

MY WILDLIFE VETS

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A FLASH FROM FINAL WEBINAR SERIES 2020 ZOOLOGICAL ANESTHESIA

15TH AUGUST 2020 | 1000-1300 (GMT+8)



*Dr. Paolo Martelli
Director Of Veterinary Services
Ocean Park Corporation, Hong Kong
Topic - Scaling Up Reptile Anesthesia*



*Dr. Lee Foo Khong
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Topic - Flip Side Of Pinniped Anesthesia*



*Dr. Abraham Mathew
Assistant Director of Conservation,
Research & Veterinary Services
Singapore Zoological Gardens
Topic - Large Herbivore Anesthesia, A Mammoth Task*

A FEW WORDS

Hi all,

We are reaching the end of an extremely challenging year. When I was young, people imagined how the world would be, especially for Malaysia with its Vision 2020. By the first quarter of the year, 2020 became an unprecedented year with a global pandemic, resulting in economic and humanitarian catastrophe.

Every single walk of life has been affected by this crisis in one way or another. The wildlife and exotic fields are no exception. The challenges came in unpleasant forms, such as slashing of veterinary care budgets, reduction of manpower and lack of training opportunities during this period. WESIG had several plans for 2020, e.g. a rabbit workshop, two Wildlife Veterinary clinical rounds and a wildlife anesthesia workshop. Unfortunately, only one clinical round was held.

Despite this, the Bornean team comprising Dr Nabila, Dr Roopan, Dr Boon Nie and Dr Reza, successfully organized the Zoological Anesthesia series. This five series webinar consisted of:

- Fish Anesthesia talk by Dr Ali Anwar
- Gas Anesthesia by Associate Prof Chen Hui Cheng
- Avian Anesthesia by Prof Jalila
- Exotic & Companion Animal Anesthesia by Dr Serena Oh.
- Large Herbivore Anesthesia by Dr Abraham Mathew, Pinniped Anesthesia by Dr Lee Foo Khong and Reptile Anesthesia by Dr Paolo Marteli.

The finale was the icing on the cake, as it marked the first regional involvement of WESIG in collaboration with the Asian Society of Conservation Medicine. Kudos to the Bornean Warriors!!!

Thank you to all contributors of the 8th edition of this newsletter. In this edition, we have an interesting story from Dr Sandy Ling on handraising a dugong calf in the Philippines, the final installment of basic fish medicine by both Dr Ali Anwar and Dr Anusia Nadarajan, Digit Amputation of a Bornean orangutan by Dr Roopan and not forgetting our ever-resourceful Dr Reza Tarmizi who yet again shares an interesting article on his innovation in developing good locally produced, high quality projectile drug administering darts. The last article of this edition of the newsletter is about WESIG and also provides an update on the Malaysian Association of Zoo Medicine registration.

We hope you will enjoy the articles shared in this edition. We wish that everyone will stay safe, as we battle this COVID-19 infection. Happy reading!!!

Handraising of a Dugong Calf at a Remote Island in the Philippines

by *Sandy Ling Choo*

I am sure many veterinarians reading this article are experienced (if not experts) in the hand raising of young animals. Whether it's a starling chick, an owlet, a tiger cub or an elephant calf, most rescue scenarios involve bringing the animal to the nearest wildlife holding facility, where it can best receive the intensive care and critical monitoring from a team of dedicated veterinarians and staff that are crucial to a creature's chances of survival.

Naturally, such scenarios also apply to the rescue of young marine mammals in most parts of the world. In the Philippines, the approach is quite different due to the challenges of the country's unique natural setting. As an archipelagic nation, the Philippines is comprised of over 7,100 islands, divided into 6 major bio-geographical regions. In locations where facilities are not accessible, to respond to stranded and stricken sea creatures and manage their rehabilitation, temporary holding facilities are set up wherever the strandings occur. In addition, trained 'first responders', ideally in the locality, are called upon to provide a first response whilst second responders, including veterinarians like me, are scrambled.

A Dugong is a species of sea cow, related to the manatee and looks like a short, stubby walrus, without the walrus' tusks. Before April 2019, I barely had any theoretical knowledge of what a dugong was, and have never met one. As has often been the case, through a phone call from Dr. Lemnuel V. Aragonés, I was notified about the stranding of a dugong calf in Palawan. Dr. Aragonés is currently the director of the Philippine Marine Mammal Stranding Network (PMMSN), and a member of my thesis panel. Within hours of the phone call, I was on my way to Manila to collect a marine mammal hand-raising kit, which had earlier been dispatched by the marine mammal veterinary team at Ocean Adventure, based in Subic Bay. By the following morning,

I flew in via the earliest possible flight to the remote Busuanga Island of the northern Palawan.

Not a One-Man Show

Upon reaching Barangay Bugtong, I was greeted by the intensely passionate first responders, Ginelle and Shalom, from C3 Philippines. The girls were visibly fatigued, whose own concerns had also been temporarily suspended and who were immersed in devoting their previous day and night to the care of the stranded dugong calf which was named 'Bughaw'.

I was immediately welcomed to be a part of the on-site rescue team. We were guided by an ad hoc messenger group chat, participated by four other PMMSN veterinarians and Dr. Aragonés himself. Three days after, Dr. Leo Suarez from Ocean Adventure joined the on-site rescue team with additional milk supply and feeding tubes, along with his many experiences in cetacean rescue and rehabilitation efforts.

And so, over the next few days, our rescue team, on-site and off-site, strove to do all it could to palliate Bughaw's condition in a make-shift sea pen. Our on-site rescue team consisted of a dynamic group of volunteers from the local and neighbouring community. The community-based international NGO, C3 Philippines, is the imminent local advocate in dugong conservation. Therefore, Ginelle and her colleagues were the key players in calling forth and managing volunteers from local barangays and neighbouring Calautit Island for Bughaw's rescue effort. Volunteers from local communities have to be managed so that those with good intentions can best be deployed to support experienced respondents. Moreover, bearing in mind the exhaustive nature of any rehabilitation attempt, rosters have to be quickly established so that responders (especially the veterinarians) get sufficient rest and sleep, and can be rotated so that everyone thinks and acts optimally.

Clinical Assessment of a Dugong

Like any other animal, the prompt assessment of the stranded creature's relevant clinical history remains a crucial aspect of a veterinarian's engagement and palliative care. Of course, such information may not always be available for stranded marine mammals, and it is for this reason that attention must first be given to acquiring a "prospective history" by observing the animal intensely, from the outset. The parameters we consistently monitor include the animal's buoyancy, along with its demeanor, activity level, defecation, posture, respiratory rate (RR) and behavioral characteristics. The typical normal respiratory rate for a dugong is, on average, 3-18 breaths per 5 minutes (or 1-4 breaths per minute) and we used this as the baseline for assessing the creature's respiration.

For any veterinarian to make meaningful observations, it is important to note that a dugong's breathing cycle is similar to that of dolphins and whales, following the exhale, inhale, apnea cycle. Moreover, the duration of each breathing cycle may vary significantly. Furthermore, as hind gut fermenters, a dugong is more closely related to an elephant than other marine mammals, the exceptions being their sirenian relatives, i.e. the freshwater manatees. Like elephants, they have auxiliary mammary glands and even, as adults, developed tusks. As sirenias have very specialized gastrointestinal tracts, the veterinarian must always anticipate the possibility of gastrointestinal ailments. For those interested to read more about marine mammal medicine, the CRC Handbook of Marine Mammal Medicine (3rd edition) is one of the most comprehensive reference available.

Table 1. *An example of a datasheet for the hourly assessment of a Dugong calf.*

Hour	Breath /5 Min	Breath /Min	Defecation		Postures		Notes
			Frequency	Color/ Texture / Smell	Flex	Rolling	
0000	III III III	3 BPM					
0100	III III III III II	4 BPM			I		FLATULENCE
0200	III III III III III	5 BPM	I	BROWN / SOFT / FOUL		II	PROLONGED EXHALATION
0300							
...							
2300							

The Right Milk Formula, or Not?

Finding the right milk formula is crucial in the hand raising of dugongs, due to their specialized gastrointestinal tracts. Inappropriate milk formula components may lead to various intestinal problems, which include constipation, diarrhea and enterocolitis. Unfortunately, there is limited information on mammary milk composition and hand raising successes of dugongs in captivity. A low lactose formula has been used successfully to raise "Pig", a rescued juvenile male dugong at Seaworld (Gold Coast, Australia). However, in the attempted rehabilitation of Bughaw, details of the optimal milk formula were not known.

