



## Original Article

# Complications, outcome and owner satisfaction after Callicrate Bander phallectomy and perineal urethrostomy in 14 equids

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## Summary

**Background:** The use of a bander castration device (Callicrate Bander) to perform partial phallectomy in combination with a perineal urethrostomy (PU) has previously been described to be an effective and well-tolerated procedure in standing sedated horses.

**Objectives:** The main objective of the present report is to share our experiences with the combined Callicrate Bander phallectomy (CBP) and PU (CBP/PU) focussing on potential complications, outcome and owner satisfaction.

**Study design:** Retrospective case series.

**Methods:** Medical records of 14 male equids that underwent CBP/PU at two different equine referral hospitals between 2012 and 2020 were reviewed. A long-term follow-up was conducted by telephone interview with the owners using a standardised questionnaire.

**Results:** Equids underwent CBP/PU to treat penile and preputial squamous cell carcinomas (11/14), equine sarcoids (2/14) and penile abscessation and paraphimosis after trauma (1/14). Early post-operative complications were mild and included transient post-urination haemorrhage, perineal or preputial oedema and partial dehiscence of the PU. Complications that required further veterinary care in the immediate post-operative period occurred in one animal, which had haemorrhage at the amputation site with subsequent haematoma and oedema formation, causing moderate signs of post-operative pain. Complications encountered after discharge from the clinic comprised transient urine leakage at the amputation site, transient purulent preputial discharge, abscessation of the penile remnant and urine staining of the hind legs, tail and/or perineum. Four equids were euthanased because of tumour recurrence.

**Main limitations:** Variable case details provided in the medical records, and information regarding the post-operative healing process were mainly based on owner assessment.

**Conclusions:** Callicrate Bander phallectomy/perineal urethrostomy is a well-tolerated salvage procedure for male equids with debilitating conditions of the penis and prepuce. Severe post-operative complications are rare. If advanced stages of penile SCC are expected, careful case selection based on a rigorous preoperative examination is mandatory. Owner satisfaction with the post-operative result is high.

## Clinical relevance

- The combination of a Callicrate Bander phallectomy and perineal urethrostomy is well-tolerated in equids and allows for the removal of penile and preputial tissues up to the level of the external preputial orifice in the standing animal.
- While transient mild post-operative complications at the amputation and perineal urethrostomy site are not infrequent, severe intra- and post-operative complications are rare.
- Owner acceptance and satisfaction with the combined Callicrate Bander phallectomy and perineal urethrostomy procedure is high, but owners must be aware that urine staining of the hind legs and perineum is a frequent consequence of the perineal urethrostomy that may require daily cleaning to prevent urine scalding.

## Introduction

Various disorders of the equine penis and prepuce may necessitate partial phallectomy with or without *en bloc* resection of the prepuce. This includes penile or preputial neoplasia (Archer & Edwards, 2004; Doles et al., 2001; Howarth et al., 1991; Mair et al., 2000; Rizk et al., 2013; Schumacher, 2018; van den Top et al., 2008b; Wylie & Payne, 2016), chronic paraphimosis (Arnold et al., 2010), penile trauma (Beavers & Mitchell, 2018; Perkins et al., 2003), priapism (van Harreveld & Gaughan, 1999), congenital malformations (Brink & Schumacher, 2011) and habronemiasis (Doles et al., 2001; Howarth et al., 1991; Stick, 1981). Squamous cell carcinoma (SCC) has been reported as the most common tumour type affecting the equine male external genitalia (Mair et al., 2000; Rizk et al., 2013; Schumacher & Vaughan, 1988; Top et al., 2010; van den Howarth et al., 1991), but equine sarcoids, melanoma, papilloma and fibrosarcoma are other neoplastic conditions frequently involving the penis and/or prepuce (Rizk et al.,

2013; van den Top *et al.*, 2008b; van den Top *et al.*, 2010). Depending on whether the neoplastic lesion has a locally aggressive growth behaviour or is benign or malignant, more or less aggressive forms of excisional surgery may be necessary. If the neoplastic lesion has invaded the tunica albuginea, prepuce and regional lymph nodes, preputial ablation and penile amputation with (Archer & Edwards, 2004; Markel *et al.*, 1988) or without (Wylie & Payne, 2016) penile retroversion and creating a perineal urethrostomy (PU) are indicated. Lesions extending proximal to the free portion of the penis yet not extensively invading the tunica albuginea or regional lymph nodes can be treated by sheath ablation and partial phallectomy, creating an urethral stoma at the level of the former preputial orifice or slightly caudal to it (Doles *et al.*, 2001). If solely the glans or the free portion of the penis are affected, partial phallectomy can be performed, sparing most of the penile shaft. Techniques for partial phallectomy include those described by Scott, Vinsot and Williams (Schumacher, 2018) and mainly differ regarding the orientation and shape of the surgically created urethral stoma or how haemostasis of the penile cavernous bodies is achieved.

Although usually performed in recumbent horses under general anaesthesia, partial phallectomy can be performed in standing sedated horses, thus effectively avoiding anaesthetic risks and reducing treatment costs (Arnold *et al.*, 2010; Perkins *et al.*, 2003). Arnold and coworkers described a modification of the Vinsot technique for partial phallectomy by performing a linear shaped urethrostomy, either at the level of the outer lamina of the preputial fold or at the subischial level of the perineum, prior to amputating the diseased penile and preputial tissues. The shaft of the penis is sharply transected distal to a strangulating latex loop, leaving a segment of penile tissue distally to slough following ischaemic necrosis (Arnold *et al.*, 2010). For this particular purpose, they first described the use of a bander castration device, the so-called Callicrate Bander (No-Bull Enterprises). Unlike the materials and methods that had previously been proposed to serve as a penile tourniquet for this procedure, including heavy nonabsorbable suture material, umbilical tape or Penrose drains, the Callicrate Bander places a robust latex loop under strong tension, which maintains maximal and continuous pressure on the underlying preputial and penile tissues (Arnold *et al.*, 2010). This not only provides reliable haemostasis, but also permits to place and maintain a tourniquet more proximal on the penile and preputial tissues compared with other tourniquets. Consequently, when combined with a PU, more proximal and substantial portions of the penis and prepuce can be amputated, including the internal lamina of the external prepuce.

