Objectives

- Become familiar with reptile gender determination & reproductive anatomy
- Overview of most common presentations in males & females
- Diagnostic approaches
- Therapy & prevention
- Questions are welcome throughout the presentation, let’s make it interactive…
- If you don’t ask, I will!
References:
Surgical Sterilization of Exotic Pets: Risk-Benefit to Procedures (Welle 2018)

Birds
• Surgery only when absolutely necessary

Reptiles
• Surgery when disease is present

Ferrets
• Deslorelin implants instead of surgery

Rabbits
• Spay/Neuter before 1 y of age

Guinea pigs
• Ovariectomy if necessary; castrate if keeping males with other guinea pigs

Chinchillas
• Spay or castrate only if necessary

Rats
• Spay or castrate if necessary

Sugar gliders
• Neuter males
Brief anatomy, physiology & gender determination:

- Male **chelonians** (turtles & tortoises) and **crocodilians** have a **single** copulatory organ.
- Male **squamates** (lizards & snakes)- **paired** hemipenes situated either side of the tail base caudal to the cloaca.
- Purely intromittent in nature (has no urethra); the chelonian phallus possesses a seminal groove.
- Chelonians gonads lie ventral to the kidneys.
- Squamates- ovoid testes that are located caudally in the body cavity and they are particularly elongated in snakes.
- Male squamates- vas deferens & ureter fuse near the cloaca & **open together** at a papilla, but there may be separate vasa deferentia & ureteral openings in some species.
Turtles- oviducts lies ventral to the ovaries and ventro-laterally enter the cloaca

Most squamates- ovaries are suspended in the body cavity and the reproductive tracts enters the cloaca through an oviductal opening

Separate ureteral opening

Oviduct: infundibulum, uterine tube, isthmus, uterus and vagina > the urodeum of the cloaca

Ovoviviparous “live-bearing” reptiles a large part of the uterus is thickened & muscular, in order to hold the developing embryo(s)
Reptiles- hormonal components of the hypothalamo-pituitary-gonadal axis are basically similar to mammals.

- Brain factors- regulate the pituitary gland, especially GnRH.
- Possess pituitary gonadotrophins (LH and FSH, others...) that control the gonads.
- Gonadal sex steroids that control peripheral sexual features and feedback on the hypothalamus & pituitary gland.

Cape Cliff lizard, *Hemicordylus capensis*
Reptiles rely primarily on AVT, not oxytocin for eggshell gland contractions
Some species respond to oxytocin injections
Gender determination-fairly straightforward in most species
The most common cause of reproductive failure in captive reptiles is the pairing of animals of the same sex
“Not that there is anything wrong with that”!!!
Sex & Gender

- **Sex** - Your assigned gender at birth and/or the gender of your reproductive organs
- **Gender** - Where you feel that you personally fall on the spectrum between male and female, but some fall in the middle or move throughout the spectrum
- **Cisgender** - When you identify with the gender you were assigned at birth
- **Transgender** - When you identify with a gender different than that you were assigned at birth
- **Transsexual** - When you have had Gender Reassignment Surgery (GRS) to change the sexual organs you were born with to that of a different gender.
Several ways to identify the gender of snakes, none are bullet proof
- Sexual dimorphism- not dramatic in snakes, but can be apparent to the trained eye
- Males have hemipenes at the base of the tail, making it much wider & longer compared to the tail of a females
- Boas and pythons- anal spurs, typically larger in the males
- Some species- dramatic differences in the overall body size between males & females, usually males being larger
Cloacal probing for the presence of hemipenes is commonly used for sex determination in snakes. An appropriately sized-lubricated probe is introduced into the cloaca and directed caudally to probe the caudal wall of the proctodeum. Hemipenes: the probe will pass deeply into the tail. Females: relatively little room for the probe to pass. As a general rule... if a snake is probed as a male you can be fairly confident of correct identification barring perforation of the caudal wall of the proctodeum, be gentle. If a snake is probed as a female there can always be room for error.
“Cloacal popping” is a method used by some herpetologists, using digital pressure on the ventral aspect of the tail base to cause eversion of caudal wall of the cloaca & hemipenes if present.
Lizards & chelonians, gender determination is usually easier, at least in adults.