We had to, therefore, rely on the artificial milk formula used to raise orphan manatees, which is available in the CRC Handbook of Marine Mammal Medicine (3rd edition). The milk formula we used for Bughaw was primarily based on the Miami SeaQuarium's recipe, with some alteration and additions made based on the local availability of ingredients. A blender was used to mix the ingredients as the resulting milk formula was thicker than a typical milk formula. The formula was heated to body temperature in hot water bath before a feeding.

To deliver the milk, we initially used 50ml syringes attached to an improvised stomach tube, which Bughaw suckled with rather poor efficiency. We eventually settled on a human

gastric tube, which Bughaw suckled on reasonably well. Notably, most published literatures with known successes in sirenian hand raising suggest a bottle-feeding technique using lamb or bovine calf nipples.

Despite the fact that Bughaw exhibited a good suckling reflex at the beginning, we still had difficulty getting it to suckle on a consistent basis. One of the possible reasons was that Bughaw suffered from chronic constipation. While we did treat the problem using glycerin suppositories, the problem was not completely resolved until a later stage. We also took a while to establish a consistent nursing technique, which likely affected Bughaw's responses to our care. Eventually, we noted that Bughaw was consistently losing weight, which led to our decision to deliver the milk formula via gastric tubing. Unfortunately, this resulted in the development of a severe bloat, and Bughaw died despite being treated with an oral simethicone. The veterinary team agreed that the cause of the bloat likely involved several factors, including reduced gut motility, the poor digestibility of milk, bacterial fermentation, intestinal dysbiosis, and/or enteritis.

Perhaps the ending of his brief life was inevitable. Harsh as it sounds, it is quite typical that palliative hand raising efforts involving dugong calves end as ours did. Unlike the case with manatees, there are only a very few instances of dugong hand raisings that have been successful; indeed, most of those successes took place in well-equipped marine mammal captive facilities and when attended by very experienced veterinary teams. For us, though, such facilities and such expertise were not accessible on a remote island in the Philippines and our boundless enthusiasm and absolute dedication could not compensate for the relative crudeness of our care.

We Cared, but Could We Have Done so Better?

It's a hard question to ask, but a veterinarian's job is to ask tough questions: What did we do right? What went wrong? What could we have been done better?

In Bughaw's case, one of the major limitations we faced was a lack of accessible diagnostic facilities. Perhaps we rightly assumed that

Bughaw was dehydrated and even hypoglycemic, considering his maternal separation and relatively thin body condition. However, it was not actually possible to assess Bughaw's physiological progress in an objective manner without hematology and serum biochemistry parameters. Certainly, we did try our best to assess Bughaw's daily progress based on monitoring his milk/fluid intake, body weight, activity and behaviors, among other parameters. From these, we assumed that we had sufficiently corrected his dehydration status and with that judgment proceeded to increase his milk intake. Unfortunately, in our haste to address Bughaw's caloric needs, we tipped the sensitive "balance" of the GI tract, leading to the severe bloat, which ultimately, and to our immense regret, hastened Bughaw's untimely death.

As I look back now, I can see more objectively, that Bughaw's inconsistent feeding could have been due to his ongoing GI discomfort from chronic constipation, and that its dehydration was not sufficiently addressed. Fluids with electrolytes (or coconut water) should have been administered via a stomach tubing during the first days to ensure an accountable volume of fluid intake and establish gut motility. And once we'd recognized that Bughaw's condition was quickly going downhill, we should have attempted to administer intravenous fluids and parenteral dexamethasone.

With hindsight, it is easy for me, now, to see all too clearly the mistakes and all the "what ifs". But could we really have done better, based on the knowledge and skills we had at the time? As responders, we learned a great deal from all we discussed while tending to him, as well as from our readings, both during and after the rehabilitation effort. While it is sad to admit that we failed in Bughaw's case, I know we all did our best for Bughaw's palliative care during his last days.

Enclosure vs Free-Ranging

About two weeks after Bughaw's rescue effort, another dugong calf was rescued off the coast of Krabi, Thailand. Many of you have probably heard about Marium, the female dugong calf which "loves cuddles and adopted an orange kayak as its surrogate mother". Marium was allowed to swim and graze freely on the sea grass beds of the Koh Libong Dugong Sanctuary, where she also received a milk supplement from dedicated veterinarians, volunteers and officers.

But like most cases of dugong hand rearing, Marium's rescue story also did not have a "happy ever after" ending. She died despite the truly remarkable rehabilitation efforts, which lasted for 111 days, and involved 27 veterinarians and over a hundred volunteers and officers. The necropsy examination by the veterinary team revealed that she'd suffered from a severe gastrointestinal infection and had ingested plastic pieces. She was also showing signs of blunt trauma that were likely caused by wild adult dugongs in the area.

On reflection, I think it is important to understand the fact that marine mammal rehabilitation is often much more complex than when contextualized only by medical intervention for the stricken animal. While it is an appealing idea to let the animal roam free in the wild where it should belong, Mother Nature is not the kindest of the environment. Apart from the unforeseen attacks by wild dugongs, Marium's free-range rehabilitation effort also involved emergency trips to a human hospital, due to potentially fatal Box Jellyfish stings. While keeping Bughaw in a sea pen have compromised its expression of normal behaviors, the sea pen setting allowed better monitoring of the animal and its environment.

Failing Forward

Responders, whose hearts and souls are given over to the well-being of a stricken animal, still make mistakes. We suffer, in the stress of the moment, burnout and compassion fatigue; we form immoderate emotional attachments; we harbor unrealistic expectations of the animal's survival chances; and we also overlook the fact that failure in rehabilitative efforts are more common than successes.

But without trying to rescue creatures like Bughaw and Marium, their demise is assured. Our efforts, as partial as they were, gave Bughaw the only chance of survival he had. Our best weren't good enough, on that occasion. But I know from experience, that for the next stranding, our best can only be one step better. And perhaps, the bundling up of all we've learned from experience, we can be hopeful that the next animal – that means that when the phone rings again, we'll be ready and willing to head out for the next rescue.

Acknowledgement

The Philippine Marine Mammal Stranding Network (PMMSN), C3 Philippines, Bantay Dugong Calaut and Ocean Adventure directly contributed to the rescue effort of Bughaw. I am extremely grateful to Dr. Lemnuel V. Aragon, Dr. Leo J. Suarez, Dr. Christopher S. Torno and Dr. Mariel B. Flores for their ever patient guidance and commitment in marine mammal stranding. Many thanks to Adrian and Balen Thirkell for their skillful editing in making this article more leisure-reading-friendly.

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The dugong calf was handraised in a makeshift sea pen owned by a local fisherman at Barangay Bugtong, Coron, Busuanga, Palawan.

Initially, the dugong calf voluntarily suckled the milk formula from a human gastrotomy tube attached to a 50ml syringe.



The milk formula was later administered directly into the stomach via orogastric tube.



FISH DISEASE INVESTIGATION

by Ali Anwar and Anusia Nadarajan

Introduction

For the last three editions, we highlighted the basic physiology of fish and basic husbandry of fish including the nitrogen cycle. As veterinarians, we need to know the anatomical and physiological differences of fish, their adaption and husbandry needs to be able to successfully investigate and diagnose fish diseases. Similarly, with other disciplines in veterinary medicine, there are standard approaches for disease investigation. In this edition, we will highlight some important steps that veterinarians need to take when there are engaging fish cases in their practice. The common fish diseases that the veterinarians may encounter in their everyday practice will also be briefly discussed in this edition.

Disease investigation

Fish disease investigation generally applies most of the same principles as in other veterinary disciplines for disease investigation such as History Taking, General Observation, Physical Examination and Ancillary tests. The approach may be different but the principles remain the same. A systematic approach is needed to develop a set of differential diagnosis based on the history, general observation and physical examination. Ancillary tests are then carried out to rule in or rule out a differential diagnosis. Finally, with sufficient diagnostic work up conducted, a diagnosis is made and a treatment

plan is created according to the tentative diagnosis that has been made. The following are some of the diagnostic steps in fish medicine:

History Taking

History taking is the single most important first step in any disease investigation (including crime investigation!!) and fish cases are no exception. The key is to ask the right questions to help you navigate the case process, plan your diagnostic work up and diagnose the disease. The questions that you ask, should always work around basic fish husbandry or fish keeping and questions that are based on the primary complaint for the fish case.

