CULTURE AND SENSITIVITY STUDIES ON EXUDATIVE DERMATITIS OF COMMON BRUSH TAIL POSSUMS IN TOWNSVILLE

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Abstract
This study was undertaken to gain more understanding of the causal agents of "Exudative Dermatitis" often called "Stress Dermatitis" and "Staff Dermatitis". The study aimed to determine the common causative agents and to see if there was some way to tell visually what the main organisms were likely to be and to select the correct treatment without going to the expense of laboratory culture and sensitivity testing.

Following a paper in 2006 (2006 awrc.org.au) on this subject we have come across a number of cases that do not respond to our standard treatment and believed that C&S studies were needed to elucidate just what bacterial agents were involved. There is some information published to say that *Staphylococcus aureus* was the most serious pathogen in brush tail possums. (Ladds, 2009) *Staphylococcus aureus* is noted as the main cause of exudative dermatitis in brush tail possums as well as P*seudomonas* by(Johnson &Hemsley)
Anyone who rehabilitates many possums has seen this condition in its many various stages. This condition appears to most frequently start with very minor lesions on the face especially around the lips and eyes. Why are these areas affected? It is probably because these are moist areas. Face lesions may start off as very minor scratches from fighting in adults. These areas coalesce and spread to the typical presentation where the eyelids are swollen and closed and moist exudative lesions with crusts are extensive on the face and because possums groom they spread to the base of tail and hind and front legs. Lesions can become progressively worse with loss of skin architecture and with deep ulcers developing. Deep ulcers exude serum and protein and the physical condition of the animal gradually deteriorates.

In our study 30 more severely affected animals came in for treatment over an 18 month period to June 2012 and were swabbed and culture sensitivity studies were carried out by Qld. Medical Laboratory to determine genus and species of the causal agents. Generally photos were taken by Jenelle and she carried out treatment and rehabilitation. This was less than half of what we see as we treat many possums in their own habitat using a single course or occasionally a double course of Ceclor antibiotic.
This study looked at the more severely affected animals.

Method.

Generally most animals were brought in by members of the public to Dr Pollock for treatment or they were collected from schools, industrial bins, vet clinics or homes at the request of MOP or vets. Jenelle collected most and swabbed and treated the possums while Jim Pollock consulted on and provided the drugs for treatment and organised the data. Jenelle did most of the photography and day to day treatments and rehabilitation.

Of thirty animals the following organisms were found

- *Staphylococcus aureus*
- *Staphylococcus sciuri*
- *Staphylococcus intermedius*
- *Staphylococcus simulans*
- *Streptococcus agalactiae*
- *Pseudomonas aeruginosa*
- *Candida yeasts*
- Mixed Enteric Flora
- *Proteus mirabilis*
- *Klebsiella pneumoniae*

2 Negative swabs: Extensive lesions were healing naturally and no organisms were found but were typical cases

21 Coag positive *Staphylococcus aureus*: *Staph aureus* or “Golden Staph” is a normal commensal of the skin of most animals and usually without disease.
It usually requires an initiating cause to start an infection e.g. a scratch and is more likely to occur under stress such as breeding season, over population or nutritional stress caused by natural disasters, cyclone, fires and droughts.
In only 7 cases was this the only organism cultured. All the rest had additional organisms. Candida yeasts were present in 6 cases, *Streptococcus agalactiae* twice, Pseudomonas in 4 cases, *Proteus mirabilis* in one case, *Klebsiella pneumoniae* in one case and mixed enteric flora in five cases.
This bacteria is by far the most common cause of this condition. This bacteria is the primary bacteria for the development of Methacillin resistance

2 *Staphylococcus intermedius*: *Staph intermedius* is again a normal commensal on the skin of many animals. It is the major isolate from pyoderma and occasionally other pyogenic infections in dogs and cats (cat bite abscess) and a rare cause of infection in other species. (The dog Staph. intermedius is now called Staph. pseudo intermedius)
Both cases had *Streptococcus agalactiae*, both had *Candida* sp yeasts one had *Pseudomonas aeruginosa* and both ended up being euthanased. I believe this bacterium could be a primary infection.