Male lizards usually have some distinctive anatomic features: hemipeneal bulges at the base of the tail, enlarged femoral or preanal pores in the underside of the leg, relatively larger body size, a comparatively enlarged dewlap, dorsal spines, casques, & showy skin coloration among others.

Some adult male monitor lizards have hemibacacula (mineralized hemipenes), which can be visualized radiographically.
Ultrasonographic examination of the gonads can be helpful in some species but there is a learning curve.
Chelonians - size of the animal & shape of the plastron & carapace can give clues to their gender.

In aquatic turtles usually the females are larger than the males, the opposite happens in terrestrial species.

Most clinicians know about concavity of the plastron as a male characteristic, but the shape of the carapace can also give some clues.

Others are eye color, length of nails on forelimbs (longer in males of some aquatic species), the length of the tail & the distance between the caudal edge of the plastron & the vent (longer in males).
Some labs offer DNA gender determination and when in doubt perform a coelioscopy. Not only gives you an immediate answer but also helps you to evaluate the condition of the reproductive tract, and if diseased samples can be taken for cytology, c/s and histopathology.
Bearded Dragon R. & L. testes
When a reptile presents with potential reproductive disease, a thorough history, especially focusing on husbandry & diet is important.

During the PE, a visual assessment, gentle palpation, and a behavioral assessment can provide critical information.

Further diagnostics include: CBC, plasma chemistries, iCa, radiographs, US, CT, coelioscopy, and/or an exploratory surgery.
Hemipeneal/penile prolapse

- Keep lubricated!
- If unable to replace > amputate
- Most can be managed under sedation with local anesthesia, but some will require general anesthesia
- Sutures, vascular clips, radio/electrosurgery and/or laser can be used for removal
- Squamates can still breed with only one hemipene, however crocodilians and chelonians only have a single structure so removal negates further breeding
Male aggression

- Physiologically normal
- Towards owner or cage mates
- Orchidectomy +/- helps if done at an early age
- It is usually more technically challenging and careful dissection is imperative; make sure to spare the adrenal gland
- GnRH agonists do not seem to help; mammalian leuprolide acetate at 0.2 and 0.4mg/kg did not significantly reduce testosterone levels in male green iguanas (Kirchgessner)
Cloacal prolapse
- Keep lubricated!!!
- Bladder, colon, cloaca, oviduct or cloacal organ
- Causes for prolapse vary and anything that can cause straining or a weakening of the musculature can lead to a prolapse
- In turtles if it comes out and comes back in, most likely a male’s phallus
Even if not purely reproductive in origin, fecal examination, cbc & blood chemistry profile (including iCa) are required along with radiography/US to check for eggs, bladder stones, intestinal foreign bodies, tumors, etc.

Surgical intervention is likely and can vary from replacement & a purse-string or mattress suture, to amputation or exploratory surgery
Identifying the prolapsed tissue is sometimes easier said than done, often chronic in nature.

If mild, only cloacal tissue may protrude.

**Cloacal mucosa**- smooth & shiny although prolapsed tissue will become swollen over time.

**Colon**- smooth, tubular appearance & sometimes feces can be observed.

**Phallus** (chelonians) or **hemipenes** (squamates)- relatively solid tissue that originates from the lateral portion of the wall of the cloaca.

**Oviduct**- “donut-like” appearance; longitudinal folds can be observed on the oviductal wall.

**Urinary bladder**- thin-walled, often fluid filled.
• **Preovulatory follicular stasis (pre-OFS)** primarily in chelonians & lizards

• **Postovulatory egg stasis (post-OES) or dystocia**

• Inappropriate husbandry (malnutrition, inadequate nesting site, inappropriate temperature & humidity, or the absence of UV rays)

• Determining when to intervene can be quite difficult since many species can delay oviposition

• Strict adherence to husbandry, adequate nesting & having optimal temperature for oviposition based on species-specific requirements is very important
Hx. of anorexia, +/- weight gain
Total Ca usually elevated due to an increase in TP & albumin levels, iCa can be low, normal or high
Hepatic lipidosis, but liver enzymes are usually unaffected
Post-OES radiographs will show calcified eggs & with digital radiography you will even pick up slightly calcified ones
Generally chelonian eggs have more calcium in the shell & will be more radiopaque than squamates
Remember that in chelonians some can be free in the coelomic cavity or retrograded into the urinary bladder
If radiographically no eggs were seen then the next step would be to confirm if pre-OFS is present.