Examples of basic questions are:

- Who normally cleans the tank or pond?
- Were there recent additions to the tank or pond?
- How often are the fishes fed and the volume it is fed with?
- When was the last time the tank or pond was cleaned?

Examples of questions based on primary complaints are; if the fish are suddenly not eating, ask if there were any changes to the diet or if there was a new brand of fish pellet given, or if there were any changes recently done at the tank or pond that may affect the water quality.

At the end of the day, History Taking is primarily to check on the husbandry and biosecurity practices of the tank or pond. By asking the correct and relevant questions, it can rule out and also narrow down possible diagnoses to the case.



WORLDFOBUBZ.COM

Man Gets Koi Pond Cleaned, But All His Fishes Die After

Figure 1: History taking can identify that cleaning of pond without proper treatment of tap water can lead to catastrophic mass mortality.

Source: <https://worldofbuzz.com/man-gets-koi-pond-cleaned-but-all-his-fishes-die-after/>

General Observation

General observation for fish cases is about spending some time, looking at the fish at the fish tank or pond, its life support system and its surroundings. Part of general observation involves looking at the fish species, the number of fish in the tank, the behavior of the fish, the overall condition of the tank, its filtration system and also the location of the tank. All of these may assist you to narrow down your diagnosis or plan the diagnostic work out of the case. For example, as you are conducting General Observation, you may notice that the tank has a lot of uneaten food that is not removed. Upon seeing this, you may want to include a water ammonia level test to determine if too much food is given, resulting in degradation of the water quality.

The power of observation is an important tool in navigating fish cases. You will be surprised that through observation, you may identify husbandry or fish keeping issues that led to the disease that you are diagnosing or treating.

Physical examination

Once we have adequate information on the history and fish keeping practice of the client, it is time to have a closer look at the patient. Physical examination of the fish can be done both consciously or anaesthetised. If the species of fish is big and powerful, such as a shark and arapaima, or small but easily succumbs to stress, it will be wiser to have the fish anaesthetised for the check.

Physical Examination of this fish involves looking at the general appearance of the fish up close to look for any injuries to its body or fin, nodules or other foreign material may be attached to the fish such as hooks. Sometimes diseases such as anchor worm (*Lerneae sp*) and fish lice (*Argulus*) can be diagnosed with physical examination. Fundamental Physical Examination techniques such as collecting the TPR (Temperature, Pulse and Respiratory) and auscultation are not really applicable for fish. Palpation may indicate if the fish has abdominal distention due to either gas or fluid.



Figure 2: Physical examination of a giant gourami reveals erythematous lesions on the scales.

Ectoparasite Check

Ectoparasites are highly prevalent and increases the mortality rate in fishkeeping. Ectoparasite checks should become a routine each time fishes are caught or anaesthetised for disease investigation. A standard procedure for fish medicine is to conduct external parasite checks on fishes with a fin clip, gill clip and body scrape. This procedure is to look out for ectoparasites such gill flukes, white spot disease and anchor worms. Gill clip is an invasive procedure and is best conducted under anaesthesia, as it may cause stress and pain.

Gill clip is done by cutting the gill filament and viewing it using a slide with a cover slip, under a light microscope. Great care is needed because if the fish struggles, or if you are not careful; you may accidentally cut the gill arch itself. This will result in severe blood loss that leads to death of the fish. When collecting the gill clip, only a small quantity of the gill is collected. If the fishes are small, for example, less than 5cm in size, it is best to actually avoid this method and have the fish sacrificed to collect the sample or completely omit this procedure if the fishes are valuable.

Body scrape is done by scraping the mucous layer of the skin to check for ectoparasites. I normally collect the body scrape using either a cover slip or the slide, and view it under a light microscope. Technically, you can use any object to scrape the mucous layer, but make sure you don't scrape too deeply, as it will damage the protective layer, making it susceptible to infection.

Fin clip is done by cutting a small wedge from the fish's fin and placing it on a slide. The sample is then viewed under a light microscope. Be careful not to cut the fin filament, as this may result in permanent damage to the fin itself.

Fin clip, body scrape and gill clip should be examined under microscope using 40x to 100x magnification. Sample should be viewed by wet mount and no staining is required. Lactophenol may be used if fungal infection is suspected, to view the hyphae of the organism.



Figure 3: Gill clipping done on an anaesthetized sutchi catfish

Water Quality Testing

Water quality testing is an important part of disease investigation. If you are in a public aquarium setting, the water quality testing would have been done by the aquarist or life support system team. However, if you are working in a private practice, chances are you will be the one conducting the water testing yourself. If you are called for any fish cases, please purchase a set of water quality testing tools before heading off to attend the case as most fish diseases are directly related to water quality. Water quality test kits can be purchased from most neighborhood aquarium shops.

Water quality testing is recommended before conducting any other checks such as physical examination and even general observation. The minimum water quality test kit that are required are for water temperature, pH, ammonia, nitrite and nitrate level.

If you are dealing with a marine tank, test for salinity and also other important ions such phosphate calcium and magnesium.

Sometimes, water quality issues may lead to clinical signs. It is important that you should know basic water quality parameters for both freshwater and saltwater fishes. Also take note on the species of fishes that is kept. Different species of fish need different water quality parameters. For example, fish species from Lake Tanganyika, Eastern Africa require alkaline water pH while fishes from the Amazon Basin require more acidic water.

Radiograph

Radiographs are useful diagnostic tools to look out for foreign bodies in the fish, such as fish hooks (if the fish is a wild caught fish) or gravel. Swim bladder disease can also be diagnosed with radiographs. However, due to the poor serosa details of fish visceral organs, diagnosing abdominal masses are difficult. Contrast studies can also be done on fishes to determine blockage or non-radiopaque foreign bodies.

Radiograph of fishes can be done by either placing the plate in a waterproof bag and the image taken with fish in the water, or the fish is taken out of the water and placed onto the plate. The former is to be done for big sized fishes such as arapaimas or sharks, where the sheer size of the fish renders taking it out of the water, impossible.

Bloodwork

For most fish, blood is collected from the coccygeal vein and there are two common approaches to the coccygeal vein. One is to approach the vein from the lateral aspect of the fish and this approach involves sticking the needle a few millimeters (mm) below the lateral line to approach the coccygeal vein. If you hit the vertebrate body, pull and redirect the needle ventrally. If you don't hit any structure, redirect the needle a few mm dorsally until you hit the vein.

For the ventral approach, fishes need to be placed in the ventral position. The needle is then directed just caudal to the anal fin. Advance the needle dorsally toward the fish until it hits the vertebrate body. The blood should start flowing into the hub now; if the vein is not located; try to move around a few mm to each side until you hit the vein. Both methods are blind techniques, hence there are high chances that blood may not be able to be obtained.

I personally found that fish blood clots faster than most species of animals. I usually prime the needle (aspirate and expirate several times) with heparinized saline before I use it for blood draw.

Interpretation of fish blood can be tricky as in other exotic species. It should be done together with clinical assessment of the fish. It is important to note that the blood value can be affected by the water quality of the fish itself. Interpreting fish blood results can be tricky and misleading, hence I would recommend assessing the blood result together with the clinical condition of the fish.



Figure 4: Blood draw from the coccygeal in a sutchi catfish. Please note that the collection was done on ventral position and just caudal to the anal fin.

Ultrasound

Ultrasound can be done on fishes. Fortunately, water is a good medium to provide good contact between the fish skin and the probe. This in turn, provides a good image of the organs. As with all diagnostic imaging, a lot of practice is needed, to learn the anatomical feature of fish on ultrasound scanning. It is important to learn the anatomical structure and how to detect lesions. Similar to the radiograph, please be careful not to get yourself electrocuted when you are conducting the scan.

Figure 5: Ultrasound on a motoro stingray. Please note that the stingray is placed on tonic immobilization by placing it upside down and ultrasound gel is used during the scanning.



Endoscopy

Endoscopy is a useful method for diagnosing diseases, sexing and treatment of fish patients. This is an invasive procedure and requires deep anaesthesia. Ideally, endoscopy must be done with the fish out of the water to provide a better aseptic method and also to prevent damage to the sensitive endoscopic equipment.

Similar to endoscopy of mammals or birds, once an incision is made on the skin of the fish, a trocar is advanced into the coelomic cavity. The cavity is then inflated, before an endoscope is used to visualize the visceral organs. Inflation is required, to allow for better visualization of the organs as it expands the body wall and allows more room for the scope to move and visualise the organs. There are sources that use saline to inflate the coelomic cavity and most authors including myself, use air such as carbon dioxide or medical air to inflate the coelomic cavity. Each has their pros and cons; hence it depends on the operator's personal preference and also the procedure to be done.

