Leeches

"The Australian Land Leech"

Host: C.Gerschicus Leech: Chtonobdella limbata
Location Berowra, NSW

This is an educational aide memoir and does not represent any medical advice. For that you need to see a qualified medical practitioner, ideally familiar with trekking and other outdoors activities.

Version 1.1

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The McGee Leech Dance

So named after Michael "McGee" who reacted with energetic slap dancing at the *thought* of an attached leech, let alone the real presence of one…

The Australian Land Leech

About 650 leech species have been identified around the world, but the good news is that very few of them are equipped to take blood from mammals. They exist in every environment except the polar regions, and are never found above 3,700m/12,139'. While there are many types of leeches in eastern Australia, the leech most commonly encountered in the Australian bush is the rather unimaginatively named the "Australian Land Leech". Not the Tiger Leech, or even the Blue Striped Upper Volta Bloodsucker or anything remotely creative. It makes up for its droll name by having a unique way of cutting into its host and, in being unique is at least consistent with so much of Australia's fauna. We can't be similar or the same. We just have to be that little bit different. Specifically, while all other leeches usually have three jaws and make a three piece cut which some liken to the Mercedes Benz star, the Australian Land Leech has two jaws and makes a V shaped incision.

This species was described in 1866 by the Polish naturalist Adolph Eduard Grube. The name *Gnatbobdellida libbata* sometimes appears as the name for the "Australian Land leech".[1] Around Sydney the local leech species is the Chtonobdella limbata[2].

What is a Leech?

We all know them as something that makes us shiver (or slap dance). But if we can get past the squeamish factor we can understand these animals to be remarkable beasts worthy of at least a modicum of admiration. Let's face it, any animal with two brains is worth at least a second look. They are generally portrayed in a poor light in

[1] https://en.wikipedia.org/wiki/Chtonobdella_limbata retrieved 28 June 2017

[2] Atlas of Living Australia http://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:902eba30-001c-4291-8d73-594af4bb7c2e#overview retrieved 28 June 2017

the context of blood letting medical practises, but today they are enjoying a resurgence, at least in medicine, in areas such as reconstructive and cosmetic surgery[3] where they are used to manage bruising, and may even have some role to play in the relief of migraines.[4] Our Chinese friends still use them for various medical therapies. They are most commonly found in fresh water, but also survive in salt water and, like the Australian Land Leech, can be quite happy in moist vegetation.

Leeches are blood sucking worms with segmented bodies and belong to the same large classification of worms as earthworms. They are primarily found in freshwater lakes, ponds or rivers, range in size from 5mm to nearly 25 cm (!) and have two characteristic suckers located at either end of their bodies. The leech has a three part digestive tract and a distributed nervous system – it has a 'brain' at the front and one at the back of its body. Its body is covered in a layer of tissue that contains sensory and mucous cells, which in turn is covered with a cuticle which the leech moults on a regular basis. There is no respiratory system but breathes through its skin.

Locomotion

The leech has two suckers, one at each end both of which are used by the leech to propel itself along firm surfaces. On the ground, it moves by affixing the rear sucker and then extending its body to attach the front sucker. It then detaches the rear disc and contracts on its point of support to move the rear part of the body towards the front sucker before re-applying the rear sucker.

Senses

It's something of a mystery to a bushwalker as to how a leech discovers its prey. They seem to drop out of nowhere, although in some cases such as our walk up Yatala Creek (above Cowan Creek, Berowra) dozens of leechs seemed to be migrating across the track,

[3] Host Matters: Medicinal Leech Digestive-Tract Symbionts and Their Pathogenic Potential
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[4] Can Leech Therapy Be Used as an Alternative Treatment for Controlling Migraine Headache? A Pilot Study
Mahmoud Bakhshi, Babak Jalalian, Maryam Valian, Saeide Shariati, Tahere Saeidi, Hossein Ranjbar, Acta facultatis medicae Naissensis 2015;32(3):189-197

and avoiding having one attach to our boots was problematic. How do leeches find their next meal?

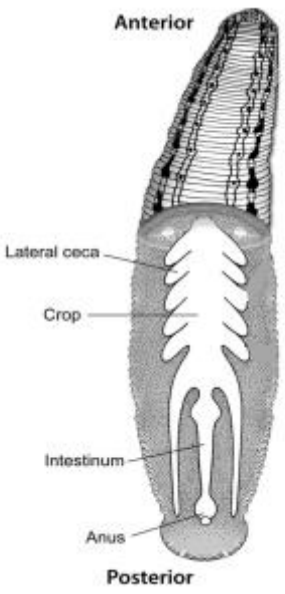
Leeches have five pairs of eyes. But it's highly unlikely they can see you and the eyes seem to be mainly used to stimulate responses to bright light, which they tend to avoid. They are sensitive to sounds, so perhaps the McGee shouting slap dance might have some sort of effect – but not sufficient to have them dislodge.

