Proceedings of the 16th Italian Association of Equine Veterinarians Congress

Carrara, Italy
January 29-31, 2010

Next SIVE Meeting:

Feb. 4-6, 2011 – Montesilvano, Pescara, Italy

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Reproductive problems of stallions occur frequently due to physiologic, pathologic, and management processes. Veterinarians should be familiar with the parameters, measurements and expectations for average fertility in stallions. Practitioners need specific knowledge of the possible differential diagnoses for fertility problems. They must have an understanding of and be able to recognize common: fertility problems, injuries and neoplasms of stallions. The definition of fertility, etiology, diagnosis, treatment, and prognosis of common reproductive problems of stallions will be reviewed.

The differential diagnosis of a fertility problem in stallions includes narrowing a list of differentials to determine if a horse has psychological, mechanical, or reproductive problems. Reproductive problems include: Poor intrinsic fertility, Testicular Degeneration, Partial Ejaculation, Spermiostasis, STD’s, Hemospermia / Urospermia, Trauma, Torsion, Tumours, and other infections1.

**Fertility** - What is the average Fertility rate of Horses? The horse is a species that was not undergone great evolutionary pressure to have high fertility. In the wild stallions are typically found with small harems of around 3 mares that they would typically breed over 1-2 estrus cycles2.

In modern times the focus of equine breeding is to create superior athletes, and with the exception of some Warmblood breeds, the focus is usually not fertility3,4. The general lack of focus on fertility in the equine industry has resulted in a per cycle pregnancy rate of 45-55% in a general population of mares. This is only slightly higher than what is reported in the dairy industry.

Statistically all mares are included in the calculations of per cycle and seasonal pregnancy rates, it is not correct to exclude less than “normal mares,” from the calculation. Ideally to avoid a larger impact of subfertile mares on a stallion’s apparent fertility it is preferable to include only 1st cycle pregnancy rates. Because the average stallion breeds relatively few mares (10 or less) a per cycle pregnancy rate is a reasonable compromise. Seasonal pregnancy rates should be above 85% in well-managed herds.

The notable exception is the Thoroughbred breed where the seasonal pregnancy rate is around 50-55%. Most stallions lose commercial viability if they have <30% per cycle pregnancy rate (Table 1).

Stallions are generally considered not suitable for commercial use if their **per cycle pregnancy rate (PR)** falls below 30%. The reason for this is that mares are rebred many more times and most mare owners are reluctant to breed their mare more than twice, let alone 3 times, because she will foal later in the subsequent year.

If a stallion was breeding at 30% per cycle PR after 3 breedings he would leave 35 out of a 100 mares open.

Expectations for a Breeding Soundness Examination satisfactory stallion include a per cycle pregnancy rate of 45-55% in a non-selected mare population, so that 75 out of 100 mares will be in foal after 2 breedings. Therefore if you consider the long gestation length of the mare, and the fact that there is pressure to get the mares pregnant early so they do not foal later and later every year, the time lapsed due to lower per cycle pregnancy rate becomes a significant problem.

**Behavioural Problems - Young stallions** problems include psychogenic ejaculatory failure. Most of these horses had intense negative reinforcement (management errors) of their sexual behaviour. It may help to administer 5-10 mg of Valium IV before breeding to alleviate any anxiety. Some 2-3 yr old stallions may exhibit submissive behaviour “chawing” (opening and closing their mouth, similar to a frightened foal) when near mares. Low libido runs in some family lines. The stallion’s method / exposure to mares is important in determining if this is a libido, health, or social issue. A 24 time lapse video of a stallion in a stall may show the stallion is capable of spontaneous erection and masturbation. Pasture mated stallions may have no interest in mares that are not ready to ovulate. Older stallions may have had a bad breeding accident, or they be worn out by the breeding season. Others develop pain and associate it with the breeding act and may refuse to breed mares. Behavioural Abnormalities include poorly socialized stallions that do not respect limits when being handled by people or when around mares. Turn out with aggressive pregnant mares usually is effective in readjusting their attitude.

