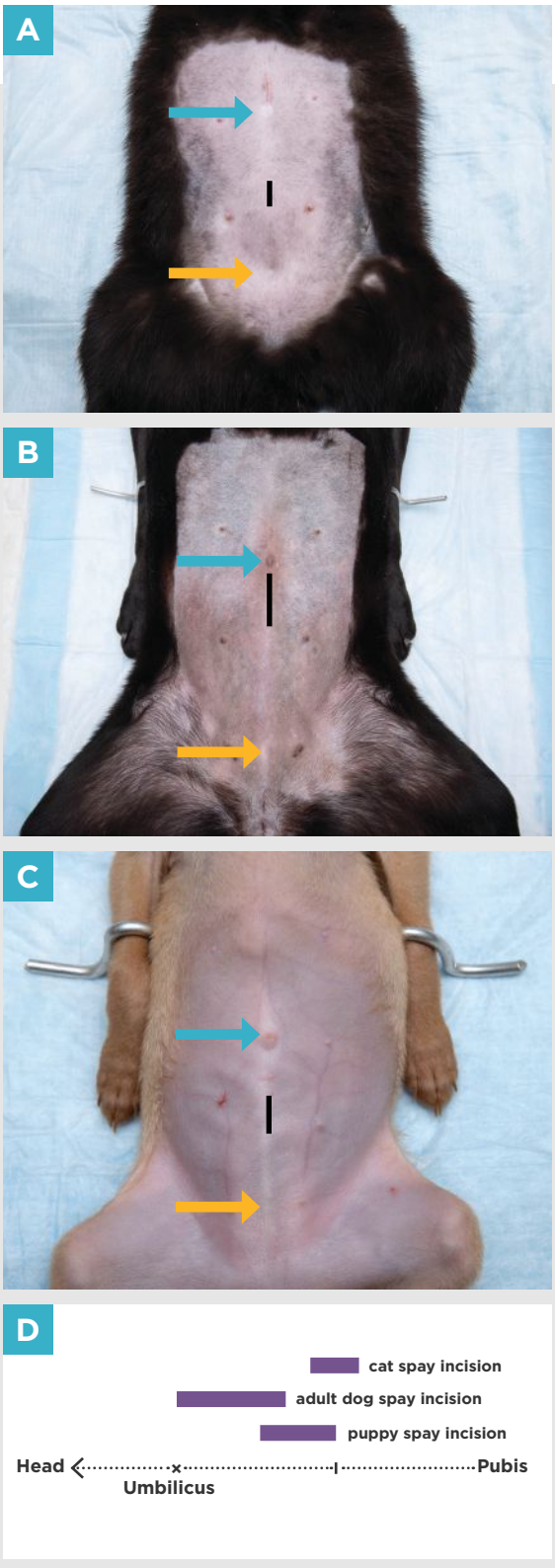

FIGURE 3. OVH incision placement and length in **(A)** cat, **(B)** adult dog, and **(C)** puppy. Incision **(black line)**; umbilicus **(blue arrow)**; cranial brim of the pubis **(yellow arrow)**. **(D)** Efficient OVH incision length and placement for cat, adult dog, puppy. May vary with species, age, and body condition.

For cats and kittens, the incision should be centered at the midpoint between the umbilicus and the cranial brim of the pubis (0.5 to 1.5 cm long) (FIGURE 3A). Its length is usually no more than a third (usually less) of the length from the umbilicus to the cranial brim of the pubis. The skin incision for an adult dog is typically just caudal to the umbilicus (2 to 4 cm long) (FIGURE 3B). It is a third of the length or less from umbilicus to cranial brim of the pubis. For a puppy, the caudal-most aspect of the skin incision should be at the midpoint between the umbilicus and the cranial brim of the pubis (1 to 2 cm long) and is usually a fourth of the length or less from umbilicus to cranial brim of the pubis (FIGURE 3C AND D).