3 *Staphylococcus sciuri*: *Staph sciuri* is a less common commensal of the coat of marsupials. In human medicine it has a propensity to develop methicillin resistance and can be a problem.
In one case it was the only organism, in one case with *Staph aureus*, and the third case with *Streptococcus agalactiae* and *Pseudomonas aeruginosa*. Can be a primary invader.

5 Beta Haemolytic *Streptococcus agalactiae*. Infection with **Group B Streptococcus** (**GBS**), also known as ‘*Streptococcus agalactiae'* and more colloquially as Strep B and group B Strep, can cause serious illness and sometimes death, especially in newborn infants, the elderly, and patients with compromised immune systems. Group *B streptococci* are also prominent veterinary pathogens, because they can cause bovine mastitis (inflammation of the udder) in dairy cows. The species name "*agalactiae*" meaning "no milk” alludes to this.
Of those cases with Strep. agalactiae 2 cases with *Staph intermedius* and *candida* both were euthanased, 2 had *Staph aureus* and one had *Staphylococcus sciuri*. I believe this is mainly a secondary invader but it should be noted that Strep.agalactiae is known to cause septicaemia and meningitis in many animals. It is an inhabitant of the upper respiratory tract and female vagina. It is known for its ability to gain entry to

the blood stream and cause septicaemia. It may be the reason two cases were so sick that they were euthanased.

***1 Staphylococcus simulans*:** Only one isolate and is probably an opportunistic invader. Not listed as found in "Bacterial Diseases of Terrestrial Mammals" chapter in "Pathology of Australian Native Animals". As it was the only isolate it probably caused the disease.

6. *Pseudomonas aeruginosa*: *Pseudomonas aeruginosa* is an opportunistic pathogen, meaning that it exploits some break in the host defences to initiate an infection. In fact, *P. aeruginosa* is the epitome of an opportunistic pathogen of humans. The bacterium almost never infects uncompromised tissues, yet there is hardly any tissue that it cannot infect if the tissue defences are compromised in some manner. Four of these had Staph aureus and four had *Candida* yeasts, two cases had *Staph intermedius*, and 1 case had *Strep. agalactiae*, one had mixed enteric flora and one had *Proteus mirabilis*. There were always other bacteria.

8 *Candida* species: One university parasitologist once told me that "The world is covered with a fine patina of candida" i.e it's everywhere and mostly not causing a problem.
Usually we found that if we treated the bacterial skin infections the yeasts disappeared themselves. Although if we smelt a yeast smell we gave some Nilstat orally for 3 days. None occurred as a single infection four were with *Staphylococcus aureus*, two with *Staph intermedius*, two with *Strep agalactiae* and two with Mixed enteric flora.

6 Mixed enteric flora: Mixed Enteric Flora basically indicates faecal contamination of existing skin lesions. Ulcers and wounds are often colonised by enteric flora. *Enterococcus* was identified once, *Enterococcus faecalis* – formerly classified as part of the Group D Streptococcus system – is a Gram-positive, commensal bacterium inhabiting the gastrointestinal tract of humans and other mammals.
Four were with *Staff aureus* alone, one with *Candida* alone and the last one with *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

2 Proteus mirabilis: *Proteus mirabilis is* a common inhabitant of animal faecal material found particularly in infections of the eye, skin, urinary and respiratory tract in humans
In skin infections it is probably just due to faecal contamination of existing lesions. Only 2 cases either with *Staphylococcus aureus* or *Staphylococcus intermedius*

1 Klebsiella pneumoniae: *Klebsiella pneumoniae* is a Gram negative, non-motile, encapsulated, lactose fermenting, facultative anaerobic, rod shaped bacterium found in the normal flora of the mouth, skin, and intestines. Most likely a secondary invader
Only one case found and it also had *Staph aureus*

What does it all mean?
26/30 (78%) had *Staphylococcal* infection 20/26 (77%) are *Staph aureus*
5/30 17%) had *Streptococcal agalactiae* but always associated with a staph infection (2 cases euthanased)
6/30 (20%)had *Pseudomonas aeruginosa* but always associated with a *Staph* infection (2 euthasased)
8/30 (27%) had *Candida* yeast skin infections 7/8 (88%) always associated with a *Staph* infection the remaining one associated with a mixed enteric flora.
5/30 (17%) had Mixed enteric flora 4/5 (80%) always associated with a *Staph* infection
The other associated with *Candida*.