**Physical abnormalities: Partial ejaculate** - The main problems identified in older stallions include a loss of breeding vigour due to health related problems, idiopathic testicular degeneration, and testicular tumours. Stallions often are neglected in terms of their health care. They may be overweight, out of shape, or foundered. They may suffer from chronic arthritis, pituitary adenomas, chronic obstructive pulmonary disease, or cardiac disease. A thorough physical examination is warranted in older stallions including flexion testing of the hind limbs. Many stallions require their hocks treated, or attention to previous athletic injuries such as carpal joint disease. They may benefit from hyaluronic acid or steroid treatments, nutriceuticals such as glucosamine, non-steroidal anti-inflammatory drugs, therapeutic shoeing or combinations of these to improve their joint health and comfort. Acupuncture may help manage pain in certain horses. It is important to observe the stallion’s ability to: mount, couple to the mare, maintain his position on the mare, thrust, and eject a number of ejaculatory urethral pulses. Stallions with sore hocks tend to have an abnormal position on the mare, as they lay back off the mare carrying more weight on their abdomen. They may fail to thrust well and have few urethral pulses. The desired number of urethral pulses is around 7. The goal is to insure that every day is a great ejaculate day for these older stallions. Stallions with COPD often run out of air during thrusting and may dismount or fail to completely ejaculate. Environmental management is important for the stallion affected by COPD, and bronchodilators such as clenbuterol seem to be effective and safe. Systemic corticosteroids should be avoided whenever possible because of the negative effect on sperm production. Older stallions that are affected by pituitary tumours, or pituitary hypothalamic dysfunction will have a host of clinical signs such as polydypsia, polyuria, muscle

<table>
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<th>Category</th>
<th>Per Cycle Preg Rate</th>
<th>Seasonal Preg. Rate</th>
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<tr>
<td>Superior</td>
<td>&gt; 65%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Average</td>
<td>45-55%</td>
<td>&gt;70%</td>
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<td>10-70%</td>
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<tr>
<td>Infertile</td>
<td>&lt; 0-5%</td>
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*TABLE 1 Description of per cycle pregnancy rates in stallions*
wasting, pot belly, founder, retained shaggy hair coats etc. They also experience a decrease in spermatozoa production, a higher percentage of morphologically abnormal spermatozoa, and lower spermatozoal motility. The pituitary tumours result in an increase in the secretion of ACTH, and cortisol. Hypercortisolemia is deleterious to the testicular tissue, and has adverse effects on lutenizing hormone secretion. Treatment of the affected stallions with pergolide (0.1 mg per day total dose) has been effective in reversing the clinical signs and improving sperm characteristics. A time frame of 2 months is required to see changes in sperm characteristics.

Neurologic disease affecting coordination, or spinal cord segments may interfere with the stallion’s breeding ability. Cardiac disease in the aged horse is relatively common. The severity of the problem is best determined by echocardiogram and colour flow Doppler. Auscultation coupled with simultaneous palpation of the pulse in the horse will help differentiate systolic from diastolic murmurs. Systolic murmurs are usually mitral valve regurgitation, while diastolic murmurs are usually due to aortic valve problems.

**Ejaculatory dysfunction** includes failure to get an erection or full erection (psychological or shunt formation), failure to ejaculate (blockage, inexperience, or spermatogenic failure), retrograde ejaculation. A solicitous mare in heat, a 24 time lapse camera of a stallion’s activity in a stall (establishes if he is able to get an erection), and alkaline phosphatase measurement in the fluid help determine the nature of the problem (lower in ampullary or epididymal blockage, higher in primary spermatogenic failure). The nature of azospermia in a stallion may be determined by seminal plasma alkaline phosphatase (SPAP) activity quantitated using a diluted sample in a serum clinical chemistry machine. The results will be reported in IU/I, total SPAP activity then can be determined by multiplying the SPAP (IU/l) concentration by the volume of the ejaculate (l).

When the SPAP is 1000 IU/l or total SPAP activity is 200 IU the result indicates that the sample contains fluid from the epididymides and testes signalling that a complete ejaculate has been obtained. Fertile stallions often have SPAP activities over 3000 IU/l, and total SPAP of 500 IU. If the SPAP activity is low, <100 IU/l, this indicates that the sample does not contain fluid from the epididymides and testis [eg, either a failure of ejaculation or a mechanical blockage (usually ampullary)]. When SPAP values are in between 100 and 1000 IU/l either partial blockage, partial ejaculate, epididymal disease, or severe degeneration may be present⁵.