It is worth noting that some species of fish, especially the cyprinid or carp family have fat layers that cover the entire visceral cavity that renders visualization of the internal organs, impossible.

Endoscopy in fish is an expensive investment but it will give excellent results to provide better disease diagnosis and sample taking. Endoscopy is also good for diagnosing other exotic species, especially birds. It is a good investment in a clinic that sees a lot of exotic species!



Figure 6: Celioscopy conducted on an alligator garfish. The endoscope was conducted out of the water with water irrigated to the gills to provide oxygen supply and maintaining anaesthesia of the fish.

Necropsy

Necropsy is an important diagnostic method in fish disease investigation. Necropsy is conducted on fishes that are recently euthanized or have just died. If the fish has been dead for more than an hour, the necropsy would not be accurate as the parasite may leave the fish carcass and the degree of autolysis may render the histopathology reading inaccurate. Necropsy is done on fishes that are too small for the clinician to safely collect the relevant samples or fishes that are moribund. Some authors recommend to humanely euthanise the fish by pithing or clubbing rather than overdosing the fish with immersion. Immersion may result in the parasite leaving the fish and it may be missed during the necropsy investigation.



Immobilization

Immobilization of fish is crucial to allow diagnostic work and treatments. Immobilization should be done to prevent stress and harm to both fish and handler. There are numerous research studies that indicate fishes can be negatively impacted by stress and pain.

The most common way to immobilize fish is by netting the fish and restraining it for sampling and checks. It is important to ensure that the nets are made from soft material and that the netting has a fine diameter. Try to avoid acquiring large mesh nettings, as certain parts, especially the fin may get caught, resulting in injury.

As mentioned in the previous edition, the fish's mucous layer forms a protective layer against any surface pathogens and scales connect directly to the dermis layer. Any loss of scales renders the dermis layer prone to infection and can compromise the fish's health.

There are limitations as to what we can achieve, when fishes are restrained by nets for examination. Restraining with nets is recommended for minor procedures, such as fin clipping and body scraping; but anything more invasive such as gill clip or blood draw should be avoided as the fish may experience stress or pain and even serious injuries if it struggles during the procedure.

Tonic Immobilization

Tonic immobilization is a state of hypnotic paralysis method achieved when the fish is placed upside down or the ventral side up. This method is widely used in the elasmobranchs (cartilaginous fish such as stingrays and shark) species where the fish goes into deep anesthesia (the fish are immobilized and loses all its muscle tone). There are reports in which

non-invasive procedures, such as placement of telemetry implants and skin sample collection, can be done with fish in tonic immobilization.

I have successfully used tonic immobilization in freshwater stingrays, sturgeons and catfish. Blood collection, gill clip, fin clip and body scrape can be conducted without any violent response from the fish. I have also used tonic immobilization for ultrasound and gastroscopy. Tonic immobilization should be avoided for any painful procedure such as celioscopy and surgery. It is also important to note that not all fish will respond to tonic immobilization, hence it is seldom used in teleosts (bony fish).



Figure 7: Tonic immobilization in shark.

Source:

<https://www.canberratimes.com.au/story/6639714/rescue-mission-to-save-snagged-shark/>

Chemical Immobilization

In my personal experience, the most reliable chemical for fish would be the bath with chemical agents, such as MS222, clove oil and phenoxyethanol. Fish anesthesia with injectable anesthetic agents are not reliable in fish, as it results in poor depth of anesthesia and prolonged recovery.

Details of fish anesthesia using bath had been explained during the Zoological Anesthesia Webinar Series in April this year. A record of the webinar can be found on this link:

<https://mail.google.com/mail/u/0/?tab=rm&ogbl#search/fish+ane+/FMfcgxwHMsmBQpLFKBwQDpjdVZgbGDNv?projector=1>

In the future, we may discuss further about fish anesthesia using the bath method. In summary, anesthesia/chemical immobilization is an important aspect for physical examination and conducting ancillary tests for fish.



Figure 8: Immersion anaesthesia of a golden masher using phenoxyethanol.

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Finger Amputation in a Bornean Orangutan

Co-authors: Navaneetha Roopan*, Reza Tarmizi, Nabila Sarkawi, Yeoh Boon Nie

Introduction

Bornean Orangutans

The Bornean orangutan (*Pongo pygmaeus*), is split into 3 subspecies namely Northwest Bornean orangutan (*P. p. pygmaeus*), Southwest Bornean orangutan (*P. p. wurmbii*) and Northeast Bornean orangutan (*P. p. morio*). The subspecies which occur in North Borneo is the Northeast Bornean orangutan. Bornean orangutans are listed in Appendix I of CITES and “Critically Endangered” under IUCN Red List. In Sabah, they are in Schedule I of Totally Protected Species and protected under the Wildlife Conservation Enactment 1997.

Bornean orangutans are the largest arboreal mammals in the world, living a semi-solitary life. Both genders reach sexual maturity at approximately 15 years old. They give birth to a single infant, after a gestation period of approximately 250-260 days. The birth spacing has an interval of 7.6 years in the wild. Orangutans are generally plant feeders and adapt their diet to natural resources available in the forest, feeding primarily on fruits, and complement their diet with young leaves, flowers, tree bark, and insects.

Although the primary habitat of Bornean orangutans is described as lowland old-growth and mosaic forests below 500m above sea level, scientists recently understood that they are thriving in the highly degraded forests landscapes. In fact, the majority of wild populations in Borneo are currently found in degraded forests and in forests that are still exploited for timber.

In recent years, there is a drastic decline in the orang utan population, driven by forest loss and fragmentation due to the conversion of their forest habitat to other types of land uses (eg. agriculture and mining), hunting due to conflicts and for bushmeat or traditional medicine.

Basic Anatomy of Digit

Orangutan are great apes with a look-alike hand anatomy with human primates. Their hand is made up of 5 digits, starting from 1st digit (thumb) to 5th digit (small finger). A digit is made up of phalanges, tendons, neurovascular bundles and surrounded by soft tissues with nail.

All digits of the hand have proximal phalange (P1), intermediate or middle phalange (P2), and distal phalange (P3) except the 1st digit, which is without an intermediate phalange. The P1 is connected to the metacarpal bone via metacarpophalangeal joints (MCP). The joint between P1 and P2 is called proximal interphalangeal joints (PIP) and between P2 and P3 is called distal interphalangeal joints (DIP). The 1st digit has a proximal and a distal phalanx connected by an interphalangeal joint (IP).

The dorsal long extensor tendon divides into a central slip that extends the PIP joint and then into two lateral bands that extend the DIP joint, where the insertion is at the dorsal base of P2 and dorsal base of P3 respectively. The volar tendons include the flexor digitorum profundus (FDP) and the flexor digitorum superficialis (FDS). The FDP tendon is runs dorsal to FDS tendon and decussates it to form Camper’s Chiasma at the level of P2. The FDP tendon’s insertion is then to the volar base of P2 and P3. The FDS tendon attaches to the base of the P2 and flexes the PIP joint.

The neurovascular bundle is located at the radius and ulnar sides of digit. The palmar digital nerve run parallel to the blood vessel. The common palmar digital arteries arise from superficial palmar arch which supplies blood to 2nd to 5th digit. The blood supply to the 2nd digit is shared with radial indicis artery which arise from the deep palmar arch, which also supplies blood to the 1st digit via the princeps pollicis artery.

