



CE

Article #6 (1.5 contact hours)

Refereed Peer Review

# Surgical Treatment of External Genital Tumors in Horses

## KEY FACTS

- Local excision is usually successful treatment of horses with solitary, focal tumors of the external genitalia that have not invaded deeper tissues.
- Cryotherapy or carbon dioxide lasers can be used to excise tumors or ablate precancerous lesions.
- Circumferential posthectomy, or reeving, is an acceptable method of treating horses with superficial tumors of the preputial tissues.

Surgi-Care Center for Horses  
Brandon, Florida

Kimberly Anne May, DVM, MS, DACVS

Oklahoma State University

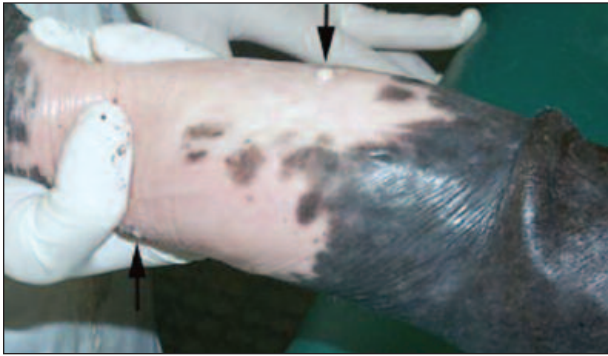
H. David Moll, DVM, MS, DACVS

Michael D. Lucroy, DVM, MS, DACVIM

**ABSTRACT:** Horses with extensive or invasive tumors of the external genitalia may require surgical intervention for successful treatment. Solitary tumors may be removed completely by local excision, laser ablation, cryotherapy, or circumferential posthectomy (i.e., reeving). Horses with advanced lesions involving the glans or body of the penis warrant phallectomy, whereas horses with infiltrative lesions of the penis and prepuce with suspected or confirmed metastasis to lymph nodes require en bloc resection and penile retroversion. This article describes the indications, procedures, aftercare, and potential complications for each surgical technique. Anticancer drugs administered perioperatively may improve outcome in select cases, and indications for their use are discussed as well.

Although many horses with external urogenital tumors can be treated successfully with radiotherapy, immunotherapy, or chemotherapy, surgical intervention may be required to achieve a successful outcome in horses with advanced tumors. Current methods of radiotherapy and intratumoral or topical chemotherapy are restricted to the treatment of horses with superficial tumors. Extension of a tumor into deep structures, such as the penile tunics, warrants aggressive surgical intervention for local control.

Primary factors that influence the choice of surgical procedure include tumor location, histologic type, and extent of tumor growth. Surgical procedures include local tumor excision, laser ablation, cryosurgery, circumferential posthectomy, phallectomy, and en bloc penile resection and retroversion. Although the importance of eliminating the tumors should outweigh cosmesis, some clients may consider cosmetic outcome important in the selection of treatment. The decision to perform radical procedures, such as phallectomy or en bloc resection of the distal penis, is more easily made in male horses not used for breeding. Horses whose breed registry requires natural cover (e.g., Thorough-



**Figure 1**—Focal, superficial SCC lesions (*arrows*) may be treated with local excision, laser ablation, cryotherapy, or topical application of anticancer drugs.



**Figure 2**—Local excision combined with topical application of anticancer drugs is recommended for treating horses with infiltrative SCC of the vulva.

breeds) may become unsuitable for breeding after penile surgery, and these are performed as salvage procedures. Furthermore, the success rate for artificial collection of stallions after penile surgery has not been reported, and the owners should be informed of the risks.

This review is intended to inform practitioners of the surgical procedures available to treat external urogenital tumors in horses and the factors that should be considered when deciding which procedure to perform. A comprehensive review of surgical techniques is beyond the scope of this article; therefore, readers interested in detailed descriptions of the techniques are encouraged to consult surgical texts.<sup>1-3</sup>

### LOCAL EXCISION

Local excision is indicated to remove small, solitary tumors, such as focal squamous cell carcinoma (SCC), squamous papilloma, and sarcoid, where there is no evidence of metastasis to regional lymph nodes or invasion of deeper structures (Figure 1). Local excision is unlikely to be successful for treating horses with coalescing melanomas (i.e., dermal melanomatosis).<sup>4,5</sup> Local excision is usually curative for horses with melanocytic nevi and solitary dermal melanomas.<sup>4,5</sup>

Extensive resection of the vulva may be necessary if a large tumor is present (Figure 2). Ablation of the clitoral fossa is often necessary when vulvar SCC involves the clitoris. If a large portion of the vulva is removed, vulvoplasty (i.e., Caslick's procedure) may be needed to prevent pneumovagina.