**Poor Intrinsic Fertility** - Young stallions may also have **poor intrinsic fertility**, which may be generally identified by a BSE. These stallions have no history of illness or trauma. Characteristics include: small soft testis, small total scrotal width (TSW) < 7 cm, low testicular volume, poor spermatozoa morphology, and low motility. They may have a specific morphologic defect that is present in a high percentage of sperm. If all medications such as anabolic steroids are discontinued, and a number of serial semen examinations spaced 2 months apart show the same results, the stallion probably has inherited genes that do not support good fertility. The stallion is an inefficient breeder but is not usually infertile⁶.

**Oligospermia** - means low sperm numbers. Many causes such as genetic, incomplete ejaculation, immaturity, small testis size, hypoplasia etc. Measure testis and determine his DSO based on testicular mass.

**Necrospermia** - high proportion of dead sperm, may be due to genetics, anabolic steroids, toxins, injury etc. Best to determine trends over time to determine if the problem is persistent or transient.

**Teratospermia** - high proportion of abnormal sperm, especially with bizarre shapes. May be anabolic steroids, genetics, toxins. Best to determine trends over time after removing any possible causes.

**Asthenospermia** - immotile sperm live sperm, usually due to ultrastructural problems with dynein arms, or microtubular structure of the sperm. Need TEM to confirm. If immotile and dead then you have 2 problems. Be sure that lubricants etc are non-spermicidal. ....
Azospermia - no sperm. Rule out primary causes, such as failure of spermatogenesis (severe degeneration) versus secondary obstruction (ampullary) and retrograde ejaculation into the bladder.

Combinations of problems are sometimes noted such as teratonecrospermia

Testicular degeneration - The cause of testicular degeneration may be traumatic, nutritional, toxic, genetic, or idiopathic. The most common type of testicular degeneration in the stallion is the idiopathic form. Older stallions are usually affected. The process of degeneration has a variable time frame where some stallions become subfertile (per cycle pregnancy rate less than 30%), and others rapidly become infertile.

Idiopathic testicular degeneration - Idiopathic testicular degeneration is a common cause of acquired infertility in stallions. Clinical findings include a small soft testis, decrease in testicular size, declining spermatozoal quality (poor sperm cell morphology) and low sperm concentration. Histologically the stallion will have vacuolization of the seminiferous epithelium, and a loss of the normal cellular arrangements in the seminiferous tubules. The Sertoli cells fail to function normally. The condition is often progressive and may result in infertility. Changes in management of these stallions are the only hope of improving their fertility. The stallion’s health and comfort should be optimized. His book may be biased with young and foaling mares to increase his chance of success. Usually this means breeding mares with large numbers of spermatozoa close to ovulation. The overall prognosis for fertility is guarded to poor. The motility and morphology of these stallions may not be as bad as the observed fertility. Typically there are 10% germinal epithelial cells in the semen, and greater than 30% head, and 25% midpiece defects. This suggests that at the light microscopic level we are unable to detect all of the damage that has occurred to the spermatozoa.

Spermiostasis - This condition is generally acquired, but may be found at the first BSE in a young stallion. This is a condition in horses where the stallions experience intermittent or complete obstruction of the ampulla on one or both sides. Thus they may intermittently ejaculate from one side or both sides. Less commonly it may be noted as a transient condition. In spermiostatis the spermatozoa accumulate in the ampulla. The ampulla may be enlarged and corded (> 1.0 cm) on palpation. The lumen of the ampulla may appear corrugated and edematous on ultrasound examination. The stallion may have irregular spermograms, such that when one of the occluded sides unblocks enormous numbers of senescent spermatozoa are released. The senescent sperm are dead sperm cells with detached heads. The treatment for this condition is frequent collection, manual massage, and/or exogenous oxytocin (20IU IV) given 10 minutes prior to collection. One of the theories as to the underlying cause of the condition is a decrease in oxytocin in the testicular secretions. The testicular parenchyma may be able to secrete oxytocin like the granulosa cells of some species. Unlike the rusty load bull where the condition is transient, the condition is usually persistent in the horse. It requires the evaluation and monitoring of the stallion’s ejaculates to determine the breeding dose. Complete bilateral obstruction has been treated with: repeated collection attempts, prostaglandin F2 alpha (5-7 mg), however stallions will exhibit signs of colic when administered this dose, or surgical flushing which has been used in some cases. It is important to rule out whether the horse is experiencing psychogenic or physical ejaculatory failure, and to determine if the stallion has a primary (failure to produce sperm) or secondary failure to emit sperm. Alkaline phosphatase is elevated in the semen of stallions that are ejaculating.