Disrupting the Suspensory Ligament

Veterinary students have traditionally been taught to digitally strum the suspensory ligament until it stretches or tears away from the peritoneum.[20] However, a recent randomized controlled trial demonstrated the safety and efficiency of sharp transection of the suspensory ligament.[7] This technique saves time and provides less nociceptive input to the patient. In larger adult dogs with strong suspensory ligaments, depending on surgeon hand strength, sharp transection may be the only way to disrupt the ligament. Sharp transection enables the surgeon to visualize the tissue to

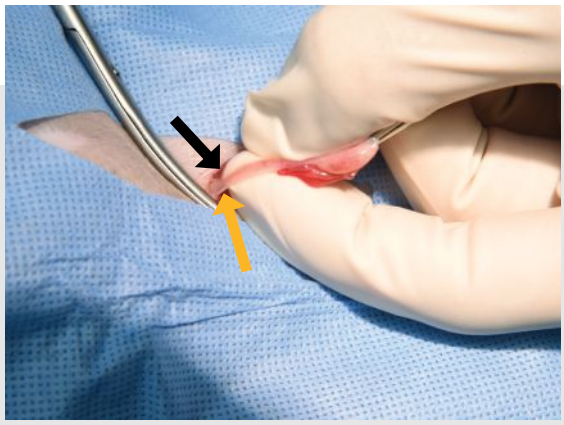

FIGURE 4. Sharp transection. To perform, place a Kelly hemostatic forcep on the proper ligament, palm the forcep with the nondominant hand, and apply upward traction on the suspensory ligament. The index finger is situated down the tensed suspensory ligament, causing the ovarian pedicle to lie on the caudal aspect of the index finger **(black arrow)** and the suspensory ligament to become separated from the ovarian pedicle and lie on the cranial aspect of the index finger **(yellow arrow)**. Sharp transection is performed in the visualized zone of transection **(yellow arrow)**.

be transected instead of blindly ripping tissue away from the body wall (FIGURE 4).

Ligatures

Veterinary students are also often taught to tie multiple ligatures per structure, using square and surgeon knots. However, recent publications have demonstrated the excellence of 2-pass binding knots.[21,22] After a surgeon has mastered appropriate knot security with these binding knots, placing one excellent ligature per structure can increase efficiency, lower the cost for suture material used, and decrease the amount of foreign material placed in the abdomen. For dogs, single ligation with a strangle knot or other appropriate 2-pass binding knot can provide proper hemostasis for most ovarian pedicles and uterine bodies encountered during OVH. Exceptions may include giant breed, obese, or pregnant animals. A recent prospective study reported no perioperative complications after ligation of canine ovarian pedicles with a single ligature.[7]

Pedicle Tie

The pedicle tie is an instrument self-tie used to ligate ovarian vessels in the cat during OVH.[6,23] It is similar to the cord tie frequently used to ligate spermatic cords in the castration of cats and puppies. For a pedicle tie, the ovarian vessels are wrapped around a mosquito hemostat and a knot is tied by using the vessels themselves (FIGURE 5). The knot should be gently tightened before the hemostat is released.[23] The absence of fat and increased elasticity in the feline ovarian pedicle allows isolation and placement of a secure knot. The pedicle tie can be safely and effectively performed in any female domestic cat, regardless of body size or