Local excision of external genital tumors in male horses can be performed using a local block for small tumors or a pudendal nerve block or general anesthesia for multiple or larger tumors. In mares, epidural or local anesthesia and standing restraint are usually sufficient for removal of external genital tumors.<sup>6</sup>

Tumor recurrence is possible when the surgeon fails

to remove all neoplastic cells from the surgical site; therefore, wide surgical excision is recommended.<sup>4,5</sup> Primary closure is indicated, if possible. Larger lesions may require segmental postectomy. If it is necessary to leave the wound open, cleansing and topical antibiotics are indicated. If adequate tissue margins are obtained, the prognosis for complete recovery after local excision is excellent.

### LASER ABLATION

The use of a carbon dioxide laser for excision and ablation of tumors of the equine male and female external genitalia has been reported.<sup>7</sup> Laser dissection provides good hemostasis, facilitating visualization and identification of abnormal tissue. Other advantages of using surgical lasers include decreased postoperative pain and swelling.<sup>8</sup> Laser energy may kill tumor cells at the base or the margins of the tumor, reducing the possibility of recurrence.<sup>7</sup> Application of excessive laser energy, however, may cause char formation and poor wound healing.<sup>8</sup>

Histopathologic identification of the tumor is recommended before laser vaporization.<sup>8</sup> As with local excision, wide margins of surrounding normal tissue should be removed with the laser. At least 1 mm of apparently normal tissue surrounding the lesion should also be vaporized using the laser.<sup>7</sup> For precancerous lesions (e.g., carcinoma in situ) of the penis and/or prepuce, a defocused beam in pulsed mode can be used to "paint" the surface of the lesions. A tumor bed can be similarly treated following resection of a larger mass.<sup>7</sup>

Use of a surgical laser poses hazards to the operator, including cutaneous and ocular damage, inhalation of smoke plume, and accidental fire.<sup>8</sup> Laser-generated smoke is a potent airway irritant and carcinogen and may contain aerosolized viruses, bacteria, and tumor cells.<sup>8</sup> Safety standards and regulations for laser use have been published.<sup>9</sup>

## CRYOTHERAPY

Cryotherapy involves the controlled application of freezing temperatures to tissues. Cellular death results from the formation of intracellular ice crystals, disturbance of electrolyte and fluid balance, denaturation of cell membranes, and thermal shock.<sup>10</sup> Vascular stasis, thrombosis, and ischemia occur within the frozen tissue mass.<sup>10</sup> Additionally, delayed antibody and cell-mediated immune responses occur following cryotherapy.<sup>10,11</sup> Regression of distant lesions has also been reported following cryotherapy, possibly caused by stimulation of the body's immune response to the tumor.<sup>10,11</sup> A commonly used agent for cryotherapy is liquid nitrogen. Because it uses less cryogen, nitrous oxide is more efficient than liquid nitrogen for cryotherapy but requires specialized equipment with an increased initial investment expense.<sup>10</sup>

Two or three cycles of rapid freezing ( $-20^{\circ}\text{C}$ ) and slow thawing to room temperature are performed.<sup>10,12,13</sup> Although not always feasible, the use of thermocouples at the tumor base and margins ensures adequate freezing.<sup>11-13</sup> Cryotherapy can be performed in conjunction with debulking of tumors, but bleeding can prevent adequate freezing.

Local edema and swelling occur within hours after cryotherapy, and a serosanguineous discharge may be observed. Tissue sloughing occurs at 4 to 7 days, and a scab forms at the site. The scab detaches at approximately 4 weeks, and the wound heals by second intention within the following 14 to 21 days.<sup>10,13</sup> A malodorous discharge may be present for several weeks.<sup>10</sup> If cryotherapy is applied to haired areas, white hair growth can occur.<sup>10</sup> Because of the ischemia associated with cryotherapy, horses should be immunized against *Clostridium tetani*.<sup>10</sup>

Protection of the surrounding tissues is critical during cryotherapy.<sup>10,12</sup> Excessive application of liquid nitrogen can result in cryogen runoff onto normal tissues, causing them to slough.<sup>10</sup>

Cryotherapy is appropriate for the treatment of horses with focal, shallow tumors. The procedure is less effective for infiltrative tumors, unless debulking is performed first. Caution should be used when applying cryogen on or near the urethra because urethral inflammation or edema can cause obstruction of urinary outflow.