Infectious causes of Infertility - Infectious causes of infertility included seminal vesiculitis, orchitis, epididymitis. These conditions usually cause pyospermia. Seminal vesiculitis is discussed under STDs. The incidence of orchitis and epididymitis is very low and may be from ascending infections, or through external puncture wounds. Rarely parasite migration may cause problems in these tissues.

Hemospermia - Condition where pure blood appears in the ejaculate. Stallion is asymptomatic when not aroused. Afflicts Quarter...
Horses idiopathically, and others due to penile urethral injury (jumping over the fence with an erection, breeding through a fence). Aroused increases urethral pressure and the stallion emits blood from an urethral tear or granulomatous lesion. Endoscopic exam of the urethra is used to obtain a diagnosis. Sexually rest for 3 weeks if blood is still present wait 3 months. If blood is present after 3 months consider a perineal urethostomy.

**Urospermia** - May be a sporadic or persistent problem. Generally the stallion is trained to urinate immediately before breeding or AI collection to prevent the problem. Urine and sperm do not mix. Urospermia has been reported in stallions homozygous for Hyperkalemic Periodic Paralysis (HYPP). Urospermia may be noted clinically in stallions with COPD, where it is exertion related in these horses. Urine crystals or sediment are present in the semen.

**Other problems include: Anabolic Steroid / Glucocorticoid use** - high percentage of abnormal spermatozoa, low motility. This may be confused with poor intrinsic fertility, poor sperm quality or with testicular degeneration. Serial examinations will show improvement if steroid use is discontinued and at least 3 months has elapsed. Full recovery may take up to 1 year.

**Sexually transmitted diseases (STD’s)** have **Bacterial, Viral, Protozoal Causes. Bacterial** - In general STD’s in horses are uncommon. The bacterial sexually transmitted diseases (STD’s) arise from mostly Gram negative infections that cause seminal vesiculitis (*Pseudomonas aeruginosa* and *Klebsiella pneumonia*) or contagious bacteria that colonize the penile and preputial tissues (*Taylorella equigenitalis*). These represent persistent conditions with carrier states in the stallion. The affected stallions with seminal vesiculitis shed bacteria into their semen with *Pseudomonas aeruginosa* and *Klebsiella pneumonia* being reported associated as common pathogens causing seminal vesiculitis other organisms include *Streptococcus* spp., *Staphylococcus* spp., *Brucella abortus*, and *Acinetobacter calcoaceticus*. *Pseudomonas aeruginosa* and *Klebsiella pneumonia* are ALSO often environmental contaminants and can be mistaken for pathogens. Therefore simply culturing them from a semen sample, or the penile tissues may have no significance. It is significant when mares bred with this semen develop signs of post breeding endometritis that MATCHES the same gram negative organism obtained from the stallion. Cultures of a precollection urethral sample that does not have the pathogen, followed by a post collection sample of the urethra suggests the organism is being emitted with the semen. The history may also show that the stallion has inflammatory cells in his semen, the mares bred to this stallion return to estrus early, or have a higher incidence of endometritis. These historical features are the indications that the stallion has a STD type problem. In true venereal infections the organism cultured from the semen will be and recovered from some mares bred with the semen that develop endometritis. Best option is to refer the stallion or treat him using local delivery of antibiotics directly into the affected seminal vesicular glands using an endoscopic approach. Treating the semen with an extender that contains antibiotics effective against the organism is another option.