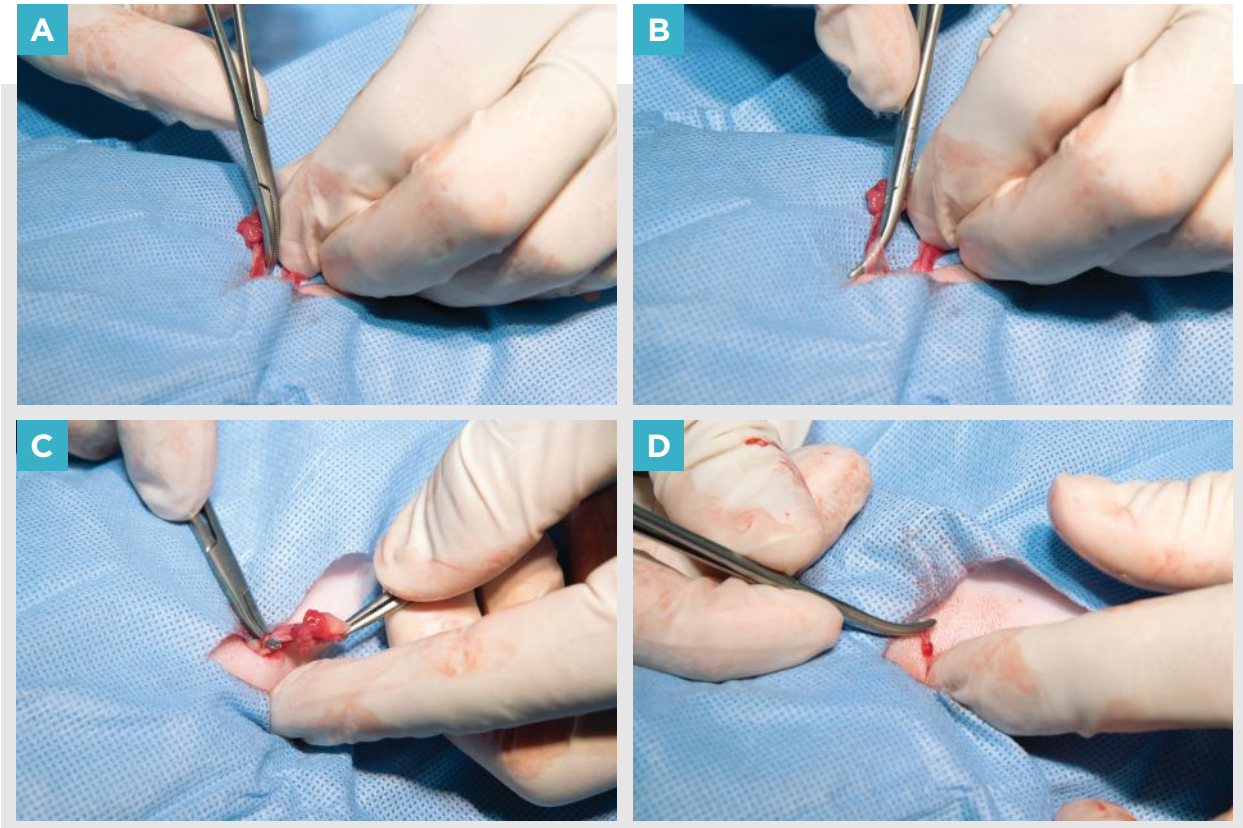

FIGURE 5. Pedicle tie. To perform the pedicle tie, place a straight mosquito hemostat on the proper ligament. Sharply transect the suspensory ligament and fenestrate the broad ligament caudal to the ovarian vessels. With the ovary pulled toward the surgeon, the surgeon's dominant hand is supinated and the tip of a curved hemostat is crossed over the vessels **(A)** and placed into the hole in the broad ligament behind the ovarian vessels. With the hemostat closed, the surgeon's hand is then pronated in order to "scoop" under the ovarian pedicle and prepare for the counterclockwise twist **(B)**. The tip of the hemostat is then directed above the vessels, and the hemostat is rotated counterclockwise until the hemostat faces the surgeon. This action causes the ovarian vessels to be wrapped around the hemostat. The hemostat should then be opened and used to clamp the ovarian vessels **(C)**. Cut the ovarian vessels between the hemostat and the ovary, gently push the tissue off the end of the hemostat, and gently tighten to secure the knot **(D)**.

reproductive status. In a study of approximately 2000 cats involving pedicle tie use during OVH, only 1 incident of postoperative ovarian vessel hemorrhage occurred (complication rate of 0.023%).[6] However, the pedicle tie should not be used for OVH of the dog.

Closure

Much of the surgical time associated with a routine OVH is spent closing the incision. Learning to perform OVH through smaller incisions (2 cm or less), especially in cats, puppies, and small adult dogs, will decrease the amount of time associated with closure. These incisions can often be closed with 1 to 2 cruciate sutures in the body wall and 1 to 2 buried simple interrupted sutures that incorporate the subcutaneous tissue and skin together (**FIGURE 6**).