## CIRCUMFERENTIAL POSTHECTOMY (SEGMENTAL POSTHECTOMY OR REEFING)

Circumferential posthectomy is indicated for removal of tumors on the loose preputial tissues without involvement of the underlying penile tunic<sup>1,2,14,15</sup> (Figure 3). Posthectomy is used for multiple tumors or for a single tumor in which primary closure would not be possible.



**Figure 3**—SCC lesions on the loose internal preputial laminae can be removed by circumferential posthectomy (i.e., reefing).

Although the procedure can sometimes be performed using local or regional anesthesia with the horse standing, general anesthesia and dorsal recumbency provide greater convenience, hemostasis, and surgeon safety.<sup>1</sup> Following surgical preparation, two parallel circumferential incisions are made, one proximal and the other distal to the tumor(s). A tourniquet can be placed proximal to the section of prepuce to be removed before the incision is made; if a tourniquet is applied, incised vessels should be ligated to prevent postoperative hematoma formation.<sup>1,2</sup> The incisions should not enter the penile tunic or the penile vasculature.<sup>1-3</sup> The circumferential incisions are then connected with a single, longitudinal incision, and the segment is dissected free from the underlying tissues. Because of concern for future copulation success, the dissection should only be as aggressive as required to completely remove neoplastic tissue.<sup>1,2</sup> The incised tissue edges are apposed with a two-layer closure.<sup>1-3</sup>

Stallions should be separated from other horses, and sexual rest must be enforced for a minimum of 2 to 4 postoperative weeks or until the surgical wound has healed.<sup>1-3</sup> Sutures can be removed 10 to 14 days postoperatively.<sup>1-3</sup> Potential complications of circumferential posthectomy include edema, hematoma formation, infection, and dehiscence.<sup>1,2,14</sup> If neoplastic tissue is adequately removed and the tumor does not extend below the dermis of the preputial laminae, the prognosis for return to normal function after circumferential posthectomy is good to excellent<sup>14</sup> (Figure 4).

## PHALLECTOMY (PENECTOMY, PENILE AMPUTATION)

Phallectomy is indicated for horses with invasive tumors of the distal penis.<sup>1-3,14-16</sup> Involvement of the urethral orifice or neoplastic invasion of the penile tunic of the glans or body warrants phallectomy<sup>2,3,14-16</sup> (Figure 5). Although copulation may still be possible following removal of only the glans penis, phallectomy is usually



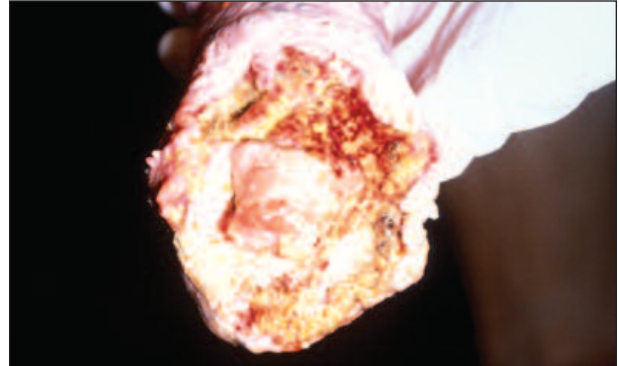
**Figure 4**—Resection of the melanomas in this horse required circumferential posthectomy and resection of a portion of the external prepuce. The horse was able to adequately retract its penis into the sheath following surgery.

performed to salvage the horse for purposes other than breeding.<sup>2</sup> Castrating the stallion several weeks before phallectomy is advisable to help modify behavior.<sup>2,17</sup> To perform phallectomy of the distal penis, the horse is placed in dorsal recumbency, and the penis is prepared for surgery. A urethral catheter is passed, and a tourniquet is applied proximal to the amputation site. The penis is circumferentially incised to the level of the urethra proximal to the lesion. The distal portion of the penis is removed, the thick fascia surrounding the corpus cavernosum is apposed, and the incised portion of the urethra is sutured to the penile epithelium.<sup>1,3,17</sup> There are three described techniques of phallectomy (i.e., Vinsor's, Williams', and Scott's); the choice of technique is based on the surgeon's preference.<sup>1-3</sup>