Another STD is caused by *Taylorella equigenitalis*, a Gram negative organism. This is a bacteria that causes a condition called contagious equine metritis (CEM). It may be spread from mares to stallions and vice versa. In stallions it colonizes the penile tissues, prepuce, and fossa glandis. It may be present in preseminal fluid. In mares it is present in the reproductive tract (uterus, cervix, vagina, clitoris) and particularly favours the clitoral sinus and clitoral fossae. This disease is present in Europe, was recently reported in the USA, but is not found in Canada. Infection results in a purulent endometritis in mares. Imported stallions from CEM affected regions should be quarantined and test bred to mares. The test mares are cultured post-breeding. Because the clitoral sinuses and fossae may harbour the organism exported mares may have clitoral fossa/sinus ablations or cultures performed. Treatment for CEM includes both local topi-
cal treatment of the vulva and clitoral sinuses and fossae and the uterus using uterine lavage, and may include the clitoral ablation surgery if the mare reoccurs with the problem. Signs in naïve mares appear ten to fourteen days after breeding to an infected or carrier stallion. A grey to creamy vulvar discharge mats the hair of the buttocks and tail, although in many cases, the discharge is absent and the infection is not apparent. Most mares recover spontaneously, although many become carriers. Infected mares are usually infertile during the acute illness. However, the infertility only lasts a few weeks, after which pregnancy is possible.

Stallions do not show signs of infection. The first indication of the carrier state is the appearance of Contagious Equine Metritis and/or lack of pregnancy in the mares covered by the stallion. The carrier state in stallions is usually eliminated with repeated treatment with topical treatment with 2% chlorhexidine of the stallion’s penis/prepuce while aroused.

**Viral STD’s** - The viral STD’s include EVA, and Equine Herpesvirus III.

**Coital Exanthema EHV III** - is a disease where stallions or mares may be carriers. Transmission is not prevented by AI, and infections are self limiting in 1-3 weeks time. Infection at the time of breeding doesn’t interfere with pregnancy. Healed lesions on the penis may leave depigmented non-raised spots that can be confused with precancerous SCC. The lesions initially are vesicles, which rupture, and form scabs. Mares erupt a few days after breeding on the vulva with vesicles. Stress may cause a mare or stallion to recrudescence and shed the virus.

**Equine Viral Arteritis** - cause by Equine Arteritis Virus (EAV), this virus infects young and mature horses. Not all exposed stallions will become chronic shedders of the virus in the semen. Infection in some breeds is widespread (standardbreds and warmbloods). The EAV is shed from the accessory sex glands of stallions and testosterone is needed for secretion, therefore gelding stops venereal shedding. An infected stallion will have an EAV titer. There are no lesions present in the stallion. Infected semen or AI equipment can spread the virus to mares. Virtually all naïve mares will seroconvert with 14-30 days if bred with EAV positive semen. The mares may shed the virus after the primary infection for weeks in bodily secretions. Infection does not prevent pregnancy. To determine if a stallion sheds EAV his semen must be tested. Presently there is a serologic test (titer) and pcrt test available for blood. The venereal form of EAV is not usually associated with abortion, but the flu-like respiratory form is associated with abortion in naïve mares. Frozen semen may be one means of bringing the virus to a farm. There is a vaccine (killed) available in North America.

**Protozoal-Dourine** - Dourine is caused by *Trypanosoma equiperdum*. The disease affects horses, donkeys and mules. The disease is found in Europe, Asia, African and parts of the Middle East. Serology may be used to identify infected animals. *T. equiperdum* is found in the vaginal secretions of infected mares and the seminal fluid, mucous exudate of the penis, and sheath of stallions. Periodically, the parasites disappear from the genital tract and the animal becomes non-infectious for weeks to months. Non-infectious periods are more common late in the disease. Male donkeys can be asymptomatic carriers. Dourine is characterized mainly by swelling of the genitalia, cutaneous plaques and neurological signs (shifting lweight, incoordination, facial paralysis). Genital edema and a mucopurulent discharge are often the first signs. Mares develop a mucopurulent vaginal discharge, and the vulva becomes edematous; this can be found in the vaginal secretions of infected mares and the seminal fluid, mucous exudate of the penis, and sheath of stallions. Pathognomonic lesions include raised plaques over the ribs ‘silver dollar’ lesions. Chronic debilitation and lymphadenopathy are common. Rarely, infected mares pass the infection to their foals, possibly before birth or through the milk. Infections are also thought to occur through mucous membranes such as the conjunctiva. Other means of transmission may also be possible; however, there is currently no evidence that insect (arthropod) vectors play any role in transmission. Sexually immature
animals that become infected can transmit the organism when they mature. The incubation period is a few weeks to several years.