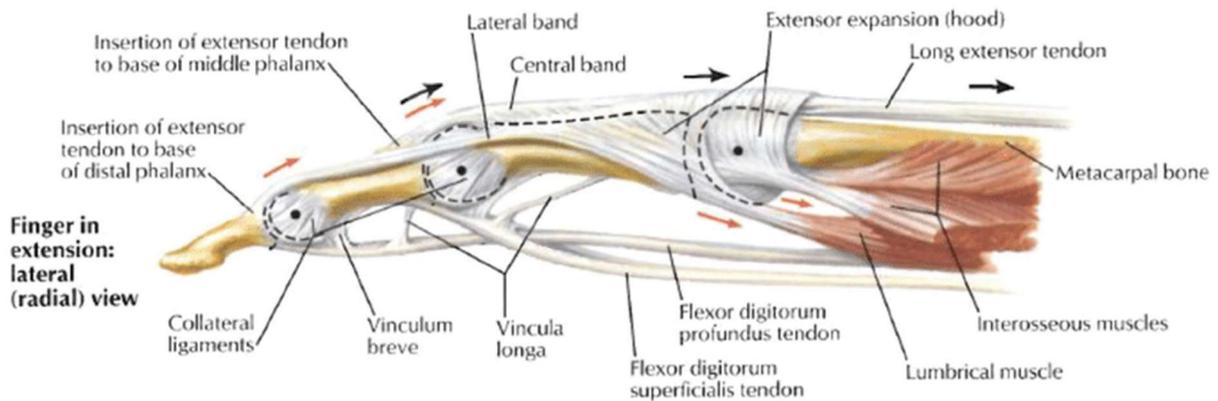


Figure 1 Phalanges, extensor and flexor tendons, ligaments

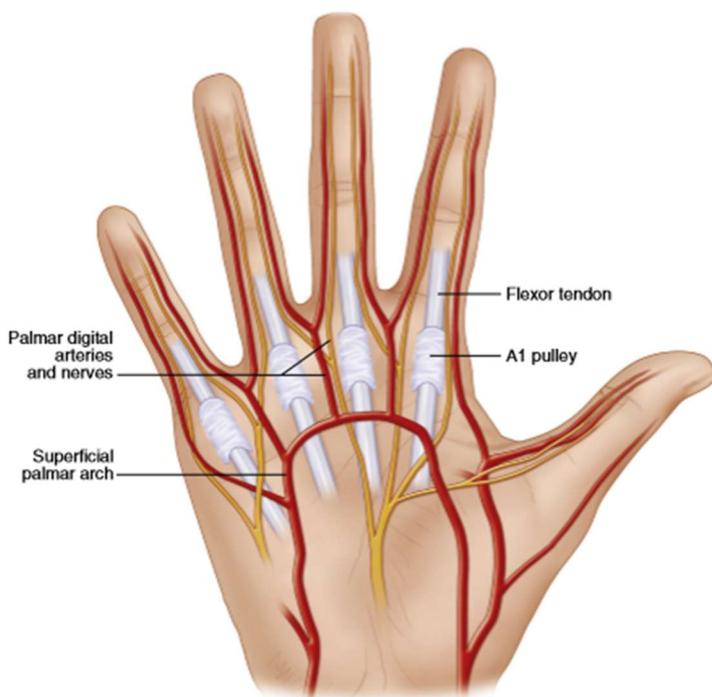


Figure 1 Neurovascular Network

Case Report

History

On 17/03/2020, a captive Bornean orangutan named Tiger with traits of a dominant male was seen to have an injured middle finger. The injury was believed to be caused by another free-ranging male orangutan in the vicinity, from the outside of Tiger’s cage. Their overlapping territory may have caused a conflict which resulted in a fight.

On 18/03/2020, Tiger was anaesthetized to perform wound cleaning and have a closer look of the injured finger. Upon physical examination, Tiger’s 3rd digit on the right hand had an open fracture with phalanges protruding out,

laceration extending to the core of the palm, infected and necrotizing tissues (Fig. 3). The wound was cleaned with antiseptics and topical antibiotic and an amputation procedure (Surgery 1) was scheduled.

Anaesthesia

On 23/03/2020, Tiger was anaesthetized for digital amputation procedure. The animal was fasted at least 12 hours prior to anaesthesia.

A premedication of 15mg midazolam was given P.O. by the keeper by mixing it with Seven Seas vitamin syrup. The sedative effect can be seen after 30 minutes when the animal was seen yawning and laying on its side on the enclosure floor. An induction dose of medetomidine 0.04 mg/kg, and ketamine 4mg/kg (previous record was used to determine body weight) was given via a CO2 powered blowpipe system (Telinject V.1, Germany) on the epaxial muscle. Animal was safely approached for transport 10 minutes after induction. A mouth gag was placed to keep the airway open during transport.

An IV catheter was placed on the cephalic vein for fluid and drug administration. Once the plane of anaesthesia was adequate for intubation, the animal was intubated in dorsal recumbency with the head extended off the edge of the table. This position helps to extend the neck to visualize the larynx and a size 10 ETT was introduced using a Macintosh laryngoscope blade. A capnograph was used to confirm ETT placement and chest auscultation performed to determine tube placement. Animal was given 100% oxygen via anaesthetic machine during surgical preparation and was maintained on isoflurane 2.5 – 3 % during surgical procedure. Heart rate and Oxygen saturation was monitored during surgical procedure via a pulse oximeter. Anaesthetic depth was monitored by assessing the pupillary light reflex and palpebral reflex.

For recovery, animal was placed on lateral recumbency in its enclosure and a reversal drug, Atipamezole 5 times the dose of medetomidine was given. ETT was removed and animal was monitored until recovered. Animal recovered 5 minutes after the reversal drug was given without complication.



Figure 3 The injury after treating with Vime-blue spray

Surgical Procedure

Tiger's hand was radiographed to evaluate the damage (Fig. 4). Based on the investigation, the final diagnosis was oblique fracture at the shaft of proximal phalanx (P1) of 3rd digit with secondary infection leading to soft tissue necrosis. Figure 5 is the author's hand radiograph taken recently after a motorbike accident, where a slight dislocation at metacarpophalangeal (MCP) joint of 1st digit and soft tissue swelling can be seen. The inclusion of this picture is to instantly observe the hand skeletal anatomy similarities of *Pongo pygmaeus* and *Homo sapiens*.

Digital nerve block was achieved with local anaesthetic drug, Lidocaine 2% (Fig. 6 & Fig. 7). A finger tourniquet was placed at the base of the 3rd digit to aid haemostasis. The surgical site was prepared aseptically. Devitalized skin, necrotic tissues and the bone fragment distal to the fracture was resected. The remaining P1 shaft end was trimmed to remove the sharp edges and to provide adequate durable coverage over the bony stump. The soft tissue proximal to fracture was selectively preserved to provide adequate soft tissue to close over the bone. Haemostasis of the bleeding arterial end of the digital vessel was achieved by the placement of mosquito forceps. The extensor and flexor tendon was pulled and divided as proximally as possible and allowed to retract into the palm. The nerves were then tunneled into the soft tissues to prevent painful neuromas. The palmar fascia and underlying tissues were sutured by buried Cushing sutures. The skin flap was closed over P1 stump and simple interrupted sutures were placed (Fig.8).

The surgical wound was healing well for 3 weeks with granulation (Fig.9). On 08/04/2020, Tiger was noticed to have the stump yet again mutilated (Fig.10). On 12/04/2020 The bone was exposed and a revision digital amputation (Surgery 2) was indicated.



Figure 4 Tiger's right-hand AP view



Figure 5 Roopan's left-hand PA view

The revision surgery warranted complete removal of the leftover P1 stump at the point of metacarpophalangeal (MCP) joint. On 12/04/2020, the revision surgery was conducted. After the removal of the P1 stump, the cartilage on the distal end of metacarpal bone was denuded prior to suturing. The lacerated wound was sutured with reinforcing buried cushioning sutures at the palmar fascia level followed by simple interrupted sutures at skin (Fig. 11).



Figure 6 Digital nerve block (Left)



Figure 7 Digital nerve block (Right)



Figure 8 Post-surgery 1 (Left)

Figure 9 Granulation post-surgery 1 healing (Right)





Figure 10 Mutilated surgical healing on 08/04/2020



Figure 11 Post-surgery 2



Figure 12 Photo taken on 27/05/2020

Prognosis

The prognosis was good. The wound healed well and the animal started adapting with 4 fingers on its right hand (Fig. 12). It could grab, climb, swing, and knuckle-walk without any complication.

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COMMON DISEASES OF FISH

by Anusia Nadarajan and Ali Anwar

In the first part of the newsletter, we highlighted diagnostic steps for disease investigation. For this part, we will discuss briefly some of the common diseases for both freshwater and saltwater fish. As in any other discipline, fish diseases are vast, ranging from management related, environment, nutrition and aetiology. In this newsletter, we will briefly talk about some common disease seen in practice. Several good references include BSAVA Manual of Ornamental Fish by Wildgoose and Fish Diseases & Treatment by Edward Noga.