The horse should receive antimicrobial therapy for 3 to 5 days postoperatively<sup>1</sup> and should be confined to a stall without exercise for 5 days after surgery.<sup>1</sup> However, calm geldings may benefit from hand walking after surgery. Stallions should not be exposed to mares for a minimum of 4 weeks after phallectomy.<sup>1-3</sup>

Hemorrhage, more common during and immediately after urination, is frequently observed after phallectomy.<sup>1,2,14,18</sup> The hemorrhage usually originates from the corpus spongiosum surrounding the urethra. Although hemorrhage may increase the risk of dehiscence, it is usually of minor significance.<sup>1-3,14</sup> Horses with persistent or severe hemorrhage may require a second surgery.<sup>18</sup> Urethral stenosis can result if dehiscence and inflammation occur.<sup>2,3,18</sup> Preputial edema may occur postoperatively, but it usually resolves with hand walking after the initial period of stall confinement.<sup>14</sup> Urethral edema can cause potentially fatal urethral obstruction.<sup>14,18</sup> Two horses died because of urinary tract complications relating to urethral obstruction, one at 7 days and one at 17 days after surgery.<sup>18</sup>

SCC with urethral involvement, representing



**Figure 5**—Advanced SCC lesions of the glans penis necessitate phallectomy. If abnormalities of the penile shaft are detected, en bloc resection is recommended.

advanced disease, was associated with decreased long-term survival (28.6%) when compared with horses without urethral involvement (66%).<sup>18</sup> It was reported that 55% of horses treated with phallectomy were free of SCC 18 months after surgery.<sup>18</sup> Treatment failure was attributed to metastasis before surgery. In one retrospective study, 17 of 24 horses (71%) with SCC treated with phallectomy were alive 1 to 6 years after surgery, and four of the 24 horses (17%) died as a result of tumor recurrence.<sup>14</sup>

## EN BLOC RESECTION

Horses with extensive penile or preputial tumors with evidence or suspicion of metastasis to the regional lymph nodes require en bloc penile resection and retroversion<sup>1,2,8,14-16</sup> (Figure 6). The procedure is also performed when tumors recur following phallectomy when there is an inadequate amount of penis to amputate a second time.<sup>14,15</sup>

As with phallectomy, stallions should be castrated several weeks before en bloc resection of the penis.<sup>2,17</sup> With the horse in dorsal recumbency, an elliptical incision is made around the prepuce. The incision is extended to the ventral abdominal wall, and the penis and entire prepuce are freed.<sup>1,2,15</sup> The external pudendal vessels are ligated, and the superficial inguinal lymph nodes are resected.<sup>1,15</sup> Because of the vascularity of the region, extensive ligation of vessels is required.<sup>15</sup> The penis and prepuce are amputated proximad to the lesions, and the penis is retroflexed through a second incision made below the anus.<sup>1,2,15</sup> The penile tunics are sutured to the subcutaneous tissues, and the urethra is sutured to the skin.<sup>1,2,15</sup> Postoperative care is similar to that for horses that have had only the distal penis amputated.<sup>1,2,15</sup>

In a review of 10 horses receiving en bloc resection and penile retroversion for the treatment of SCC, complications included partial dehiscence of the urethrot-

omy/retroversion site (four horses), dehiscence of the ventral abdominal incision (one horse), excessive postoperative hemorrhage (one horse), urine scald (one horse), and cystitis (one horse).<sup>15</sup> Abdominal metastasis of SCC caused severe diarrhea that resulted in the death of one horse.<sup>15</sup>

An alternative technique of penile amputation and preputial ablation has been reported.<sup>19</sup> This technique involves more conservative dissection than en bloc resection and retroversion and preserves the ventral position of the penis. This procedure also allows exploration and removal of the inguinal lymph nodes. Because of the reduced dissection required for this procedure, the likelihood of complications, such as incisional dehiscence, are reduced. Infrequent complications that affected two of 25 horses included hematoma formation and severe postoperative pain. Long-term follow-up at an unspecified time revealed no disease recurrence in eight horses.

Because en bloc resection is indicated for horses with advanced genital neoplasia, the prognosis for long-term survival and return to normal function following en bloc resection is worse than that for other procedures.<sup>14,15</sup> A guarded prognosis should be given for horses with extensive cancer of the prepuce, penis, and superficial inguinal lymph nodes.<sup>15</sup> However, with aggressive intervention, a successful outcome is possible. Eight of nine horses were free of recurrence of SCC at a mean follow-up of 27 months (range, 6 to 96 months) following en bloc resection and retroversion.<sup>15</sup> One horse had a recurrence of SCC 6 months after surgery and was euthanized.