The combination of performing a Callicrate Bander phallectomy (CBP) with a perineal urethrostomy (PU) was reported to be a simple, safe and inexpensive procedure that does not cause discomfort to the animal as long as appropriate local anaesthesia is used and recovery was reported to be fast with minimal post-operative complications (Arnold *et al.*, 2010). Self-limiting haemorrhage at the site of the PU, and urine scalding of the tail were identified as potential complications with this approach (Arnold *et al.*, 2010). The main objective of the present report is to share our experiences with a combined CBP and PU (CBP/PU) in a mixed population of equids with pathologies involving the

penis and prepuce and focussing on potential complications, outcome and owner satisfaction.

## Materials and methods

Medical records of all equids subjected to CBP/PU between 2012 and 2020 were reviewed at two equine referral hospitals, Fethard Equine Hospital, Ireland, and the Equine Clinic Bern at the Swiss Institute of Equine Medicine, Switzerland. Data retrieved from the medical records comprised age, sex, breed, clinical examination findings, the nature of the underlying lesion (i.e. type, location and duration of penile lesions), presence of concurrent lesions, findings of ancillary diagnostic tests to detect metastases, results from histopathology and the medical history regarding previous treatments whenever available. For the immediate post-operative period, information pertaining to subjective post-operative pain assessment (appetite, activity, heart rate and respiratory rate) and post-operative complications at the PU or site of penile amputation (i.e. haemorrhage, swelling, suture dehiscence and wound discharge) were obtained from medical records for the duration of the hospitalisation.

### Preparation for surgery

All subjects received nonsteroidal anti-inflammatory drugs (NSAIDs) (flunixin meglumine 1.1 mg/kg bwt IV or phenylbutazone 4.4 mg/kg bwt IV) and prophylactic antimicrobials (trimethoprim-sulphadiazine 30 mg/kg bwt IV or per os, doxycycline 10 mg/kg bwt per os, oxytetracycline 6.6 mg/kg bwt IV or a combination of benzylpenicillin 30,000 IU/kg bwt IV and gentamicin sulphate 6.5 mg/kg bwt IV) prior to surgery. In cases with an unclear tetanus vaccination history, tetanus serum (Equilis<sup>®</sup>, MSD Animal Health GmbH) was given according to the manufacturer's recommendations. Subjects were restrained in stocks and sedated with a combination of an  $\alpha_2$ -agonist (detomidine HCl 0.005–0.08 mg/kg bwt IV or romifidine HCl 0.04–0.06 mg/kg bwt IV) and an opioid (levomethadone HCl 0.05 mg/kg bwt IV or butorphanol 0.02 mg/kg bwt IV). An adequate level of sedation was achieved by repeated injection of boluses of  $\alpha_2$ -agonists as needed, or by continuous rate infusion of romifidine (0.03–0.05 mg/kg/h) or detomidine HCl (0.005–0.01 mg/kg/h). The penis was washed using povidone iodine soap and rinsed with clean water. A stallion catheter was placed in the urinary bladder, and the tail was wrapped and secured to the stocks. The perineal area was clipped and aseptically prepared. A subcutaneous ring block at the level where the Callicrate Loop (specialised latex loop with an aluminium clip, No-Bull Enterprises) was to be applied, and a subcutaneous line block at the site of the perineal incision were performed. To provide additional local anaesthesia, a pudendal nerve block was placed (Schumacher, 2018) with 10 ml of 2% lidocaine HCl on each side, and most patients received a caudal epidural with mepivacaine HCl (0.2–0.25 mg/kg bwt) in combination with xylazine (0.17–0.35 mg/kg bwt) or morphine (0.1 mg/kg bwt).

### Surgical procedure

The main stages of the surgical procedure are illustrated in **Figures 1 and 2**. The PU was created first by making a 4–8 cm vertical skin incision 6–10 cm ventral to the anus on the perineal raphe. The incision was propagated through the subcutaneous tissues, the retractor penis and



**Fig 1:** Illustration of the main stages of the surgical procedure: (a) Creation of a perineal urethrostomy. (b) Application of a Callicrate Loop using the Callicrate Bander, approximately 2–3 cm proximal to the intended site of partial phallectomy. (c) Transection of the penis and prepuce distal to the Callicrate Loop.

bulbospongiosus muscles, the corpus spongiosum penis with its overlying tunica albuginea and the urethral mucosa, using Metzenbaum scissors. In most cases, the bulbospongiosus and the retractor penis muscles were oversewn with simple continuous sutures using USP 2-0 polydioxanone as a deep layer. To create the urethral stoma, the urethral mucosa was sutured to the skin with simple interrupted sutures of USP 2-0 polyglactin or USP 2-0 polydioxanone. Subsequently, the stallion catheter was removed and a 16-French Foley catheter with a check valve was introduced into the urinary bladder through the urethral stoma and left in place for 24 to 48 h. Once the PU was in place, a Callicrate Loop was firmly applied 2–3 cm proximal to the intended site of penile transection using the Callicrate Bander. Finally, the distal penis and the inner laminae of the prepuce distal to the Callicrate Loop were transected using a scalpel blade.