Management Related

Management related diseases are related to the fish keeping practice in the tank or pond. Some common problems relating to improper fish keeping are:

High Stocking Density

Overcrowding in a pond or aquarium will lead to a variety of problems. The filtration system may be unable to cope with the nitrogenous waste caused by a large amount of waste. High stocking density leads to stress that will affect immunity and increases susceptibility to other diseases. Diagnosing high stocking density involves general observation, to determine if the tank or pond has too many fish. Water quality testing is performed to determine the level of nitrogenous waste. The most ideal way to overcome this issue is simply to reduce the number of fish in the pond or tank. Sometimes, this may not be applicable due to the limited resources of the client. An alternative is to provide more filtration systems to manage the nitrogenous waste.

Improper Stocking

Improper stocking refers to keeping inappropriate species of fish together. This may lead to predation, fighting and stress to the fish. Examples are keeping the quiet and sensitive discus cichlid together with the highly predatory and aggressive oscar fish. In my experience, you may be called to come to attend one or two inhabitants of the tank or pond that are not eating or continuously dying. History taking, general observation and some knowledge of fish keeping is important to determine if the fish species are suitable for this communal setting. Once the inappropriate species has been identified, the species need to be moved to another tank or pond.

Water Quality

An acute change of water quality such as a sudden increase of nitrogenous waste, fluctuation of pH, water temperature, salinity and decrease dissolved oxygen (DO) will manifest in sudden mass mortality or large numbers of fish with clinical signs of inappetence, lethargy, surface breathing and abnormal swimming. However, slow or gradual changes in water quality can result in subtle clinical signs. For example, Old Tank Syndrome refers to a tank in which there is accumulation of nitrogenous waste of fish due to poor filtration or not changing the water of the tank regularly. The fishes that are already in the tank can tolerate high nitrogenous waste level but these fishes may not have good growth or coloration due to chronic poor water quality. A telltale sign of Old Tank Syndrome is that each time the owner put in a new fish, the new fish will succumb within hours or days of being placed into the tank. This occurs because the new fish cannot tolerate the high levels of nitrogenous compound.

As mentioned in the previous article, water quality testing should always be part of disease investigation. Any abnormal water quality would be flagged during the test and the issue can be rectified by changing or treating the water (for low water pH). After stabilizing the water quality, it is time to identify the cause of water quality deterioration. You may need to check if they are feeding too much food which leads to degradation of uneaten food, leading to an increase in nitrogenous waste, a new cement place in a pond that leads to rise of water pH or practice of using tap water without treating the chlorine that leads to increase in chlorine or chloramine level. History Taking is crucial in identifying water quality related diseases.

Parasitic Disease of Fish

Even the healthiest fish can possibly carry pathogens with them, whether it's with a direct or indirect life cycle of parasites. Having a good knowledge about a specific fish host is important to help with the identification of specific parasites. Examination of fresh smears with live parasites is often diagnostic. There are a few groups of parasites that affect the fish, namely external and internal protistans (ciliates, flagellates, water molds) and metazoan parasites (helminths and crustaceans).

External Protistans

Ciliates have a very simple life cycle and are usually found within the epithelium. The most infamous organisms in this group is *Ichthyophthirius multifiliis* which causes White Spot Disease in Freshwater Fish and its counterpart, *Cryptocaryon irritans* which causes Marine Ich. These parasites are usually transmitted via direct exposure from species to species or from fomites. The parasite will encyst in the epithelial tissues of the gills, skin or fins which causes substantial damage. An outbreak of this disease in a public aquarium tank can be catastrophic.

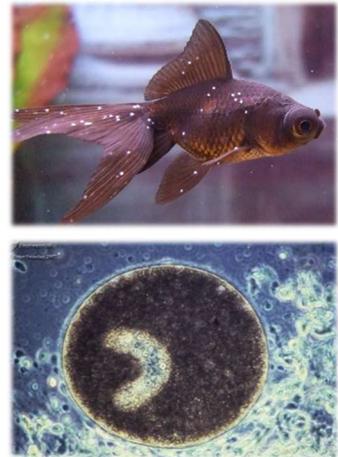
Parasitic dinoflagellates generally encountered in aquatic species are the *Amyloodinium spp* and its freshwater counterparts, *Piscinoodinium spp*. This disease is generally called rust, velvet or gold dust disease because of the powdery gold appearance on the skin of the animals. This parasite can be found on the skin or gills of the host fish. The parasite penetrates deep into the host epithelium and causes damage to the tissue. Respiratory signs will be observed first such as piping and gathering at the water inlet as the gills are damaged. Mortality can be sudden and high.

Oomycetes (water molds) share some morphological traits with true fungi. More frequent encounters of water mold are the Saprolegnia and Aphanomyces. Both are more associated with freshwater fish. It is not frequently seen in our region, and is more common in four-season countries with lower temperatures at certain times of the year. Oomycetes are classical saprophytic opportunists, multiplying on fishes that are physically injured, stressed or infected (Pickering and Willoughby, 1982a). This water mold commonly infect fish eggs and external tissues of fish. The cotton-like, white-greyish growth on the skin layer, is diagnosed through direct smear of the infected area.

Most of them are easily diagnosed with gill or skin biopsy. The organism can be identified using a light microscope with magnification of 40x or 100x and observing large non-septate filaments. Treatment choices include Hypo salinity treatment for marine tank (16ppt), Hyper salinity of 3-5ppt for freshwater aquarium and chemical treatment can be opted using formalin or hydrogen peroxide with 25mg/L dosage for 30 minutes bath. Chloroquine diphosphate with a dosage of 10-20 mg/L once had also been reported to be effective for water mold.

Internal Protistans

Coccidiosis is common in both freshwater and marine fish. Species that are commonly reported are the *Cryptosporidium spp.* and *Eimeria spp.* Freshwater fish such as gourami can be particularly susceptible. Rays are frequently presented with this infection, and it is advisable to treat and check in quarantine when stocking in. Animals can be presented with weight loss over time despite good appetite. Diagnosis is through fresh scrape of the intestinal sample and viewing under microscope. For a smaller sample, you can preserve the specimen of the gut to be sent for histology to reveal the macro and microgametes that adhere to the mucosa. Treatment is by using Totrazuril 10mg/kg/day, PO for 5 days.



Pic 1: Top, fish with white spots, typical clinical signs of white spot disease.

Bottom : Ichthyophthirius multifiliis under microscope.

Source:

<https://www.thesprucepets.com/treat-ichthyophthirius-multifiliis-1378482>
<https://alchetron.com/Ichthyophthirius-multifiliis>



Left: Adult *Gyrodactylus*; Right: Stained *Dactylogyrus* with 4 eye spots (arrow), X 200.

Pic 2: Differentiating *Dactylogyrus* and *Gyrodactylus*.

Source:

https://www.adfg.alaska.gov/static/species/disease/pdfs/fishdiseases/gyrodactylus_and_dactylogyrus.pdf

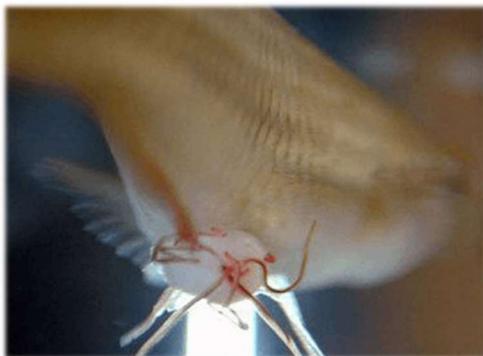
body against objects. Pale gills, rapid breathing, and localised ulceration are some of the clinical signs. According to the life cycle of these species, the treatment should be repeated accordingly using Praziquantel at 5mg/L prolonged bath. Freshwater bath or dip is only effective for adult monogeneans and not effective on the eggs.

Trematode Infection

These are also known as flukes and they have an indirect life cycle which involve several intermediate hosts. Fish can be intermediate or final hosts but there is usually involvement of molluscs as the intermediate host. Most of the cysts (metacercarial stage) can be found in fish, but it may not cause much harm. In freshwater fish, large numbers of digenean cyst are found in the gill tissue and causes impairment to the normal function of the cells. Management is usually to eliminate the source or intermediate host in the enclosure.



Pic 3: Top, Tapeworm infection in fish under microscope 4x mag.



Pic 4: *Camallanus* infection in guppy.

Source :

<https://www.myaquariumclub.com/treating-camallanus-worms-8289.html>

Nematodes

Most of the fish reared in aquariums or ponds will have nematode infestation, as some of the feed source serve as the intermediate host for the infection. A common nematode that infects guppies are the *Camallanus spp.* which can be seen protruding out from the anus.