Tumor metastasis to the regional lymph nodes is associated with a high risk of abdominal metastasis and tumor recurrence; therefore, affected horses have a poor prognosis for long-term survival.<sup>8,15,18</sup> Palpable thickening or increased firmness of the penis suggests neoplastic invasion of the corporeal bodies, which may be associated with a high risk of abdominal metastasis and increased likelihood of tumor recurrence after surgery.<sup>14</sup>

### PERIOPERATIVE ADMINISTRATION OF ANTICANCER DRUGS (COMBINATION THERAPY)

Incomplete excision of tumors results in tumor recurrence.<sup>20–23</sup> Surgical error or the inability to obtain adequate margins because of tumor size, location, or extension to deeper tissues results in incomplete tumor excision. Tumor growth is limited by blood supply and nutrient availability; therefore, as the tumor enlarges, its rate of growth decreases.<sup>21,23</sup> Following surgical debulking, there is a transient change in tumor cell kinetics that results in a rapid increase in growth of remaining tumor cells.<sup>21,23</sup> Because rapidly growing cells



**Figure 6**—Extensive penile melanomatosis necessitating en bloc resection. The glans penis (*arrow*) is oriented to the right of the figure. (Copyright © 2002 J. Dascanio, Virginia Tech, Blacksburg, VA)

are more susceptible to the effects of many anticancer drugs, the efficacy of such drugs would be optimal during the immediate postoperative period.<sup>22,23</sup>

The perioperative administration of anticancer drugs has been recommended to decrease the risk of recurrence by destroying residual tumor cells following surgery.<sup>21,23</sup> A multidisciplinary approach, integrating surgery, radiation therapy, and chemotherapy, has become a mainstay of modern human cancer treatment.<sup>24</sup> Clinical trials have demonstrated that human cancer patients treated with surgery and chemotherapy have higher cure rates when compared with similarly affected patients treated with surgery alone.<sup>24</sup>

Anticancer drugs suppress proliferation of residual tumor cells and metastases when administered perioperatively.<sup>22–24</sup> This effect is most pronounced when anticancer drugs are administered before surgery and is reduced as the interval between surgery and chemotherapy is lengthened.<sup>22</sup> However, preoperative systemic chemotherapy has led to increased wound morbidity following surgical excision of neoplastic masses in women with breast cancer.<sup>25</sup> It is important to remember that anticancer drugs target rapidly dividing cells, and their action is, therefore, not limited to neoplastic cells.<sup>23</sup>

Anticancer drugs suppress wound repair by decreasing the proliferation of inflammatory cells, suppressing protein synthesis, and inhibiting cellular replication.<sup>23,25</sup> This suggests that the use of these drugs during the perioperative period may cause increased wound morbidity. Evaluation of excisional biopsy specimens from human cancer patients after surgical removal of dermal melanomas revealed that chemotherapy decreased wound tensile strength and wound tear energy of healed incisions.<sup>25</sup> Likewise, in rats, wound tensile strength after chemotherapy was significantly less in tumor-bearing rats compared with non-tumor-bearing controls.<sup>18</sup> This led to a conclusion that treatment with anticancer drugs is detrimental to the early phases of

wound repair. The investigators, however, did not address the cachectic effects of the presence of tumors and their impact on the healing process. Although data suggest that wound healing may be affected by preoperative chemotherapy, this has not been shown to be a significant clinical problem.

Another indication for combination therapy may be cytoreductive surgery.<sup>23,26</sup> Surgical debulking of large tumors increases the sensitivity of the remaining tumor cells to anticancer drugs or radiotherapy.<sup>22,23,26</sup> Cisplatin was administered intralesionally during the perioperative period in 27 horses and one mule with a total of 22 sarcoids and 10 SCCs.<sup>20</sup> The tumors were debulked, and the first treatment was administered intraoperatively by infiltrating the entire surgical wound with cisplatin. Cisplatin injections were repeated every 2 weeks for a total of four injections. Minor wound complications—described as 30% or less wound dehiscence—were observed in three of nine sutured wounds. Wounds left to heal by second intention healed, but the contraction phase was slightly impaired. Cosmesis was considered good in all cases. The mean overall relapse-free interval was 41 months ( $\pm 3.7$  months), and survival rates at 1 year, 2 years, and 3 years posttreatment were 92%, 86%, and 77%, respectively.<sup>20</sup> The investigators concluded that the detrimental effects of cisplatin on wound healing may not be clinically relevant. We have observed similar results with perioperative administration of 5-fluorouracil in a small number of cases of SCC and sarcoids (data not shown).