In water the leech will move towards potential hosts by detecting vibrations in the water. Vibrations on land may also attract them – the McGee dance may therefore not deter but rather encourage detection. But the major stimulus for the leech is heat, and it's your body heat to which they are attracted.

The sucker at the front includes a mouth, at the back of which are the jaws which contain rows of teeth, used for cutting the skin of its host. The leech prefers to attach itself to warm skin where it makes its cut. It draws blood through rhythmic contractions, and brings blood into its crop where it is stored until it is digested. Interestingly, the leech does not just 'eat' blood. Young leeches will feed on insect larvae and small molluscs. They may also feed on amphibian eggs, amphibians and fish.

Digestive Tract

The digestive tract is made up of three parts – the pharynx, crop and intestinum. The pharynx is a muscular section immediately behind the jaws and adjacent to the saliva glands. The throat, if you will. The crop is the largest component of the digestive tract. Your blood is immediately stored here and, while stored, water is extracted from it, a process assisted by pairs of bladders that sit alongside the crop. Osmolytes are also extracted. Given that osmolytes are compounds that impact osmosis and help cells maintain cell volume and fluid balance it makes sense these be removed as well as water. As water is drawn out of the blood cells the leech would not be well served by osmolytes drawing water back from its own body. The blood, sans water forms a viscous 'intraluminal fluid' (ALF).



This intraluminal fluid, described by some scientists as a 'syrupy fluid' is then digested in the intestinum over a period of weeks. Red blood cells can remain intact in the crop for a long period of time despite the presence of bacteria capable of destroying them. You will hear all sorts of periods quoted for a leech's time between drinks. Studies show that six months is about as long as they can survive.[5]

Saliva Chemistry

If you have had the pleasure of a leech attachment you will no doubt be familiar with the fact that you are never aware of the leech clinging on and making its cuts. They are often discovered when they naturally let go after taking the blood they need (after which they are incapable of biting again), or when you take off boots and socks or other clothing and discover, horror, that you have unwittingly been host to the Transylvania Red Striped Gnarly Leech and scream the house down. The leech achieves this surprise by anaethetising (see below) its host, using bio-compounds found in its saliva.

To appreciate the sophistication of what the leech does when it takes your precious blood you need to understand the basic process of what happens when you have an open cut. In the classic injury scenario (open wound, cut), coagulation or clot formation involves two processes that occur simultaneously to fill the vascular gap: platelet aggregation (primary haemostatis) and conversion of soluble fibrinogen into insoluble fibrinogen, as a result of a cascade of enzymatic reactions (plasma coagulation). Fibrogen is a complex protein chain involved in coagulation, one of its actions being to link platelets together by fusing each end of the chain to the surface of a platelet.

When the leech attaches itself to a warm portion of your skin a number of bio compounds get to work. The saliva glands produce two groups of secretions which are:

a. a mucous to help lubricate the bite site, and the jaws, and to hydrate your blood as it flows into the digestive tract, and

b. proteins which help ensure blood diffusion, dilation of your blood vessels, anticoagulation, and digestion. It's not

[5] Sawyer, R. T. (1986). Leech Biology and Behavior. Oxford, UK: Clarendon Press.

just about anticoagulants, on which we all usually focus as the blood flows freely from the wound site.

Having had the pleasure of being host to the Australian Land Leech, you will be familiar with the fact that blood can take a long time to stop flowing, the end result of a remarkable bio-compound called Hirudin. Hirudin is an anticoagulant which is very effective in preventing the digestion of proteins (antiprotease) while directly preventing the creation of thrombin. Thrombin is the enzyme critical to your blood being able to clot. But Hirudin does not act alone. The following chemicals are involved –and this is not an exhaustive list, given leech saliva contains about 100 pharmacologically active biological substances.[6]

- Platelet aggregation inhibitors. Leech saliva stops platelets from congregating and forming a clot.
- Calin. This is a protein which is believed to inhibit the ability of platelets to stick together.
- Apyrase. A chemical also shown to be a powerful preventer of platelet adhesion.
- Collagenase. This enzyme splits collagens which happen to be involved in activating platelet aggregation.
- A vasodilator substance which is not identified but is known to be a histamine type compound. This relaxes your veins making it easier for the leech to drain your blood.
- Leech saliva contains anti-inflammatory substances such as bdellins and eglins.[7]
- An anaesthetic? Actually, it is only assumed there is an anaesthetic since we don't usually feel the bite. No anaesthetic substance has yet to be identified.[8]

[6] Lone AH, Ahmad T, Anwar M, Habib S, Sofi G, Imam H. Leech Therapy- A Holistic Approach of Treatment in Unani (Greeko-Arab) Medicine. *Ancient Science of Life*. 2011;31(1):31-35.