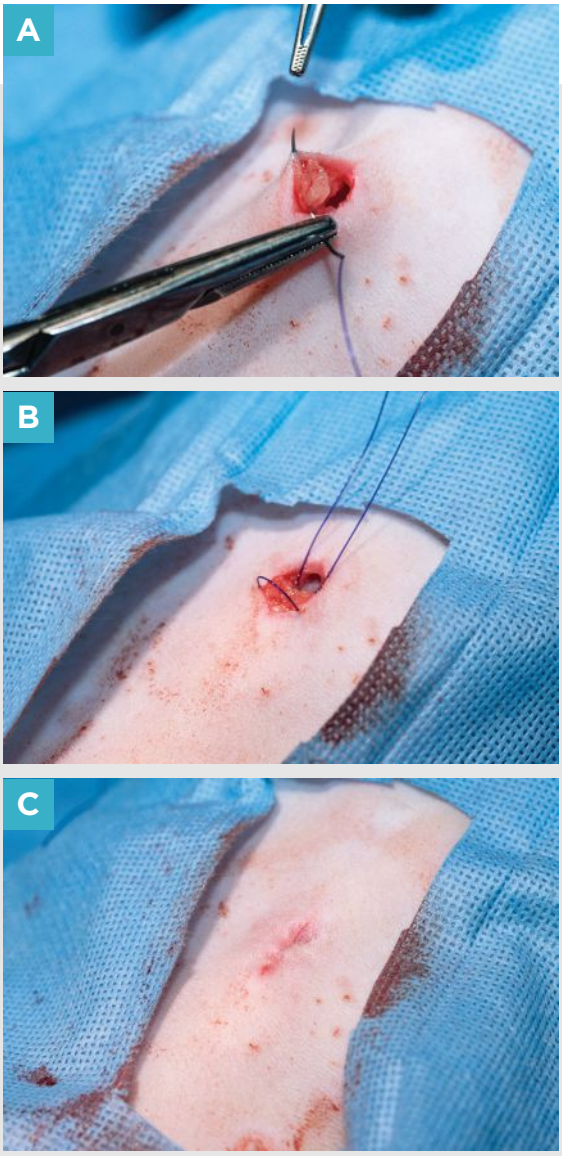

FIGURE 6. Buried simple interrupted closures for incisions that are 2 cm or less. Note how the closure incorporates both the subcutaneous tissue and skin together **(A AND B)**, forming a secure, cosmetic closure **(C)**.

Longer incisions often used for OVH of the adult dog (3 to 4 cm) and extended incisions may be more efficiently closed with a "continuous-continuous" pattern (**FIGURE 7**). To create this pattern, the external rectus sheath should be closed in a standard simple continuous pattern from the surgeon's dominant hand toward the nondominant hand. Remember that the function of the body wall closure is apposition, not ligation.

SUMMARY

OVH has found its place as one of the most commonly performed surgical procedures in veterinary medicine. The surgeon should choose specific surgical techniques according to skill, surgical equipment available, and technical efficiency, all while being mindful of what is best for the patient. An awareness and use of efficient surgical techniques should prove beneficial for the patient, surgeon, and veterinary business alike. TVP

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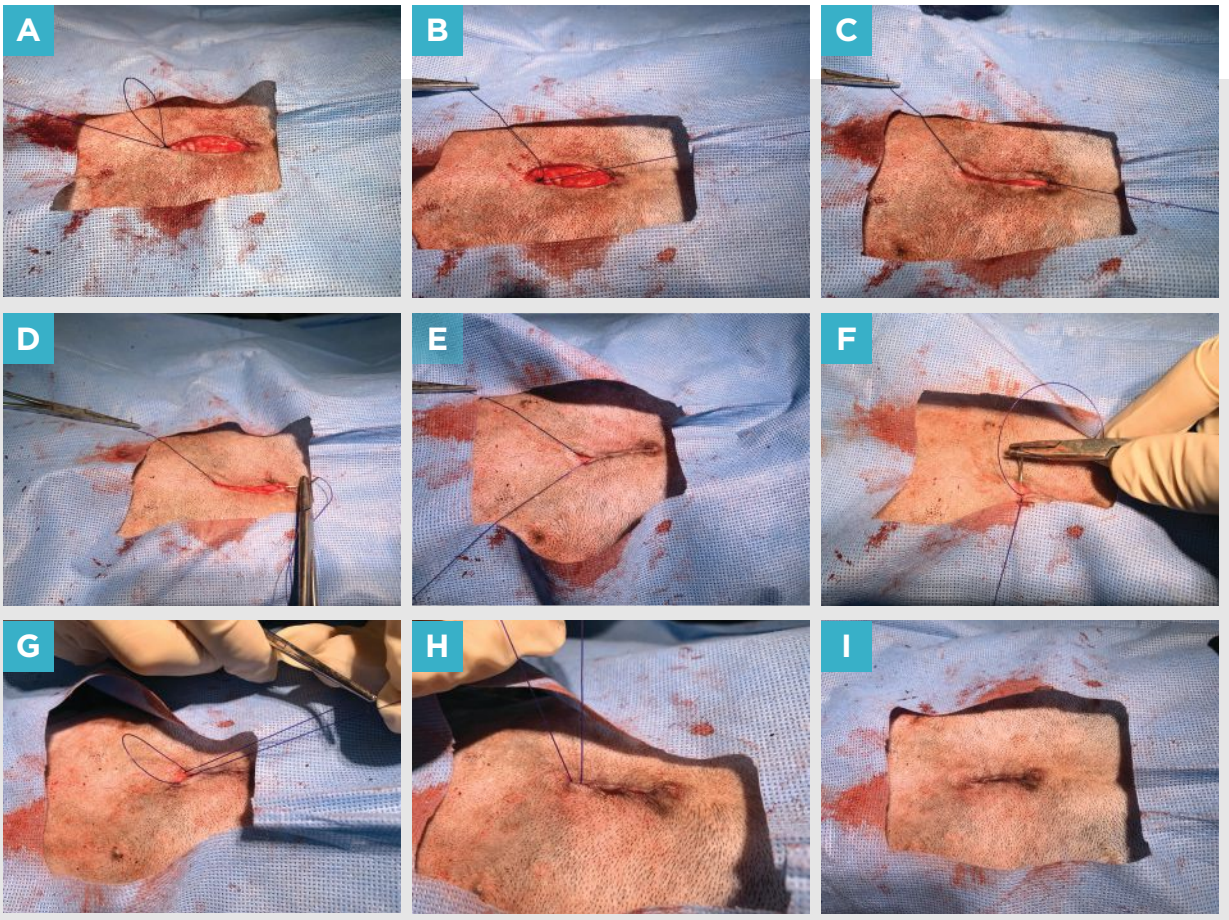