### Post-operative care

All subjects received systemic NSAIDs, and the majority also received antimicrobials in the post-operative period. The choice of orally administered agents used and the duration of post-operative medication were at the discretion of the responsible surgeon. The perineum and hind legs were cleaned on a daily basis, and petroleum jelly (Vaseline, Christoffelapotheke) was applied to protect the skin if needed. Owners were instructed to continue this care at home until wound healing at the site of the PU was completed. Regular turnout was recommended, and equids returned to their usual management immediately after being discharged from the hospital. Once the surgery sites had healed, regular ridden exercise could be resumed. Owners were told that the latex loop used as a penile tourniquet and the necrotic tissue distal to it would detach

between 3 and 4 weeks after surgery, not requiring any further manipulations.

### Follow-up after discharge from the hospital

At the time of manuscript preparation, long-term follow-up was conducted by telephone interview with the owners and using a standardised questionnaire. Collected follow-up data included perceived general condition of the equid after surgery and signs of discomfort and complications at the PU and amputation site after discharge from the hospital. Furthermore, owners or caretakers were asked whether and when detachment of the latex loop was observed, whether and when subjects showed an adaptation of posturing to urinate, and whether and for how long urine staining or even scalding of the hind legs and tail were observed. Finally, owners were asked about signs of tumour recurrence and their satisfaction with the overall outcome.

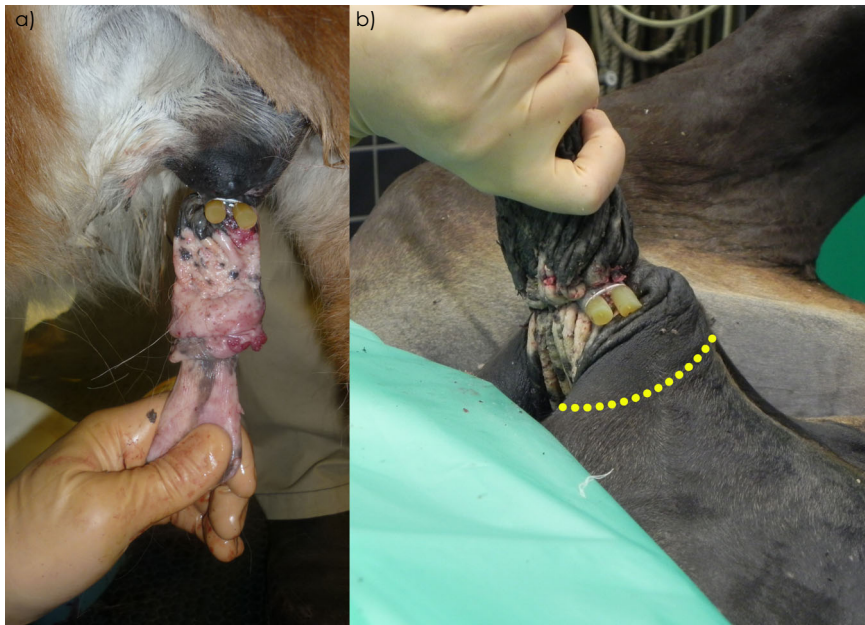
### Statistical analysis

Numerical variables were presented as median and interquartile range (IQR) based on normality testing (Shapiro–Wilk test) using R 4.0.5 statistical software (R Core Team).

## Results

### Clinical presentation

Fourteen equids were subjected to CBP/PU between 2012 and 2020. Four horse breeds, eight pony breeds, one horse and pony crossbreed and one donkey, with ages ranging from 3 to 38 years (median 21, IQR 14), and three intact stallions and eleven geldings were included. In thirteen cases, the indication for partial phallectomy were neoplastic growths involving the penis and/or the prepuce. In one case,



**Fig 2:** Combined Callicrate Bander phallectomy and perineal urethrostomy allows for amputation of penile and preputial tissues as proximal as the level of the external preputial orifice in standing (a) and in recumbent (b) animals. For lesions close to the preputial orifice or involving the external preputial skin close to it, the skin can be incised hemi-circumferentially over the ventral aspect of the external prepuce (dotted line). The latex loop is then seated in the incision to prevent slippage.

partial phallectomy was performed to treat persistent paraphimosis associated with a cavernosal abscess. Clinical signs reported by the owners included malodorous preputial discharge, the presence of a penile/preputial mass or ulceration, induration and pain of the penis upon palpation, and paraphimosis. Duration of clinical signs as noticed by the owners was documented in eight of fourteen cases and ranged from 1 week to 1 year. Case details are presented in **Table 1**.

In 11/14 cases, the clinical diagnosis was SCC, based on gross appearance of the lesions. The median age of equids with the clinical diagnosis of SCC was 22 years (IQR 5). In addition to the glans and/or the free part of the penis, variable portions of the internal preputial lamina were affected. Histopathology was performed in five cases and confirmed the clinical suspicion of SCC. In addition to penile SCC, one gelding (Case 10) had nodular sarcoids involving further proximal parts of the internal prepuce and multiple sarcoids affecting extensive surfaces of the integument. Other medical conditions unrelated to the urogenital tract were recorded in two cases with SCC and included concurrent ocular disease (Case 5) and pituitary pars intermedia dysfunction (PPID) and chronic laminitis in another (Case 7).

Superficial inguinal lymph nodes were not palpable at initial examination in Case 8. In Case 12, ultrasonography of the inguinal area revealed bilateral inguinal lymphadenopathy, but differentiation of reactive vs. metastatic lymphadenopathy just based on this modality was not possible. In the other cases, no information about possible inguinal lymph node enlargement was available. Rectal palpation or thoracic radiography had not been performed in any case prior to partial phallectomy.