**Injuries - Examination of the penis and prepuce** - Determine if there is evidence of physical injury, swelling, trauma, hematoma formation, bruising etc. Many times the owners report injury as an assumption rather than actually having seen the injury occur. Determine if the **sensory function** of the penile and preputial tissue is within normal limits (hot then cold water test, noxious stimulation by pinching with forceps etc. Determination if the **motor function**, observation of penile retraction during hot and cold water test and noxious stimuli is within normal limits. Determine if you have an injury determine is **mechanical factors** are preventing penile or preputial retraction. Is the swelling preventing the penis from retracting? Or is the penis physically able to be replaced in the sheath but the stallion is unable to keep it that way? Does the stallion have normal penile sensation? Does he withdraw his penis in response to pinching or cold water hosing? Other problems include **Hydrocoele** - fluid in between parietal and vaginal tunics, where >1cm is considered abnormal. The testes difficult to palpate. Maybe climatic and breed factors that increase the incidence. **Varicocele** - vascular dilations, may interfere with normal counter current heat exchange between the testicular artery and veins. **Hematocoele, Hematoma** - concern re Damage to Blood Testis Barrier, Antisperm antibodies if produced could harm the stallion’s sperm. The Antibodies opsonise the sperm make them easier to phagocytose. **Flaccid Penile paralysis** - This is common following chronic debilitation. It does not resolve even after the horse is refed. Other causes include penile trauma (such as trying to breed through a fence or a breeding related injury) prognosis is guarded as up to a year may be required for nerve regeneration. The penis is edematous and is flaccid. Topical treatment should be used to keep the skin soft. **Priapism** - Priapism is non-natural penile tumescence. The penis in these cases is hard like a wooden baseball bat. Occurs secondary to drug administration (acepromazine induced priapism, or general anesthesia while the penis is out resulting in a compartmentalization of blood). This is treated by benztpine mesylate (8 mg IV/500 kg), and/or by removal of sludged blood using pressured 1 liter bags of saline and through needle lavage if the condition is recent. Symptomatic care of the exposed tissue is required. This includes hydrotherapy, emollient treatment (Zincofax) and tissue protection (kling and tensor type wraps). Support the penis once it softens following benztpine mesylate 8 mg IV (cholingeric blocker) administration. Flushing of cavernous spaces, and surgery have also been reported. **Paraphimosis** is when the penis cannot be retracted within the prepuce. In stallions the condition is usually caused by a breeding injury is more correctly termed **Balanoposthitis** (inflammation of the penis - prepuce). The swelling mechanically prevents the penis from retracting. The condition is treated by symptomatic care. This includes therapy to decrease tissue edema and hematoma formation. The goal is to replace the penis into the internal and external preputial cavity as fast as possible.

1. Daily or twice daily exercise 10-15 minutes at a canter or trot
2. Hydrotherapy SID or BID to encourage circulation and aid in wound healing
3. NSAID phenylbutazone 1-4 grams daily as needed, SID BID
4. Pressure wrapping - apply an emollient then wrap tightly using a tensor (reuseable elastic bandage) from the glans penis up the shaft. Use 3 layers of tensors, applied very tightly. Leave in place for 15-20 minutes SID BID. Repeat over a number of days
5. Mechanical support
6. Rest from Sexual Arousal
7. Time for recovery

**Mechanical support** - in cases where the penis may be replaced manually into the prepuce a purse string suture may be used. Purse string suture should not be in place for more than 3 days, and should be done using non-reactive
heavy suture such as Prolene, Nylon, or PDS. Preputial stricture (Phimosis) has been reported as a complication that may preclude natural breeding unless repaired surgically. This is why umbilical tape is avoided for the purse string material. Occasionally hematomas are drained if they are excessively large.

Mechanical support - Sling or truss. Screen door mesh, pantyhose, stretch lace fabric for lingerie, or netting is used. It is cut to size to support the whole scrotum and prepuce. The shape is a triangle or trapezoidal. Rubber IV tubing is sewn around the netting if that material is used. The wide end of the Trapezoid has 2 long straps attached that support the back of the truss and that run up between the legs along either side of the stallion’s tail. The front of the trapezoid has the straps running laterally along the flank to connect with the hind straps over the back of the stallion. The back of the stallion is padded where the straps intersect. The stallions will get sores in the flank area from the straps if long term use is needed. The straps need to be fairly tight to stop the prepuce and testes from falling out of the truss. Occasionally a front chest strap, or 2 straps between the front legs are used to help hold the whole thing in place. Ideally this type of device is used for less than 5 days.