Capillaria disease in freshwater fish is common as well. The clinical signs would be fish that are unthrifty and have poor growth. Diagnosis is usually via post mortem or live sample under a microscope. Treatment options include Fenbendazole 25mg/kg for 3 days or Levamisole 10mg/L in bath for 3 days treatment.

Crustaceans infection

Lernea spp. anchor worms are particularly common in freshwater fish that are reared in ponds. They have a multistage life cycle and common sites of infections include the skin, fins, gills and oral cavity. It damages the gills and causes skin ulceration, leading to secondary bacterial infection. Diagnosis is usually by observing the adult stage anchoring on the skin. Under microscope, paired egg sac can be seen. Other crustaceans e.g. *Argulus spp.*, are common too.

Management and treatment include removing the adult worm manually, cleaning the environment, raising the salinity to 5 ppt for 2-3 weeks and rechecking the condition. Other options are to use a chitin inhibitor, Diflubenzuron once at 0.03mg/L.



Pic 5: Top picture is Anchor worm with the egg sac. Bottom, Argulus can be seen with naked eye.

Source :

<https://www.lalaukan.com/2019/06/penyakit-ikan-lernea-cacing-jangkar.html>
<https://canalrivertrust.org.uk/enjoy-the-waterways/fishing/caring-for-our-fish/guide-to-fish-health/argulus-fish-louse>

Bacterial Infection

Outbreaks of bacterial disease are usually associated with poor water quality, high organic loading of the environment, handling and transport, high density and stressful conditions. Common bacteria that cause diseases in fish include the *Aeromonas* and *Pseudomonas spp.* in freshwater fish and *Vibrio spp.* in marine water fish. Diagnosis is based on culture and identification, while control is based on the removal of predisposing factors and antibiotic therapy, based on antibiotic sensitivity test.

Just to highlight, in aquariums, mycobacteriosis can be subclinical and can easily cause an outbreak in unfavorable conditions when the fish are low in immunity. These granulomatous diseases can be controlled and reduced using ultraviolet light treatment of the water. Clinical signs are always non-specific such as emaciation, ascites and ulceration. On post mortem, granulomas can be found in the kidney or spleen. Diagnosis is based on visualization of the bacteria under acid fast staining. This bacteria in particular can cause zoonotic infections, hence extra precaution should be taken while handling such cases.



Pic 6: Angelfish with fibromas on the lips.

Neoplastic Infection

Neoplasia cases in display aquariums are often associated with old age, viral infection and may sometimes be genetically induced. Cases might be under-reported and the confirmation of neoplastic disease is by using biopsy and ultrasound

Lymphocystis is a typical viral infection in wild or captive marine or freshwater fish caused by a virus from the Iridoviridae family. Infection is benign and have cauliflower-like lesions. Diagnosis is by using light microscope. The presence of enlarged fibroblast is confirmed by histology. The disease is usually self-limiting but it can be of aesthetic concern.

Viruses such as retrovirus are always associated with neoplasia in fishes. Encounters of angelfish with fibromas on the lips is typically viral induced. Removal of the tumor can help the fish to feed again. Often, it will regrow again.

Dartcraft: A Guide to the Art of Zoo Vet Survival Skill...

By Mohamed Reza Tarmizi

Working in zoos, we have all come to agree that many procedures in the field of zoological medicine was made possible with the development of remote drug delivery system (RDDS). The most basic and popularly available type of RDDS is the simple blowpipe dart system which is powered by the clinician's lungs. As pressurized CO₂ systems are becoming more available, blowpipes are used less frequently, however, they are still significantly useful. The blowpipe system is cheap, and can be accurate with practice and the beauty lies in its simplistic design. The heart of the blowpipe system is the blowdart which offers a silent and non-traumatic impact when used properly. However, there are disadvantages as they are frequently destroyed when bitten and have limited range and drug volume.

Historically, the light weight polypropylene dart was developed in Germany by inventor Werner Kullmann in early 1970's in response to the need of Fallow deer safe capture and transport. The invention was based on an application of the hydraulic principle where the injection liquid is under pressure that is sufficient for injection and was originally called "Automatic universal injection device" (Figure 1). This dart was the beginning of the Telinject darting system.

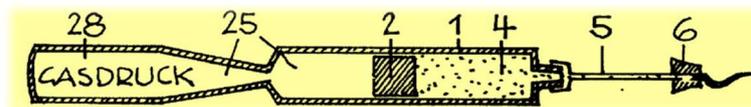


Figure 1. One of the blowdart drawings presented by Werner Kullmann in 1972.

When I started working in the zoo field in 2007, blowpipe darts were hand-made due to cost restrictions as the commercial darts were expensive. The most commonly handmade blowdart those days (maybe until today) were what we called the "mickey mouse dart 😊" (Figure 2). Making the dart has been described by Reddacliff (Reddacliff, 1979). However, to pressurize and depressurize the dart, a 25-gauge needle had to be used to puncture the rear plunger.



Figure 2. The commonly seen handmade blowdart as described by Reddacliff 1979. Photo taken from Veterinary Anesthetic and Monitoring Equipment (Wiley Blackwell).

This article is intended as a supplement to a recently published article on Low-cost Remote Drug Delivery Blow-dart for Veterinary Use (Journal of Wildlife and Parks, 35). The 3ml hand-made blowdart described follows the design of a Werner Kullman invention which resembles the commercial Telinject blowdart. The advantage is that

no needle is needed to pressurize/depressurize the blowdart and it is simpler in usage and maintenance. This pictorial supplement follows some minor upgrades to the original article to make a 3ml two chambered blowdart (Figure 4). The first section of this pictorial instruction will explain how the dart body is made (Figure 5.1-5.9). The second section will explain how the tailpiece is made (Figure 6.1-6.12). A more extensive explanation will be available in the original published article (please read). Do take note that this blowdart is strictly for lung powered blowpipe system only. It is my hope that this article would benefit in significant cost reduction when RDDS is required in local zoos and wildlife rehabilitation centers. Personally, this will add up to your survival skills in this field. Do note that this article should be used for non-commercial purposes.



Figure 4. The end product of this article.

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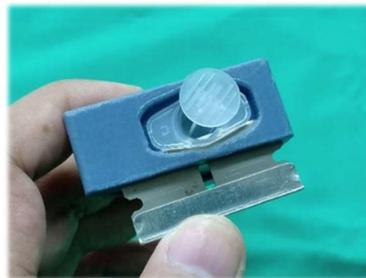
Supplementary materials

Syringe cutting jig with spacer STL file can be found at <https://www.thingiverse.com/thing:4634511>

Figure 5. Making the dart body.



5.1. Refer to original article for Bill of materials. To make the dart body, a 3ml BD syringes (Luer lock and Luer slip) is needed. The syringe cutting jig is 3D printed (files available at <https://www.thingiverse.com/thing:4634511>)



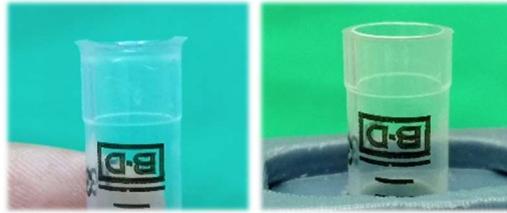
5.2. The drug chamber is made by trimming off Luer lock syringe flange using the syringe cutting jig top port. This will result in a rough cut.



5.3. Cut off the rod from the rubber plunger and replace back only the rubber plunger.



5.4. A finishing cut is made 5mm below the rough cut with a rolling motion.



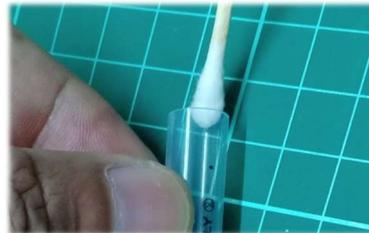
5.5. Comparison between a rough cut rim (left) to a finishing cut (right). It is crucial to get an even and smooth rim cut.



5.6. The air chamber is made by trimming off the Luer slip syringe flange using the syringe cutting jig side port with spacer. Cutting is done in a rolling motion. Discard the whole plunger.



5.7. Insert a silicone rubber plunger into the air chamber. Refer to the original article on how to acquire the silicone rubber plunger.



5.8. Apply a thin layer of xylene to the cut rims.



5.9. Apply heat to both rims using a ceramic soldering iron. Use the aluminum U channel as an alignment guide. While both rims are heated, roll each syringe until an even tubular shape is achieved. Press both rims against another to create a welded joint.