In 2/14 cases, equine sarcoids were diagnosed as the underlying pathology. One (Case 4) with a large fibroblastic sarcoid near the free portion of the penis and several nodular sarcoids on the external prepuce, and the other (Case 9) with an accumulation of mixed fibroblastic and nodular sarcoids involving extensive portions of the internal preputial laminae and a small portion of the external preputial orifice. The latter, a 6-year-old donkey gelding (Case 9), had a segmental postthetomy performed 3 years earlier to address a fibroblastic and a nodular sarcoid at the level of the preputial ring.

One Connemara stallion (Case 14) presented with nonreducible paraphimosis associated with a large abscess affecting the corporeal penile tissues that had developed following a kick injury. All prior attempts of more conservative treatment to maintain the possibility of an intended breeding career had failed. This included drainage and flushing of the cavernosal abscess under general anaesthesia with subsequent partial closure of the preputial orifice with a purse string suture to confine the swollen penis within the sheath. After twice repeating this process without improvement, it was decided to castrate the stallion and perform a PU and partial phallectomy.

#### **Additional surgical interventions and modifications of the surgical technique**

Two of the three stallions (Cases 4 and 14) were castrated at the time of partial phallectomy. One (Case 4) was castrated standing and without primary skin closure under the same sedation. In the other stallion (Case 14), the castration and partial phallectomy were performed under general anaesthesia after the PU had been placed standing. Because the internal laminae of the prepuce were

**TABLE 1: Case details**

Case	Breed	Age	Sex	Lesion		
				Clinical diagnosis	Histopathology	Site
1	WB	10	G	SCC	–	Free part of the penis, internal prepuce
2	Pony	25	G	SCC	–	Glans penis, free part of the penis, internal prepuce
3	Pony	36	G	SCC	–	Glans penis, free part of the penis, internal prepuce
4	WB	5	S	ES	–	Internal and external prepuce
5	Pony	38	S	SCC	–	Inconclusive
6	Icelandic	29	G	SCC	SCC	Free part of the penis, internal prepuce
7	Miniature Shetland	24	G	SCC	–	Glans penis, free part of the penis, internal prepuce
8	Welsh x Cob	15	G	SCC	SCC	Glans penis, free part of the penis, internal prepuce
9	Donkey	6	G	ES	ES	Internal and external prepuce
10	FM	21	G	SCC + ES	SCC	SCC: Glans penis, free part of the penis ES: internal and external prepuce
11	Connemara mix	22	G	SCC	SCC	Glans penis, free part of the penis, internal prepuce
12	Pony	16	G	SCC	SCC	Glans penis, free part of the penis, internal prepuce
13	Connemara mix	21	G	SCC	–	Glans penis, free part of the penis, internal prepuce
14	Connemara	3	S	Paraphimosis, cavernosal abscess	–	Penile shaft, internal and external prepuce

Abbreviations: ES, Equine Sarcoid; FM, Franches Montagnes (light breed of draught horses, indigenous to Switzerland); G, Gelding; S, Stallion; SCC, Squamous Cell Carcinoma; WB, Warmblood.

oedematous and necrotic, they were incised circumferentially and stripped distally, before two latex loops were applied on the exposed penile shaft at a level between the preputial ring and preputial orifice using the Callicrate Bander. A closed castration technique via scrotal approach and without primary skin closure followed. In one other horse (Case 11), PU and partial phallectomy were performed under general anaesthesia. In this case, the temperament of the animal did not allow for a thorough examination or surgical intervention under standing sedation. In two cases with lesions close to the preputial orifice, the external preputial skin was incised hemi-circumferentially over its ventral aspect and slightly proximal to the preputial orifice (**Fig 2b**), and the latex loop was placed in this incision to avoid it from sliding distally when tightening it. Ultimately, this adaption of the technique was effective in allowing for a more proximal application of the penile tourniquet.

### Intraoperative complications

Minor intraoperative complications included moderate bleeding from the bulbospongiosus muscle and rupture of the latex loop upon tightening, necessitating a second attempt. Case 9, a 6-year-old donkey, became recumbent after caudal epidural anaesthesia with 2 ml of 1% morphine and 7 ml of 2% mepivacaine HCl. Surgery was then performed with the donkey sedated in lateral recumbency and without intraoperative complications. Case 5, a 38-year-old pony stallion, showed an intraoperative neurological episode. The pony began to tremble and became recumbent. After intravenous administration of lactated Ringer's solution, the pony's condition gradually improved. Within an hour, the pony was standing and systemically stable, and surgery was completed without further complications.

### Post-operative medical treatment

Prophylactic antimicrobials were continued for 0–13 days (median 6, IQR 5) after surgery. In three cases, prophylactic antimicrobials were administered exclusively in the immediate

perioperative period. NSAIDs were administered for 3–12 days (median 7, IQR 3).

### Post-operative healing process and early post-operative complications

The post-operative hospitalisation period ranged from 1 to 9 days (median 3, IQR 4).

Generally, equids seemed comfortable, with the exception of Case 11 that showed reduced appetite 1 day post-operatively, transient mild tachycardia, and local pain on palpation of the prepuce after a haematoma and oedema developed at the surgical site.

An overview of the post-operative complications is presented in **Table 2**. Mild-to-moderate post-urination haemorrhage (PUH) from the PU was identified in 7/14 cases, which was self-limiting within 1 week in 4/7 cases, but observed for 2–4 weeks by owners in 3/7 cases. Mild oedema at the PU was recorded in 2/14 cases and partial suture dehiscence in 3/14 cases, including the donkey with persistent PUH for 4 weeks.