FIGURE 7. The "continuous-continuous" pattern for use in incisions that are 3 cm or longer. **(A)** To ensure knot security, each body wall knot should have a minimum of 6 throws. The first 2 throws should be only tight enough to snuggly appose the body wall, followed by 4 tight throws to secure the knot. **(B AND C)** Without cutting the loop away from the second body wall knot (instead, cut only one side of the loop to create a longer tag), move directly to a continuous pattern in the subcutaneous tissue, moving from the nondominant hand toward the dominant hand. **(D)** After the end of the incision is reached and the dead space is closed, proceed directly into a subcuticular pattern, without tying a knot in the subcutaneous layer. **(E)** The subcuticular pattern is now moving from the dominant hand toward the nondominant hand. **(F AND G)** At the end of the subcuticular pattern, a "deep strand" is created by taking a bite of dermis in a superficial-to-deep direction. **(H)** This strand can now be tied back to the initial tag kept from the external rectus sheath closure. **(I)** This efficient closure apposes 3 layers of tissue with only 3 total knots.

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Jacob M. Shivley

Dr. Shivley obtained his DVM degree from Mississippi State University College of Veterinary Medicine in 2008, followed by a rotating internship. He then completed a surgical internship at Wheat Ridge Animal Hospital in Wheat Ridge, Colo. After 3 years in small animal practice, he returned to MSU as faculty of the shelter medicine program. In 2019, he obtained his master's degree with an emphasis on teaching and learning. His interests include veterinary medical education and HQHVSN techniques. He is passionate about songwriting and worship music and is the worship pastor at his church.

Philip A. Bushby

Dr. Bushby, a 1972 graduate of the University of Illinois College of Veterinary Medicine, is a board-certified surgeon who has served on the MSU faculty for 42 years. He established the MSU CVM shelter program and is a frequent speaker on efficient spay/neuter techniques. He was a member of the organizing committee for the shelter medicine specialty board, received the ASPCA Henry Berg Award in 2008, the AVMA Animal Welfare Award in 2012, and the Association of Shelter Veterinarians Meritorious Service Award in 2015.

Wilson Cooper Brookshire

Dr. Brookshire is a 2010 graduate of the MSU CVM. After 5 years of companion animal practice in Germantown, Tenn., he joined the faculty of MSU. He is a diplomate of the ACVPM as well as the ACVPM Epidemiology Specialty. He holds a master's degree in population medicine from MSU and a graduate certificate in shelter medicine from the University of Florida. He is a member of the AVMA Committee on Antimicrobials and is the 2020 Mississippi Veterinary Medical Association Young Veterinarian of the Year.

Kimberly Woodruff

Dr. Woodruff obtained her DVM degree from MSU in 2008. She completed a 1-year shelter medicine internship, followed by a 3-year shelter medicine residency in 2012, at which time she joined the faculty at MSU. She became a diplomate of the ACVPM in 2016 and was board certified in veterinary epidemiology in 2017. Her interests include disease control, shelter epidemiology, and teaching HQHVSN in the curriculum at MSU.