It is extremely important that the stallion is sexually rested. He should be kept in a context where he is highly unlikely to become sexually aroused. Sexual arousal increases the problem and delays healing. Some stallions may require a year of symptomatic care to regain breeding ability. Others never fully recover due to vascular shunt formation (cannot obtain a full erection, or have the glans bell), or problems with penile sensation (stallion cannot find the mare as he seeks the mare’s vulva). These stallions can be managed using semen collection for artificial insemination and/or training them to accept other stimuli such as pressure and warmth on the base of the penis in order to elicit ejaculation. In natural matings the stallion’s penis may be manually introduced into the mare and then the base of his penis stimulated to elicit ejaculation. These stallions may be collected using chemical ejaculation methods. Most of the stallions with a severe preputial scar will not be able mechanically to withdraw the penis nor will they usually be able to obtain a full erection. These stallions may have the scar tissue resected (reefing surgery).

In cases where the penis has been out and exposed to the elements the skin becomes thickened and leathery almost lichenified. This requires rehabilitation using emollient application, and bandaging. If the horse is outside apply emollient, wrap with Kling and then apply a fuzzy stall leg wrap. Do not include the urethra in the wrap Phallocampsis - or penile deviation may result from injury. Stallions are taught to mount in a fashion that aids introduction.

Tumours of the penis and prepuce - Squamous cell carcinoma is the most common tumour of the external genitalia in horses. Males are more commonly affected than females. Typically there are multiple lesions located on the internal preputial lamina, penis and glans penis. Breeds of horses with little skin pigment such as appaloosas, and paint horses, or light coloured horses such as cremellos, or buckskins are more commonly affected. Exposure to ultraviolet radiation from the sun is believed to be an inciting cause. Surgery including resection of the prepuce or penile amputation, cryotherapy, chemotherapy (topical 5-Fluorouracil), and radiation therapy have been used to treat lesions. Squamous papillomas often accompany squamous carcinoma. The invasive nature of this tumour may result in extensive tissue destruction, and malodorous bloody preputial discharge. These tumours have a low grade of malignancy and surgical excision is frequently used to treat the condition. Topical treatment of squamous papilloma lesions with 5-Fluorouracil has been successful. Tumours may be primary or secondary.

Melanoma - Melanoma is an invariably malignant condition in horses often found in grey horses. The tumours are common in the ventral tail region, preputial tissues, and perineal (perianal) tissue areas of grey horses. They are found in the parotid salivary gland.
Melanomas are usually firm nodular dermal masses that are locally invasive, and over time metastasize. They are dark on cut section. Surgical removal or debulking or histamine (H2) receptor blockers (cimetidine) have been reported to control the spread of the tumours. Due to their slow growth they are usually left untreated.

**Lymphosarcoma** - Cutaneous lymphosarcoma may cause firm dermal masses in horses either focally or in a disseminated fashion. Diagnosis is made by biopsy and or aspiration.

**Sarcoids** - Sarcoids are tumours that have 5 classifications: occult, verrucous, fibroblastic, nodular and mixed. They frequently occur on the head, limbs, and ventral abdomen of horses. They have been described on the prepuce of horses. Exposure to cattle or areas where cattle have been is a risk factor. Repeated sublesional injection with immunomodulators, cryotherapy and excision have been described.

**Testicular Tumors** - The list of primary testicular tumours in the horse is fairly short. The tumour that is most common in the horse is the *seminoma*. Other tumours that have reported include: teratomas, Leydig cell, Sertoli cell, Mastocytoma, and leiomyomas. Ultrasound examination of the testis is very helpful in differentiating tumours, from orchitis or infarction such as caused by testicular torsion. Fine needle aspiration may be used to confirm the diagnosis. Unilateral castration to excise the tumour may induce testicular degeneration in the remaining testis. In all cases stallions undergoing surgical removal of the testis bearing the tumour will have impaired fertility due to the loss of the testis and the additional damage from the surgery.

**Seminoma** - Most common testicular tumour - it is highly aggressive and metastasizes. Therefore it is advisable to check the regional lymph nodes. The tumour arises from germinal epithelium. Teratomas next most common, usually in cryptorchid testis, it arises from pluripotential germinal cells.