Although the perioperative administration of anticancer drugs may increase wound morbidity on a cellular level, the clinically observed effects are minimal and may be outweighed by the importance of preventing or delaying tumor recurrence.<sup>20,23</sup>

## CONCLUSION

Prompt recognition, assessment, and surgical intervention can result in successful management of horses with external urogenital tumors. Early and aggressive therapy can prolong the lives and function of many horses with external urogenital tumors. The combination of surgery with local chemotherapy further improves the outcome for many horses.

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### ARTICLE #6 CE TEST

The article you have read qualifies for 1.5 contact hours of Continuing Education Credit from the Auburn University College of Veterinary Medicine. Choose the best answer to each of the following questions; then mark your answers on the postage-paid envelope inserted in *Compendium*.

1. A solitary, 1-cm-diameter mass is identified on the penile body of a 13-year-old Appaloosa breeding stallion. The mass is cauliflower-like in appearance, has a narrow base, and does not appear to invade the penile tunic. The regional lymph nodes are not enlarged. Which of the following procedures would be most appropriate in this case?
  - a. Wait and recheck the mass in 6 months, and then remove the mass if it has enlarged.
  - b. Perform an en bloc resection because the tumor has likely metastasized.
  - c. Perform a local excision or circumferential posthectomy (reefing).
  - d. Perform a phallectomy immediately.
2. Phallectomy
  - a. should be performed when severe preputial lesions are present.
  - b. is indicated for horses with severe lesions of the distal penis.
  - c. involves the removal of a circumferential ring of preputial tissue.
  - d. should not be performed on geldings.
3. Circumferential posthectomy (reefing)
  - a. is performed only for severe, infiltrative lesions of the prepuce and penis.
  - b. is associated with a poor prognosis when compared with other surgical techniques for external genital tumors.
  - c. should be performed only as a salvage procedure in stallions.
  - d. involves the removal of a circumferential ring of preputial tissue.
4. En bloc resection and penile retroversion
  - a. are warranted for the treatment of horses with extensive lesions of the penis and/or prepuce with metastasis.
  - b. involve the resection of only the distal penis, including the glans.
  - c. are associated with an excellent prognosis.
  - d. should not be performed on geldings because of the change in urination behavior.
5. A 15-year-old American paint gelding is presented for severe preputial swelling with a foul odor. There are multiple SCC lesions on the penis and prepuce. The penis feels thickened, and the superficial inguinal lymph nodes are enlarged. Which of the following techniques is indicated?
  - a. circumferential posthectomy and lymph node removal
  - b. phallectomy
  - c. laser ablation of penile and preputial lesions
  - d. en bloc resection and penile retroversion with superficial inguinal lymph node removal
6. Local excision of solitary tumors of the equine external genitalia
  - a. is usually not possible because of rapid metastasis and invasion of lesions.
  - b. requires general anesthesia.
  - c. can be performed in the standing horse using local or epidural anesthesia.
  - d. is associated with a high cure rate for the treatment of horses with coalesced melanomas (dermal melanomatosis).
7. SCC of the penis with involvement of the urethra
  - a. is associated with a better prognosis for long-term survival than SCC that does not involve the urethra.
  - b. is associated with a poorer prognosis for long-term survival than SCC that does not involve the urethra.
  - c. necessitates immediate circumferential posthectomy.
  - d. has no effect on the prognosis for long-term survival of the horse.
8. Laser vaporization of external urogenital tumors
  - a. has been successful for the treatment of horses with precancerous lesions.
  - b. is associated with a high risk of complications and should not be attempted.
  - c. does not require adequate surgical margins because the heat from the laser destroys all tumor cells.
  - d. is commonly performed using an Nd:YAG laser.
9. Incomplete tumor excision
  - a. is associated with a transient decrease in proliferation of residual tumor cells and metastases.
  - b. is associated with a transient increase in proliferation of residual tumor cells and metastases.
  - c. has no effect on the kinetics of remaining cells.
  - d. is easily avoided when debulking tumors.
10. Perioperative administration of anticancer drugs
  - a. is not advised because of the high risk of wound dehiscence.
  - b. is not effective in treating horses with tumors of the external genitalia.
  - c. decreases the efficacy of the drugs because residual tumor cells are resistant to anticancer drugs.
  - d. optimizes the efficacy of the anticancer drugs against residual tumor cells.