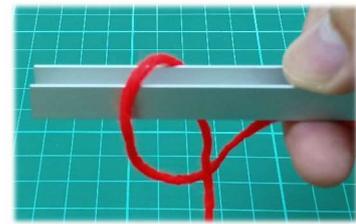
Figure 6. Making the tail piece.



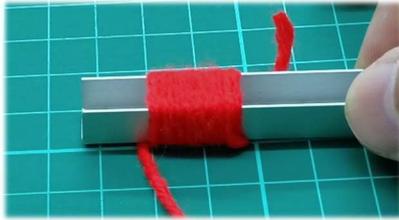
6.1. Instruments and material to make a tail piece. (From left) Fishing line, scissors, knitting yarn, fine comb, toothbrush, U channel, eyelets, Gorilla glue.



6.2. An eyelet holder is made by cutting a 1ml syringe flange and thumb press. A tail piece guide is made by cutting a 3ml syringe up at the 1ml mark (You can use the syringe cutting jig to do this)



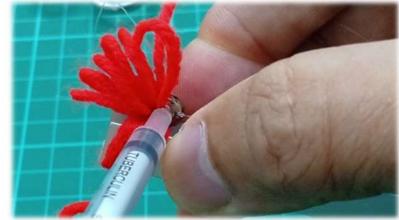
6.3. A yarn is cut to 70cm. An overhand loop is made around the U channel and tighten.



6.4. Following the overhand loop, make 12-15 loops along the U channel without overlaps.



6.5. Place a fishing line encircling the yarn loops followed by a slipknot. An eyelet is set between the fishing line and yarn loops assisted by the eyelet holder.



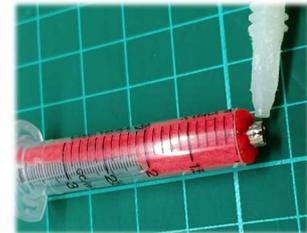
6.6. Pull taut the slipknot while pushing the yarn loops out of the U channel.



6.7. An even loop of yarn around the eyelet barrel will be created if done right. Remove the eyelet holder.



6.8. Flip over the loops and use the eyelet holder to hold the eyelet.



6.9. Expose the eyelet barrel by pushing the loops through the tail piece guide. Place a thin layer of Gorilla glue around the eyelet barrel.



6.10. Remove the tail piece guide and press the loops of yarn against the eyelet barrel. Let the glue to sit for 15 seconds.



6.11. Cut all the loop apex to form a single yarn. Use the tail piece guide to form the loop apex.



6.12. Use a fine comb to break the single yarns to single strands. Use a toothbrush to create a fluff. Trim of the fluff to form an arch shape.

WILDLIFE AND EXOTIC SPECIAL INTEREST GROUP (WESIG) AND MALAYSIAN ASSOCIATION OF ZOOLOGICAL MEDICINE (MAZM)

by Ali Anwar

The idea of creating an association for wildlife veterinarian in the country was conceived in the night of October 2016 in a 'Mamak' stall in Kota Kinabalu. As we drank our Teh Tarik (the all-time Malaysian favourite), we envisioned an association

that will lead Malaysian Wildlife Veterinarians to a higher level of medicine and skills, through continuous availability of programs and activities that builds foundations and knowledge. Four years on, with this pandemic, situations and tragedies in our midst, we go another year without an association for our fraternity.

There are many factors that lead to the delay and I am not going to mention about it today. Rather I will mention what I and a number of eager veterinarians did in response to this delay. Rather than just sit and wait for Malaysian Association of Zoological Medicine (MAZM) to register, we started organizing a number of activities to get things in motion. Hence the Wildlife and Exotic Special Interest Group (WESIG) was established. This unregistered association comprises of eager volunteers, leading programs that provide learning opportunities for wildlife and exotic veterinarians. We started with this newsletter in early 2018. This was followed by case sharing sessions, workshops, seminars, talks, clinical rounds and adhering to the new normal; webinars.

Personally, I think we did well, considering the fact that everyone involved in this effort were young and novices in the field. It is our sheer determination and belief to commit to our vision of "To Bring Community Together in Promoting Wildlife and Exotic Animal's Healthcare, Welfare and Conservation" that we beat the odds and were able to muster good programs for the fraternity. I am forever grateful to everyone that made this possible by being part of the team and also for those that supported the program. It was the overwhelming support from the masses that allowed us to continue our course!

Amidst the lockdown and restricted movement, the steering committee for the upcoming Malaysian Association of Zoological Medicine (MAZM) after close to 2 years of hiatus had organized a meeting for registration of the association. Complying with the global new normal, a meeting was organized in August via Zoom platform with a number of new committee members on

board. The outcome of the meeting was promising and by the grace of God, the fraternity will see the association up and running early next year. We hope the steering committee headed by Dr Kevin Lazarus and Dr Reuben can finally pilot this long overdue association to its establishment.

Speaking about the establishment of MAZM, I as the head editor of the My Wildlife Vets and WESIG, decided it is time for us to roll up our mat and place our 100 percent support to the steering committee. We believe WESIG had served its purpose, that is to provide activities for veterinarians as the steering committee are establishing an association. It certainly will not serve the best interest of the fraternity if two associations are running, as this may confuse everyone. We trust that the steering committee will uphold the wishes of the zoo, wildlife, exotic and aquarium veterinarians in the country, to see an association to lead and guide them. Finally, there will be one official voice for challenges faced by veterinarians in this field. We trust that the future committee members of MAZM will erase the race, gender and age stigmas that plague our fraternity (and our country as well). We hope MAZM will be the force in improving the life of veterinarians in this field, with support and continual capacity building opportunities. A more confident and knowledgeable veterinarian is essential in providing the best medical support and welfare needs to the animals under our care.

As for this unofficial newsletter, it's fate lies in the hands of the future committee members of MAZM. It is up to them to decide if this unofficial newsletter will be reinstated as an official newsletter

or another team and newsletter will be in place. Let us place hope in the decision of the future committee of MAZM. Do voice your interest or support if this newsletter should continue once MAZM is established. We are always happy to provide stories and cases to the community!

Another request for the readers and member of this small fraternity, please do your part in constantly asking for updates on the establishment of the association, and remind them of their commitment when they volunteer themselves to be the steering committee. Bill Gates once said, "if you are born poor it's not your mistake. But if you die poor it's your mistake." Taking the deep and far reaching meaning of this quote into consideration; it clearly points out that we ourselves are responsible for our destiny. Having said that, please continue to take charge in ensuring the association is established. I believe a number of people had put their trust on me, so I am now putting my trust on you my fellow Malaysian Zoological Medicine members! That's why for the last three years, WESIG toiled to provide opportunities for knowledge and learning with everyone.

Finally, I wish to thank all that made this newsletter possible, starting with my two highly efficient editors Dr Sarah Chong and Dr Caroline Ho who without fail amidst their busy schedule, assisted me with the editing of the newsletter. Miss Egnest Amat and Mr Rustam, who for the last few editions made this newsletter look sleek and smart. To the many contributors of the newsletter article, especially Dr Reza Tarmizi, who without fail have inspiring articles that rekindle our spirits to see major wildlife work done in the remote parts of Borneo. There are many others I'd like to thank over these three years, such as Dr Boon Nie, Dr Pakeeyaraj, Dr Roopan, Dr Nabila, Dr Bryan Lazarus, Dr Vellan, Dr Lee Jie Min, Prof Jalila, Dr Chen Hui Cheng, Dr Kavitha, Dr Eve Foong, Dr Charisha, Dr Donny, Dr Felix, Dr Anusia, Dr Vijay and many others that I haven't named in this article. Your support, wishes and efforts are truly a blessing from God, and your support to WESIG helped us achieve the impossible.

With MAZM in the final stage of establishment, it is time for both My Wildlife Vet and WESIG to sing its Swan Song. Rather than just sing a sad song as we depart; I'd like to share a picture that I took as I climbed Mt Kinabalu last year. The picture that you see below was taken when I was at the peak of Mt Kinabalu with the rising sun shining at my back. What looks like another mountain is actually the shadow of Mt Kinabalu. For all who supported us, especially those who assisted with WESIG's programs, the shadow represents WESIG's achievement. So ladies and gentlemen, we have achieved a great deal and the legacy that we left is like the shadow in the picture. It is huge, and sometimes we don't notice if we don't look at the right direction. Thank you everyone for allowing WESIG to leave a huge legacy in our lives for the past three years!