US examination will give you a quick answer!
- Chelonians- probe in the pre femoral/inguinal fossa
- Lizards- probe either ventral or laterally & in snakes run it up & down the caudal 1/3 of their body, spot the gall bladder & the ovary should start just caudal to that
- Do not confuse fat pads with malformed eggs
- pre-OFS- large number of follicles will be present, range from hypo- to hyperechoic based on the chronicity of the ds. process
- Identifying follicles in the ovary does not equal pre-OFS
- It takes a good evaluation of the clinical scenario to make the decision whether to intervene or not
- Endoscopy can also be used but is usually not necessary at this point
Once a dx. has been made a therapeutic plan must be established

In **chelonians** with pre-OFS correcting husbandry & Ca supplementation are imperative

Some clinicians advocate exposure to a male to stimulate ovulation, GnRH analogs can be tried to suppress ovulation & perhaps reabsorption of follicles, but most cases end up being surgical

With post-OES correct husbandry first; if no oviposition occurs and no evidence of obstruction is seen then start supportive care
Give Ca, then oxytocin 1-20 IU/kg approximately one hour later, 2-3 subsequent doses can be repeated from 30 min to 4-6h, ranges & intervals vary widely in the literature.

A recent study by Ianni et al demonstrated that Oxytocin given IV works significantly faster than when given IM.

If the right case was selected oviposition will result shortly, if not then surgery is recommended.
Surgery for either of these 2 conditions, a ventral plastrotomy has been utilized over the years, but a pre femoral/inguinal approach is becoming more popular.

We start with an endoscopic assisted pre femoral approach, if the ovaries +/- oviduct can be ligated and removed then we proceed, if not then we convert to a ventral plastrotomy.

Different techniques for plastrotomy have been described in the literature.

Pre-OFS - no need to remove the uterus unless there is pathology involved vs. with post-OES it is imperative to also remove the ovary to prevent further "ectopic ovulations" and it related side effects.
Dystocia in snakes is primarily seen in oviparous (egg-laying) snakes like pythons, colubrids & elapids than in ovoviviparous (live-bearing) snakes like boas, rattlers, some colubrids, cooperheads & other vipers. Unlike other reptiles most snakes presented for dystocia are not due to hypocalcemia, hypoglycemia or d/t having a “weak” uterus (uterine inertia) since it is quite thin.
Red-tailed Boa
We usually see mechanical obstructions from the clutch itself (some will pass others will not) or from excess or dried up feces.

If a snake is straining for a “reasonable” amount of time, it is an emergency.

Supportive care- parenteral fluids, Ca, analgesic/anti inflammatories & perhaps antibiotics is usually warranted.

If a cause of obvious obstruction is not determined, oxytocin or AVT (not readily available) can be tried with mixed results.

First, the cloaca should be infused with warm water and/or a water-soluble lubricant.

If nothing happens, then attempt gently massaging the eggs or embryos towards the cloaca, sometimes a percutaneous ovocentesis might facilitate the passage even more.
If the previous attempts fail then surgical intervention (salpingotomy or salpingohysterectomy) is warranted, always make sure of the reproductive long-term goal for the patient (pet, breeder, endangered species, ect.)

As a general rule to fully “spay” a snake can be challenging in larger specimens due to the linearity of the reproductive tract & that multiple skin & uterine incisions will be required.

- Paramedian approach between lateral & ventral scales is recommended.
- Carefully exteriorize & evaluate anatomy of the oviduct, look for underlying ds. & make a plan based on the amount of eggs, embryos or “slugs” present.
- Minimum amount of incisions & gently manipulate them to a common site for removal, take samples for cytology, biopsy or for c/s if warranted.
Careful closure with an inverting pattern on the oviduct & an *evertting* pattern on the skin should suffice.

In cases were future reproduction of the snake is not desirable or in which the amount of pathology (torsion, necrosis, severe infection, neoplasia, ect.) precludes saving the oviduct, then perform an ovariosalpingectomy.

Make sure to remove the entire ovary so future ectopic ovulations or egg yolk coelomitis does not occur.