Mild preputial oedema developed in 2/14 cases post-operatively. More severe oedema occurred in Case 11, where significant haemorrhage from the amputation site had developed 1 day post-operatively. This horse was given 12 mg/kg bwt tranexamic acid IV initially and another 3 mg/kg bwt 12 h later. Bleeding subsided after several hours, yet a preputial haematoma formed and 2 days later was drained by incising the ventral aspect of the prepuce. The moderate preputial and ventral oedema was successfully treated by daily in-hand walking and cold hosing in addition to systemic NSAIDs and antimicrobial therapy.

### Long-term follow-up and outcome

The follow-up period ranged from 3 to 88 months (median 14, IQR 16). Six equids were presented for a scheduled control examination 2–7 weeks after the surgery, and of these six, four were presented again on later occasions because of signs of tumour recurrence ( $n = 3$ ) or problems unrelated to

**TABLE 2: Post-operative complications and outcome**

Case	Associated with the amputation site	Associated with the perineal urethrostomy	Urine staining	Tumour recurrence (euthanised: †)	Follow-up period [months]
1	Transient urine leakage from the amputation site	–	Transient urine staining of the hind legs and tail with urine scalding of the hocks	No	88
2	Transient urine leakage from the amputation site	–	Persistent mild urine staining of the inner thigh	No	54
3	–	PUH	Transient urine staining of the hind legs and tail	Yes (†)	41
4	Transient urine leakage from the amputation site; mild preputial oedema	–	Transient urine staining of the hind legs and tail	No	26
5	–	Partial dehiscence	–	Yes (†)	12
6	Mild preputial oedema; transient purulent discharge 6 weeks post-operatively	–	Transient urine-induced dermatitis of the perineum; persistent urine staining of the inner thigh, hind legs and tail	No	19
7	–	PUH; mild oedema	Persistent mild urine-induced dermatitis of the perineum	No	14
8	–	PUH	Persistent urine staining of the hind legs and tail	Yes (†)	14
9	Malodorous sanguineous and purulent discharge 3 weeks post-operatively	PUH for 1 month; partial dehiscence	–	No	8
10	Transient purulent discharge 3 weeks post-operatively	PUH	–	Suspected (†)	3
11	Post-operative haemorrhage and preputial haematoma formation; preputial and ventral oedema; transient urine leakage from the amputation site; abscessation of the penile remnant	PUH; mild oedema	Transient urine staining of the hind legs and tail	No	14
12	–	PUH; partial dehiscence	Persistent urine staining of the inner thigh	No	7
13	–	–	Persistent urine staining of the hind legs and tail	No	8
14	–	–	–	–	9

Abbreviation: PUH, post-urination haemorrhage.

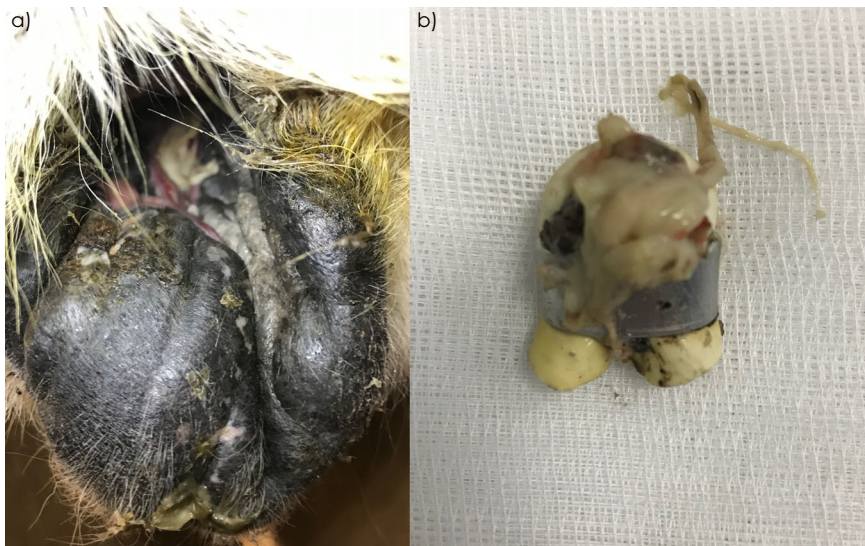
CBP/PU ( $n = 1$ ). Another pony was seen again on several occasions due to unrelated reasons.

In four cases (1, 2, 4 and 11), owners noticed a clear fluid dripping from the remaining preputial orifice and suspected that this was urine. In three cases, this was reported to be associated with micturition. In the fourth case, a continuous drip not in association with micturition was observed. Owners consistently recognised this condition in the first days after discharge from the hospital. In one case (Case 1), the attending surgeon confirmed urine leakage from the amputation site at reexamination. In all cases, this condition was self-limiting within weeks to months. In three cases, no adverse effects of the presumed urine leakage from the amputation site were noted, whereas in one case the owner reported that flies were attracted to the amputation site until urine dripping had ceased several months later.

Cases 6 and 10 developed mild purulent preputial discharge 6 and 3 weeks after surgery respectively. In both cases, the latex loop was still in place and was easily removed by the attending veterinary surgeon (Fig 3). The

discharge subsided in the following days. In Case 9, the owner reported transient mild haemorrhage and subsequent malodorous discharge from the prepuce at the time when it was observed that the latex loop had fallen off, about 3 weeks post-operatively. The time of detachment of the latex loop was only observed in two other cases, one at 3 weeks and the other at nearly 2 months after surgery.