[7] Efficacy of leech therapy in the management of osteoarthritis (Sandhivata)
P. K. Rai, Ph.D., A. K. Singh, Ph.D. Scholar, and A. K. Dwivedi, Ayu. 2011 Apr-Jun; 32(2): 213–217.

[8] http://leeches-medicinalis.com/the-leeches/biology/

Other Cool Stuff

While it is feeding almost all other functions (like locomotion) are suppressed.

It can take up to ten times its mass, after which it is sluggish (pun intended) and is reluctant to swim (heeding Mother's 'no swimming after eating' rule!) The amount of blood usually amounts to 5-10ml of blood (5ml is about a teaspoonful)

The leech has a remarkable stretch capability. They can be turned inside out, with their gut on the outside, and then turned inside out again and off they go. Mind you, survival after that would be problematic given the gut is probably stripped away in the process.

The leech is a hermaphrodite, meaning it contains both male and female reproductive organs. However they do need another leech with which to reproduce. A pair of leeches will swap sperm and the resultant eggs are stored in a mucous cocoon on the leech until they are ready to be deposited on the ground or in the water.

Danger to Humans and First Aid

Leeches have been used for centuries for medicinal and therapeutic purposes. In fact records suggest leechs have been used at least since 1500BC. A Greek doctor Nicander of Colophon used leeches for therapeutic purposes between 200-130 BC. Paintings of medicinal leeches have been found in pharaohs' tombs, while the Mayans and Azteks also applied leech therapy. It was also known in Ayurvedic medicine, described in Sushruta samhita. Dhanvantari, the Indian god of Ayurveda holds a leech in one of his four hands. In the English language *laece* once meant "doctor" or "leech", no doubt reflecting its use in medicine, rather than the medicine man's billing practises. During the 18th and 19th centuries their use to treat a wide range of aches and pains, including arthritis became very popular. Between 1829 and 1836 hospitals in Paris used 5-6million leeches, while St Bartholomews in London in 1832 used 97,300 leeches. Such intensive use of leeches led to a supply crisis in Europe.

"Contemporary leech therapy was pioneered by the surgeons, M Derganc and F Zdravic, who elucidated the use of leeches in tissue flap surgery in which a flap of skin is freed or rotated from an adjacent body area to cover a defect or injury. Their rationale behind the use of leeches was based on a unique property of the leech bite, namely, the creation of a puncture wound that bleeds for hours."[9] In 2004 the FDA approved the use of the *Hirudo medicinalis* leech as a medicinal leeches but the species used was misidentified and a second species, *Hirudo verbena*, was found to be used in error. The FDA approved the second leech type in 2007 which means two species are now approved for therapeutic use by the FDA.[10] The use of leeches in medicine is known as "hirudotherapy".

Many of these medicinal leeches are the product of leech farms rather than being harvested from the wild. So, on the face of it you should not be concerned about leeches being a threat. However we need to qualify this by noting that only those two leech types are approved for use as medicinal leeches. Those two types are not found in the Australian bush.

Nonetheless the use in medicine does underscore the general rule that leeches do not pose a health risk to human beings. The notion that they transmit diseases is unfounded but it's worth exploring our understanding of what that actually means.

Can Leeches Transmit Disease?

The real question should be "can I contract a disease from a leech?' because the answer to the broad question 'can leeches transmit disease?' is answered in the affirmative. Yes, a leech can transmit a disease. However, there is no evidence to suggest leeches are vectors for diseases that impact humans. Having said that there is evidence that a leech can onboard viruses contained in blood and re-transmit those same viruses. Tests with 'hog cholera' virus and myxoma virus (used to kill rabbits) show that the virus can survive in a leech gut for a long period of time. Those viruses don't

[9] Lone AH, Ahmad T, Anwar M, Habib S, Sofi G, Imam H. Leech Therapy- A Holistic Approach of Treatment in Unani (Greeko-Arab) Medicine. *Ancient Science of Life*. 2011;31(1):31-35.

[10] Maggots and leeches are the first living creatures to be approved by the FDA as medical devices. http://www.pharmacytimes.com/publications/issue/2005/2005-11/2005-11-5004 and https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpcd/classification.cfm?id=nrn

appear to enter either the leech tissue, or the leech saliva. Where the hog cholera virus (also known as 'Swine Fever') may have infected another hog it is likely through regurgitated blood.[11] The presence of trypanosomes, (malarial parasites), in the gut of jawless leeches has been noted, but jawed leeches do not appear to be hosts.