In cases were unilateral disease is present it is possible to only remove the affected side.
Lizards - similar to snakes

More common in the oviparous lizards (iguanas, dragons, monitors, Gila monsters, beaded lizards, anoles, tropical chameleons, many small skinks, Uromastyx lizards & most geckos among others)

Less common in ovoviviparous lizards (large skinks such as the bluetongue skink, prehensile tail skink & montane chameleons such as the Jackson's chameleon)
Dx. & Tx. approach is similar to that of snakes & chelonians

Non-obstructive dystocia- medical treatment is only effective during a small 48-72h window

Check iCa but in most cases we end up using Ca+ even if within reference ranges

Ca+ is given IM/SC first, followed by oxytocin around one hour later; two to three subsequent doses can be repeated from 30 min to 4-6 hours, ranges & intervals vary widely in the literature
Varanid lizards are very intelligent & some species can even count

Careful studies feeding at the San Diego Zoo varying numbers of snails showed they can distinguish numbers up to 6

Some have been observed to cooperate when foraging

One varanid lures the female crocodile away from her nest, while the other opens the nest to feed on the eggs, the decoy then returns to also feed on the eggs

Komodo dragons at the National Zoo, recognize their keepers and seem to have distinct personalities
- No eggs are passed in 48h, surgery is recommended
- Either with pre-OFS & post-OES the same general rules apply for surgery as with chelonians
- The approach utilized is based on body shape
- Round bodied & ventrally compressed lizards (iguanas, Uromastyx & monitors)- paramedian approach is recommended avoiding ventral abdominal vein/sinus
- Laterally compressed lizards (chameleons)- paralumbar approach is recommended with rib resection
USE OF COMPUTED TOMOGRAPHY–GUIDED PERCARAPACIAL OVOCENTESIS IN THE MANAGEMENT OF DYSTOCIA IN AN EASTERN BOX TURTLE (JZWM 2018)
Case 1 “#21”

- ~20yr old, Cooter turtle (*Pseudemys concinna*)
- Hx. anorexia, not floating right
- Diet: mainly pellets (improper)
- No UVB, ok tank
- PE: unremarkable
- CBC- n, Chem-n, iCa-n
- Next step?
CUS can pick up ovarian activity (pre-OFS) and uterine activity or lack off (post-OFS)

Next step?
- Supportive care
- IV if debilitated, SC/IC fluids
- CA?
- +/- antibiotics
- NSAIDS?
- Next step?
Endoscopic-assisted oophorectomy
Dx: pre OFS most likely secondary to poor husbandry and lack of nesting site
Tx: Endoscopic-assisted oophorectomy
Case 2: “Peeka”

- Adult ~ 6yr, gender?, Argus monitor (Varanus panoptes), recently rescued/adopted
- Hx: several months on/off anorexia, quiet, treated twice, Baytril then gentamicin for presumptive pneumonia with slight improvement
- Diet: mice and eggs
- Husbandry: Currently very adequate, previously very poor
“Peeka”

- Why did she respond to antimicrobials twice?
- PE: BCS 4/9, mild coelomic swelling, palpable ovoid mass, scabs on nose that easily bled
- CBC: relative azurophilia, +/- inf/inf
- Chem: ~n
- Fecal: neg
- Next step?
“Peeka”

- Next step?
“Peeka” Exploratory coeliotomy

“Hook to the monitors to the monitor” or “Hook the monitor to the monitors”
“Peeka”
“Peeka” Dx?
“Peeka”

- Dx: post-OES, infectious oophoritis
- Tx: Exploratory coeliotomy, salpingohysterectomy
• Make 100% sure of gender
• History, History, History… Husbandry and time are of essence
• Observe closely prior to restraint
• Upon presentation most have been sick for a while, do supportive care first
• Run iCa when you can, total Ca usually elevated on females unless a chronic condition
• Give your clients handouts or refer to websites otherwise your appointments will take forever
Conclusion

• Reptile reproductive medicine can be quite challenging & rewarding at the same time since once the condition is diagnosed & treated most patients tend to recover uneventfully

• Remember to always listen to the reptile caregiver, get a good chronological history of events if available and review the husbandry requirements, anatomy and physiology of the species in question

• Attend CE wet labs to enhance skills

• Thank the internet for some great images

• Publish what you see, it is easier than you think
Thanks!