Case 11, the horse that suffered post-operative haemorrhage and haematoma formation at the amputation site, was re-admitted to the hospital 13 months after CBP/PU. The horse had been febrile for several days and had developed preputial oedema and purulent discharge from the PU. The left superficial inguinal lymph node was enlarged. The bloodwork revealed a leukocytosis with neutrophilia, hyperglobulinaemia and an increased serum amyloid A of 5900 mg/l. An abscess of the residual urethral and penile tissues ventral to the PU was diagnosed. Fine-needle aspiration biopsy of the enlarged superficial inguinal lymph node and thoracic radiographs were unsuspecting of tumour metastases. With the horse under general anaesthesia and in



**Fig 3:** Purulent preputial discharge (a) in a 29-year-old Icelandic gelding 6 weeks after Callicrate Bander phallectomy. The latex loop (b) was still in place and was easily removed by the attending veterinarian. The purulent discharge subsided in the following days.

dorsal recumbency, the well-encapsulated abscess, measuring 35 cm × 16 cm × 10 cm in size, was excised in to through a median incision caudal to the preputial orifice. The abscess incorporated most of the remaining penile cavernous bodies distal to the PU. To prevent haemorrhage from these structures, the penile shaft was transected in healthy tissue after application of a Callicrate Loop around the tunica albuginea of the penile shaft 10 cm distal to the PU. Histopathology of the resected tissues showed no evidence of tumour recurrence. Post-operatively, the horse was kept on broad-spectrum antimicrobials (i.e. benzylpenicillin 30,000 IU/kg bwt IV q.i.d. and gentamicin sulphate 6.5 mg/kg bwt IV s.i.d.) including anti-anaerobic agents (i.e. metronidazole 15 mg/kg bwt per os t.i.d.). The horse was presented for skin suture removal and clinical examination 3 weeks post-operatively. At that time, the surgical wounds had healed, the preputial oedema had resolved entirely and the Callicrate Loop was removed along with the necrotic penile stump distal to it.

Eleven equids adapted their posture to urinate and lifted their tail thus effectively avoiding substantial urine staining of hind legs and tail. This transition occurred within the first month after surgery in 9/11 equids. Two horses (Cases 1 and 11) took nearly an entire year to adapt posturing to urinate, according to their owners. One of these horses (Case 1) also developed urine scalding of the hind legs with transient dermatitis at the level of the hocks. Three cases, although having soon adapted in posture to urinate, developed urine-induced dermatitis of the perineum (Case 7) or persistent mild urine staining at the level of the inner thigh (Cases 2 and 12) (Fig 4). Three equids never adapted to a new way of posturing and therefore continued to show urine staining of the hind legs and tail. One of these three equids initially also had transient urine-induced dermatitis of the perineum. Urine staining was generally managed by regularly washing these areas and protecting the skin with petroleum jelly or baby oil as needed, thereby preventing problems with dermatitis.

Clinical signs of tumour recurrence were first observed 6 months and 3 years after surgery in Cases 5 and 3 respectively. In both cases, the suspected underlying

pathology was that of SCC and both ponies were ultimately euthanised within 6 months after diagnosis of tumour recurrence. In Case 8, *en bloc* resection of the penis and prepuce was performed as previously described (Wylie & Payne, 2016) at 10 months after CBP/PU. Preoperative ultrasonographic examination of the thorax and liver revealed no signs indicative of tumour metastasis. The pony was euthanised 3 months later, after inguinal masses recurred and led to hind limb oedema and lameness. Similarly, Case 10 was euthanised 3 months after CBP/PU because of progressive pelvic limb lameness and the development of firm inguinal masses. This horse also had pre-existing inguinal sarcoid growth, but local SCC spread was suspected to cause the clinical signs.

Owner satisfaction with the surgical procedure was high, with all owners reporting that they were satisfied with the outcome of the surgical procedure, including cases where persistent urine staining or tumour recurrence occurred.

## Discussion

The main objective of this retrospective case series was to share our experiences with CBP/PU, focussing on post-operative complications, outcome and owner satisfaction.

Although generally mild and transient in nature, we report a higher prevalence of post-operative complications compared with the initial report describing the CBP (Arnold et al., 2010). In our study, short-term complications included moderate signs of post-operative pain, transient PUH, mild oedema at the urethral stoma, partial dehiscence of the PU, mild-to-moderate preputial oedema, and haemorrhage and haematoma formation at the amputation site. Complications observed after discharge from the hospital were transient urine leakage or purulent discharge from the amputation site, abscessation of the penile remnant, variable degrees of transient or persistent urine staining of the hind legs, tail and perineum, and tumour recurrence (Table 2).

With the described protocol for intra- and post-operative analgesia, subjects generally appeared comfortable after surgery. Only in one case (Case 11), clinical observations



**Fig 4:** Two equids showing persistent urine staining of the inner thighs after perineal urethrostomy. The owner of the horse in (a) reported that the horse never adapted the posture to urinate or learn to lift the tail while urinating. The pony in (b) showed urine staining despite lifting its tail and adapting the posture to urinate.

indicative of increased levels of post-operative pain were made, and these were most likely associated with the substantial preputial swelling that had developed after haemorrhage and haematoma formation.

Post-urination haemorrhage from the urethral stoma is a frequently reported complication after phallectomy using various techniques (Archer & Edwards, 2004; Doles et al., 2001; Mair et al., 2000; Schumacher, 2018; Wylie & Payne, 2016). The haemorrhage usually originates from the corpus spongiosum and may persist for up to 5 weeks (Mair et al., 2000) after surgery and, in rare cases, necessitates a perineal incision into the corpus spongiosum to control excessive blood loss (Mählmann & Koch, 2014). The incidence of transient PUH in the present study (50%) is also higher than previously reported (Arnold et al., 2010) and occurred despite efforts to increase the seal of the corpus spongiosum with a second suture layer involving the retractor penis and bulbospongiosus muscles. A second suture layer was placed in six of the seven cases that showed PUH, thus indicating that it is not effective in preventing PUH and potentially even disadvantageous. This additional suture was not used in the original description (Arnold et al., 2010), where only a mucocutaneous suture was applied. We conclude that some degree of PUH can be expected in the first days after surgery but persists for more than a week only in rare cases.