**Testicular Torsion** - Dynamic rotation of the testis occurs in some stallions, and is considered an unsoundness. Maybe an incidental finding during a BSE, cauda epididymides is/are located cranially. Torsion causing vascular compromise, results in acute pain, colic like signs, and infarction of the testis. Requires surgery, prophylactic orchipexy has been described.

**Habronemiasis** - this is due to the larvae of Habronema and Drashia resulting in an intense inflammatory reaction. The condition is called Called Summer Sores. The flies are attracted to the moist tissue prepuce/penis/urethra. Treatment is with ivermectin, organophosphate dewormers, or topical dewormers. Dexamethasone may be used to decrease the inflammation.

**Congenital Abnormalities** - Phenotypic Sex, Gonadal, Chromosomal sex are sometimes mismatched.

**Testicular hypoplasia** - azospermia or oligospermia, uni or bilateral. Rule out testicular degeneration, biopsy important. No spermatids, vacuolar degeneration.

**PMDS - male pseudohermaphrodite** - Mullerian structures persist (uterus, oviduct), in XY chromosome males, The development abnormality includes both testis attached to the ends of a uterus, testis are in the ovarian position. It is a failure of the MIS signal to be received. Probably due to non-responsiveness of the receptors.

**Unexplained subfertility- When the sperm looks good and mares still aren’t getting pregnant, what now?**

Additional tests include: Special stains (Feulgen, acridine orange, chlortetracycline, PITC etc) to evaluate membrane function, Transmission electron microscopy (TEM) of the sperm to evaluate the axoneme or the acrosome, Sperm chromatic structure assay SCSA, plasma membrane function tests (hyposmotic swelling test, sephadex glass wool), antisperm antibodies, acrosome reaction tests (A23187, progesterone, heparin), mitochondrial function tests, hormonal tests (FSH, LH, hCG response) and testicular biopsy.

TEM used as a confirmatory sperm to evaluate defects with an ultrastructural basis. Includes the integrity of the microtubular as-
sembly (9+2+2) nine sets of doublets with one central doublet. Can evaluate the dynein arms and linkages etc. The dyneine arms are missing in Immotile Cilia Syndrome. Vacuoles, acrosomes etc are also more easily evaluated. Not all sperm are normal therefore normal so caution must be observed in interpreting the results

SCSA Sperm Chromatin Structure Assay: Semen is collected and filtered. It is then treated with acid. Healthy chromatin resists the digestion with HCl, however if the chromatin is weak the DNA will break and the dye intercalates into the DNA. SCSA uses metachromatic dye called acridine orange. This dye fluoresces green with double stranded intact DNA and fluoresces red with single stranded (denatured DNA).

A flow cytometer is used to determine the ration of red and green fluorescence in the sperm. This is plotted on a scatter diagram. The assay is used in stallions to determine the cells outside the main population, called the COMP-T. The more cells outside the main population the more problematic is the sample.

The process of DNA condensation requires the substitution of a number of zinc containing proteins. These proteins neutralize the charges on the DNA allowing it to fold up. The proteins need to be substituted in a specific order and in a specific time frame. We know that immature sperm like those with proximal droplets are immature and not able to fertilize because their DNA is not fully condensed.

The substitution of zinc containing proteins allows the sperm to condense (also called compaction) but neutralizing charges. The process of condensation begins in the testis but is not completed until the epididymis. Therefore sperm with proximal droplets do not fertilize due to the droplet it is simply a marker that the sperm with droplets have immature chromatin. Feulgen stain results correlates with the SCSA's COMP-T. Fertility is correlated with the SCSA results, however no stallion has 100% normal chromatin.

Plasma membrane; cholesterol phospholipid ratios important and ability to undergo the acrosome reaction. Can use calcium inophores like A23187 to acosome react the sperm and determine if the sperm respond. > 90% of sperm should react.

In vitro fertilization is used in other species but not the horse. Hyposmotic swelling test is used to evaluate membrane integrity. Sperm cells that swell are the ones with the intact membranes. Other fluorescent dyes are used to evaluate membrane integrity, chromatin, mitochondria etc. In the future genomics, proteomics, DNA microarrays may be used to identify problem stallions.

Current in vitro tests only estimate fertility they do not predict fertility. There is no substitute for breeding mares. Tools such as cloning, and freezing/ harvesting of germ cells are used to circumvent male factor infertility in the future.

REFERENCES