1/30 (3%) had Klebsiella or Proteus and always associated with a *Staph* infection.

When looking at the results it appears that *Staphylococcal* infection is the underlying cause and was involved in 78% of cases. If we just treat this organism, most will heal up and apart from those severe cases with secondary Pseudomonas aeruginosa infections this holds true

SENSITIVITY TESTING

Antibiotic Sensitivity
Staph aureus

***Stafflococcus aurius* Coag +**																		
CASE NUMBER	**1**	**3**	**7**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**17**	**18**	**19**	**22**	**23**	**24 B**	**27**	**27 A**
Ampicillin Amoxicillin	S	S		S	S	S	S	S	S	R	S	S	S	S	S	S	S	S
Ceftazadime																		
Cephalexin	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Gentamicin			S				S											
Fusidic Acid			S															
Neomycin			S															
Pollymyxin B																		
Clindamycin	S	S		R	S	S	S	S	S	S	S	R	S	S	S	S	S	S
Tetracycline	S	S		S	S	S	S	S	S	S	S	S	S	S		S	S	S
Timentin							S											S
Tobramycin							S											
Sulpha/Trimeth	S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Enrofloxacin	S	S	S	S	S	S	S	S	S	S	S	S		S	S	S	S	S
Clavulan/Amox	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Chloramphenicole		S										S	S					

Antibiotic Sensitivity
Other *Staph species and Streptococcus*

Staphlococcus intermedius			***Staphloccus sciuri Coag -ve***		***Staphloccus simulans***			**Beta Haemolytic *Strepyococcus***					
Case Number	**4**	**8**	**Case Number**	**6**	**Case Number**	**6**	**12**	**Case Number**	**1**	**4**	**8**	**11**	**12**
Ampicillin Amoxicillin			Ampicillin Amoxicillin	S	Ampicillin Amoxicillin	S	S	Ampicillin Amoxicillin	S			S	
Ceftazadime			Ceftazadime		Ceftazadime			Ceftazadime					
Chloramphenicol	S	S	Chloramphenicol	S	Chloramphenicol	S		Chloramphenicol		S	S		S
Cephalexin	S	S	Cephalexin	S	Cephalexin	S	S	Cephalexin	S	S	S	S	S
Gentamicin	S	S	Gentamicin	S	Gentamicin	S	S	Gentamicin		R	R		R
Fusidic Acid	S	S	Fusidic Acid	S	Fusidic Acid	S		Fusidic Acid		S	S		
Neomycin	S	S	Neomycin	S	Neomycin	S		Neomycin		R	R		
Polymyxin B	R	R	Polymyxin B		Polymyxin B			Polymyxin B		R	R		
Clindamycin			Clindamycin		Clindamycin		S	Clindamycin	S			S	S
Tetracycline			Tetracycline		Tetracycline		S	Tetracycline	S			S	S
Timentin			Timentin		Timentin		S	Timentin					S
Tobramycin			Tobramycin		Tobramycin		S	Tobramycin					R
Sulpha/Trimeth			Sulpha/Trimeth		Sulpha/Trimeth		S	Sulpha/Trimeth	S			S	S
Enrofloxacin	S	S	Enrofloxacin	S	Enrofloxacin	S	S	Enrofloxacin	S	S	S	S	S
Clavulan/Amox	S		Clavulan/Amox	S	Clavulan/Amox	S	S	Clavulan/Amo	S	S	S	S	S