Partial dehiscence of the PU occurred in three cases but did not impede complete healing in any case. This is in

agreement with a previous report, where partial mucocutaneous dehiscence at the PU was observed in the majority of cases, also invariably followed by complete second intention healing (Wylie & Payne, 2016). Although acute urinary obstruction caused by severe oedema or fibrosis has been reported with other techniques (Howarth et al., 1991; Mair et al., 2000; Schumacher, 2018), this does not seem to be a concern with the technique described here. Nonetheless, a Foley catheter was routinely placed for the first 24 to 48 h following surgery to prevent acute urinary obstruction and to minimise forces associated with micturition which could result in dehiscence and haemorrhage.

Although premature detachment of the latex loop and subsequent haemorrhage at the amputation site was mentioned as a hypothetical concern by the authors of the original description of the CBP, no haemorrhage from the amputation site was observed in any of the cases (Arnold et al., 2010). Considering the absence of post-operative haemorrhage, it was concluded that haemostasis achieved with the Callicrate Bander was superior to that of other amputation techniques. In the present study, one equid (Case 11) haemorrhaged from the amputation site the day after surgery, which led to the formation of a haematoma and oedema. The most likely explanation for this complication was slippage of the latex loop that incorporated parts of the external prepuce, as it was applied very proximal at the orifice of the external prepuce in this



case. Consequential to this, either the bulk of tissue strangulated by the tourniquet was too voluminous to achieve reliable haemostasis in the corporeal tissues and dorsal arteries and veins of the penis, or the shaft of the penis retracted through the loop with compression only remaining on the preputial tissues. In two other cases (Cases 8 and 9), the site of penile transection was similarly proximal and close to the preputial orifice at a level incorporating a large bulk of preputial tissues. Thus, the skin of the external prepuce was incised hemi-circumferentially over its ventral aspect to allow the tourniquet to be imbedded in this surgically created groove (**Fig 2b**). Neither of these two cases haemorrhaged from the amputation site. We speculate that post-operative haemorrhage from the amputation site can effectively be avoided with this technique, if slippage of the applied latex loop can be prevented.

Interestingly, urine leakage from the amputation site was confirmed in one (Case 1) and reported in three other cases (Cases 2, 4 and 11). In an attempt to further substantiate the suspicion of the fluid being urine, owners were asked whether fluid was expelled from the remaining prepuce during or immediately after micturition or not. This association with micturition was clearly confirmed in two of three cases. In all cases, the condition was self-limiting and required no additional care. We concluded that urine leakage at the site of penile amputation can occur but is of little clinical significance.

In three cases (Cases 6, 9 and 10), purulent discharge from the amputation site was observed 3–6 weeks after surgery and coincided with the time period when the latex loop was expected to detach. Similar observations have been reported in a previous case series (Arnold et al., 2010). Therefore, although unproblematic in most cases, a review of the amputation site 1 month after surgery may be recommended to ensure that the latex loop is no longer in place and acting as a foreign body.

Abscessation of the residual urethral and penile tissues (Case 11) was the most important long-term complication following CBP/PU. The deep-seated infection and abscessation presumably developed after the haematoma was incised and drained, yet remained unnoticed for a long period.

Urine staining of the perineum, hind legs and tail, alone or in combination, was frequently (in 10/14 cases) observed following PU placement in this report (**Fig 4**). This led to temporary urine-induced dermatitis of the hind legs in one, classified as scalding, and mild local dermatitis of the perineum in another two cases. In six cases, persistent urine staining of variable degrees or mild perineal dermatitis made regular cleaning of the hind legs, the tail and/or the perineum, necessary on a long-term basis. The incidence of persistent urine staining reported in this case series is higher when compared with previous reports. While Archer and Edwards (Archer & Edwards, 2004) reported one in five horses developed urine scalding of the hind legs, Arnold and coworkers (Arnold et al., 2010) reported persistent scalding of the tail in only one of nine horses, and Wylie and Payne (2016) reported temporary perineal and/or hind leg scalding in two of fifteen horses. Although this complication was mild in most cases and all owners were satisfied with the outcome regardless of this complication, owners must be made aware of this possible complication prior to surgery and that this may demand a more involved long-term post-operative management, such as daily cleaning of the affected area.

Recurrence of penile and preputial SCC after surgical treatment is not uncommon and is the main factor affecting prognosis (Howarth et al., 1991; Mair et al., 2000; van den Top et al., 2008a). In most cases, tumours recur within 1 year after surgery (van den Top et al., 2011). Removal of sufficient margins is crucial when surgical treatment of SCC is performed, but tumour properties such as invasiveness or tumour differentiation grade determine the likelihood of recurrence and tumour metastasis and therefore the chance of a successful outcome (van den Top et al., 2011). A penile SCC assessment and treatment protocol has been suggested (van den Top et al., 2011). In the present case series, case selection was based on gross examination of the tumour and histopathology of diseased penile tissues was not performed prior to surgery. Furthermore, the information regarding the preoperative examination of the superficial inguinal lymph nodes was not conclusive in the medical records for most cases. In fact, preoperative ultrasonography of the inguinal lymph nodes was only documented for one case. A tentative diagnosis of recurrence of SCC based on clinical findings was made in three cases and was histopathologically confirmed in an additional case. All four patients were euthanatised within half a year after diagnosis of recurrence. Although difficult to compare to previous reports (Mair et al., 2000; van den Top et al., 2008a; van den Top et al., 2011) because of different follow-up periods, this study's reported recurrence rate of 36.4% (4/11 cases) is rather high, suggesting that a more elaborate diagnostic protocol and more careful case selection would have been indicated. For instance, a firm palpable thickening of the body of the penis has been shown to be a useful preoperative indicator of urethral, lymphatic or vascular involvement and increasing the likelihood for abdominal metastases (Mair et al., 2000). This was also found upon initial examination in two of the cases of the present study, and both of these horses later had recurrence of the tumour.