Antibiotic Sensitivity
Enteric Flora, *Proteus* and *Klebsiella*

Enteric Flora						**Proteus mirabilis**			**Klebsiella Pneumoniae**	
Case Number	**5**	**7**	**10**	**15**	**27A**	**Case Number**	**4**	**14**	**CASE NUMBER**	**26**
Ampicillin Amoxicillin	S	/	/	/	/	Ampicillin Amoxicillin	S		Ampi/Amoxacillin	R
Ceftazadime		/	/	/	/	Ceftazadime		S		
Cephalexin	R	/	/	/	/	Cephalexin	S	S	Cephlexin	S
Gentamicin		/	/	/	/	Gentamicin	R	S	Gentamycin	S
Clindamycin	S	/	/	/	/	Clindamycin				
Tetracycline	S	/	/	/	/	Tetracycline	R		Tetracycline	S
Timentin		/	/	/	/	Timentin				
Tobramycin		/	/	/	/	Tobramycin				
Sulpha/Trimeth	R	/	/	/	/	Sulpha/Trimeth	S			
Enrofloxacin	S	/	/	/	/	Enrofloxacin	S		Enrofloxacin	S
Clavulan/Amox	S	/	/	/	/	Clavulan/Amox	S	S	Clavulan/Amoxil	S
						Fusidic Acid		R		
						Neomycin		S		
						Poly Mixin		R		
							No Hope	Pop Eye		
							EUTH	**EUTH**		

Antibiotic Sensitivity
Pseudomonas aeruginosa

Pseudomonas aeruginosa

Case Number	8	9	12	14	24B	27A
Ampicillin Amoxicillin		R	R		R	R
Chloramphenicol	R					
AmIkacin		R				S
Ceftazadime injection only	S	S	S	S		S
Cephalexin	R	R	R	R	R	R
Gentamicin	S	R	S	S	S	S
Fusidic Acid	R			R		
Neomycin	R			R		
Polymyxin B	S			S		
Clindamycin			R			
Tetracycline		S	R			R
Timentin			S			R
Tobramycin			S	S		
Sulpha/Trimeth		R	R		R	R
Enrofloxacin	S	S	S	S	S	S
Clavulan/Amox	R	R	R	R	R	R
	Sad Sally	Bruce Lee	Rapunzel	Pop Eye	24B	27A
	EUTH			**EUTH**		

TREATMENT

Our standard treatment for this condition was to place the animal on “Ceclor” or “Keflor” Cefaclor monohydrate. I have been using this drug of choice for over 20 years and have found it superior to all other drugs on the market. This strawberry flavoured antibiotic is highly palatable and I have yet to find a possum that does not like it. 2000 possums can’t be wrong.

Unfortunately it is packaged for human use only and I buy the stronger strength “Ceclor” or “Keflor” 250mg/5ml. The drug comes as a powder and we weigh it out using a micro scale into a pill vial. The powder is weighed in 15 aliquots of about 3.2 grams.This powder will keep for months. Once made up with 10mls of pre-boiled or sterile water it is good for 14 days if kept in fridge. Usually we make up a few half amounts that we add 5 ml of water to and this is great for pinkie and very small possums where we would throw away a lot of the 10 mls

The dose is 1 ml /2kg possum or 0.1ml per 200grams of possum
We see staff infections in hand reared and wild possums that are only 350 grams so the dose is only 0.2ml and 5mls of drug will give 25 doses with less wastage.

. Strictly speaking these packs are not meant to be broken up into smaller units so this is an “OFF LABEL USE”. This is an S4 drug and can only be dispensed by a veterinarian for animals under his care.

Amoxil/Clavulanic acid “Clavulox”
It is also possible to do this with Clavulox (Amoxil/Clavulanic acid) powder to make up smaller amounts of suspension. The veterinary Clavulox drops make up 15mls and the dose rate is 1ml/5kg or 0.4ml for a 2kg possum. There is enough drug to give 3 possums a 12 day course so you could possibly weigh the powder into 3 aliquots and add 4 mls of water giving 5 mls of made up drug .
There is a human preparation that renders 250mg / 5ml and this can be treated similarly to Ceclor to get many courses of the drug for minimal cost.

In our hands Ceclor was effective in treating all cases save those six where five were too advanced and were in so poor a condition that they were put down usually in the first 24-48hrs, one was euthanased at 7 days.

All our animals were put on Ceclor and we would wait for the Lab work to come back. Usually we would get a preliminary report just saying that it was a Coag pos *Staphloccal* or a gram neg bacillus and a few days later it would be confirmed as *Staph aurius* and *Pseudomonas aeruginosa*
After the first 6 months we told the lab to not send a prelim report and that we would rather wait to get the final definitive report.

Enrofloxacin

Usually if we had a Pseudomonas we would be noticing a poor or slow response and were not surprised by the report when it arrived. We did notice some improvement in all animals on Ceclor but it seemed to stall after a few days and then there was no further improvement. Once placed on Enrofloxacin (Baytril, Entrotril) there was a very rapid response.

Enrofloxacin was effective on C&S for 100% of organisms but our experience has shown that when applied as the first drug of choice a good percentage of animals do not respond quickly and we have had many animals that were treated by other veterinary clinics show a poor response to treatment after 5-7 days and as soon as the animals were changed to Ceclor the response was a rapid and marked improvement to complete healing.
Enrofloxacin was primarily designed to treat gram negative bacteria and as with many synthetic drugs when this happens if's efficacy against gram positive bacteria can be decreased and it is not the most effective for staphylococcal infections..

I believe Enrofloxacin is a wonderful drug but I do not use it because the other group of drugs Cefaclor and amoxil/clavulanic acid are better when treating *Staph* and *Strep* infections and I like to use enrofloxacin to treat more difficult organisms like Pseudomonas. If we start using Enrofloxacin as our first choice to treat everything then we are more likely to get resistance developing to this class of drug. The good thing is that all vet clinics stock it and it is one of the few antibiotics that can be used for Pseudomonas that is in an oral form.

Ceftazidime is a third-generation cephalosporin antibiotic. Like other third-generation cephalosporins, it has broad spectrum activity against Gram-positive and Gram-negative bacteria. Unlike most third-generation agents, it is active against *Pseudomonas aeruginosa*; however it has weaker activity against Gram-positive microorganisms and is not used for such infections. It is only available as an injection and once a vial is made up must be used immediately.

Convenia (cefovecin sodium and and is the first antimicrobial for the treatment of common bacterial skin infections in cats and dogs that provides an assured course of treatment in a single injection because it offers 100% compliance. Convenia at a dose rate of 8mg/kg (1ml/10kg) provides up to 14 days of treatment in just one dose. This drug has only been on the market the last few years and has been used on a few possums with Exudative dermatitis. Some have responded well and a few others had to be supported on Ceclor to achieve treatment.
Convenia is a third generation cephalosporin that again has a wide spectrum of gram +ve and gram –ve bacteria that may be less efficient against the common Staph. It has not been used on enough cases for us to give a critique on its performance but there is value in a drug that gives 14 days of treatment following a single injection e.g, trap, treat and release a.s.a.p.

Conclusion Can we determine visually if an animal is most likely to respond to our standard treatment from an animal that is likely to have secondary Pseudomonas infection and is going to need Enrofloxacin to treat it?

I can summarise our findings in the following table

***Pseudomonas* Cases**	***Staph/Strep* Cases**
Almost all cases with Pseudomonas were well advanced and in very poor body condition.	In most cases the body condition was good
The skin condition was more generalised	The skin lesions were localised and the coat in other areas was normal and healthy
The hair was sparce and easily pulled out	The hair in other areas dense and did not pull out easily
Poor or limited response to treatment with Ceclor or Clavulox	Excellent and rapid response to Ceclor or Clavulox

Happy treating

Jim Pollock BVSc and Jenelle Gay
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Dr Jim Pollock Graduated 1967. Jim spent 4 years Commonwealth DPI, 34 years Private practice always treating wildlife free. Semi retired 10 years ago from small animal practice but is still treating wildlife. Awarded an OAM in 2011 for “Contribution to Wildlife Conservation”

Jenelle Gay is an experienced member of North Queensland Wildlife Care having treated and reared a huge number of possums as well as other species. She is a dental surgical nurse by profession and her clinical training has helped her with the medical treatment of all the diseased possums that she has handled. Jenelle has performed the majority of the rehabilitation of the cases presented here.