The high owner compliance and satisfaction with the CBP is likely explained by the relatively noninvasive nature of the technique, avoiding the need for general anaesthesia. Furthermore, it was the subjective impression that post-operative pain levels were low and that subjects generally had a fast recovery, contributing to the high acceptance of the procedure. The change in appearance of the external genitalia with a new urethral stoma at the perineum was of little concern, and even if urine staining requested daily cleaning of the hind legs, perineum and tail, it was generally considered as unproblematic.

In the present study, two animals became recumbent prior or during the surgical procedure. One was a 6-year-old donkey that became recumbent shortly after placing the epidural with mepivacaine and morphine. This could be attributed to a cranial spread of local anaesthetics causing a sympathetic blockade cranial to the hindlimbs (Doherty & Valverde, 2006). The other case, a 38-year-old pony, had a neurological episode, consisting of severe trembling prior to going into lateral recumbency. This could have been a consequence of local anaesthetic toxicity, as this 200 kg pony was administered a total of 3200 mg mepivacaine HCl subcutaneously (Day & Skarda, 1991; Meyer et al., 2001). Furthermore, decreased liver metabolism in this very old individual or a low serum protein level may have resulted in higher blood drug concentrations, promoting the clinical signs observed (Malone et al., 2006; Meyer et al., 2001).

Based on our experiences with CBP, we share the opinion that this is a relatively simple, quick and well-tolerated procedure with little risk of serious intra- or post-operative complications and associated with a fast recovery. Neoplastic growth at the external genitalia was the most common indication for partial phallectomy in the present study (13/14 cases) and SCC the most frequent diagnosis (11/13 cases). The median age of horses with the clinical diagnosis of SCC in our study was 22 years. Typically, SCC of the male external genitalia is found in aged horses (Archer & Edwards, 2004; Howarth *et al.*, 1991; Mair *et al.*, 2000; van den Top *et al.*, 2008a; van den Top *et al.*, 2010) and the advanced age certainly influenced the decision for standing surgery. Furthermore, average costs for standing partial phallectomy were less than 50% of the costs for sheath ablation and partial phallectomy as described by Doles *et al.* (2001) or by Wylie and Payne (2016) compared for the Equine Clinic Bern at the Swiss Institute of Equine Medicine and for the period of this case series (data not shown in results).

Partial phallectomy techniques are normally designated to amputate portions of the penis distal to the preputial ring (Rizk *et al.*, 2013; Schumacher & Vaughan, 1988; van den Top *et al.*, 2008a). An advantage of the CBP described here is that the robust latex loop can effectively strangulate a great bulk of penile and preputial tissues. Furthermore, the urethral stoma is created remote from the amputation site. Therefore, more proximal aspects of the prepuce and penis can be removed than with other techniques of partial phallectomy. This is especially useful for advanced lesions requiring amputation more proximal than the preputial ring. Although the exact location of penile amputation was not consistently recorded, amputations as proximal as the level of the external preputial orifice were performed in at least five cases in the present study (Fig 2). If concurrent circumstances require general anaesthesia (as was the case in Cases 11 and 14), both PU and partial phallectomy can be performed with the horse recumbent or the surgery can be performed as a two-stage procedure, starting with the creation of the PU with the animal standing and subsequently CBP is performed under general anaesthesia.

There are several limitations due to the retrospective nature of this study. The quality and completeness of clinical records was variable, potentially leading to bias regarding the incidence of post-operative problems, especially if these were mild (e.g. mild PUH). Furthermore, information about the post-operative healing process was based on owner assessment rather than a veterinary follow-up for the majority of cases and the follow-up period was long in some cases, complicating a precise reconstruction of the events after CBP/PU. Nevertheless, this is important information, because fellow veterinary colleagues, mainly because of worries regarding post-operative pain or other complications, generally perceive the described procedure with scepticism.

## Conclusion

Callicrate Bander phallectomy/perineal urethrostomy is a well-tolerated salvage procedure for male equids with debilitating conditions involving extensive parts of the penis and prepuce. Because the intervention can be carried out in standing, sedated subjects which mitigates against additional costs and risks associated with general anaesthesia, and because severe post-operative complications are rare, this approach is a valuable alternative to other partial

phallectomy procedures with or without preputial ablation. However, in cases of suspected advanced stages of penile SCC, the long-term outcome depends on careful case selection based on a rigorous preoperative examination. If clinical, diagnostic imaging and histological findings are indicative of urethral, corporeal and/or inguinal lymph node involvement, more aggressive surgical techniques or humane destruction of the animal need to be considered. Overall, the acceptance and owner satisfaction with the outcome of the procedure is high. Nonetheless and regardless of the indication, owners have to be aware that daily cleaning of the perineum, hind legs and tail may become necessary.

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## Author's declarations of interest

No conflicts of interest have been declared.

## Ethical animal research

Retrospective study of archived medical records. Verbal or written informed client consent was given for use in retrospective studies.

## Authorship

T. Maurer collected and analysed the data and prepared a first draft of the manuscript. C. Koch, M. Coleridge and T. O'Brien prepared the final version of the manuscript. All surgeries were performed by the co-authors, and all authors approved the final version of the manuscript.

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