In more recent studies in Taiwan leeches are shown to carry the pathogen (a bacteria that can cause disease) *Bartonella,* which can infect humans and cause serious infections. But there is no evidence to show that the pathogen has been passed on to humans from any leech.[12] The same can be said about many other diseases which are suspected of being carried by the leech – the leech may carry the virus or the pathogen but has not been shown to pass the same on to humans.

One of the variables at play is the fact that while a virus or pathogen may last for some time in the gut of a leech, they eventually expire. And a leech with a full gut is not inclined to be looking for prey. Indeed, many of the studies which explore this issue are concerned with those leeches which are used for medical applications where they are repeatedly used. A leech in the scrub is only looking for you after it has digested its previous meal, after which time any virus or pathogen it might have picked up from its previous meal has been destroyed.

An example of this expiry is seen with a leech carrying the feline calicvirus virus. Feline calicivirus (FCV) is a virus which is one of the two important viral causes of respiratory infection in cats. The virus was carried into the leech via a meal of pig blood. The gradual expiry of the virus over a period of weeks is shown in the following table where the leech existed at a temperature of 10 degrees Celsius. When the temperature was raised to 30C (not shown) the expiry rate of the virus accelerated.[13]

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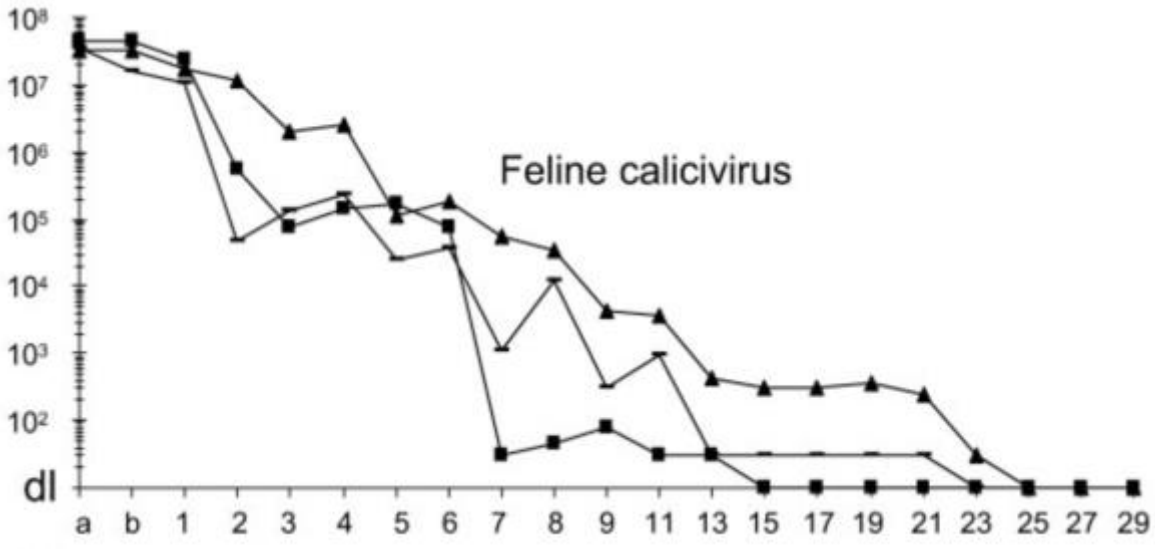
[11] Shope, R. E. "The Leech as a Potential Virus Reservoir" The Journal of Experimental Medicine, 1957, Vol.105(4), p.373-382

[12] Molecular detection of Bartonella spp. in terrestrial leeches (Haemadipsa rjukjuana) feeding on human and animal blood in Gageo-do, Republic of Korea, Jun-Gu Kang, Sohyun Won, Hye-Won Kim, Baek-Jun Kim, Bae-Keun Park, Tae-Seo Park, Hong-Yul Seo and Joon-Seok ChaeEmail author Parasites & Vectors20169:326 DOI: 10.1186/s13071-016-1613-3

[13] Tenacity of mammalian viruses in the gut of leeches fed with porcine blood, Ahmad Al-Khleif, Manfred Roth, Christian Menge, Jorg Heuser, Georg Baljer1and Werner Herbst. Journal of Medical Microbiology (2011), 60, 787–792



But I React to A Leech Bite

Allergy to leech bite is widely reported and our own walkers have experienced what appears to be an allergic reaction to a bite. If you do have a wound that doesn't heal and becomes infected, it makes sense to seek medical advice, depending on the severity of the reaction."[14] The presence of hirudin in the wound following a leech bite may cause oozing to continue for several hours. Although inconvenient, blood loss is not significant – only one to two teaspoons as noted above.

Leech gut bacteria can cause wound infection. "Complications of leech therapy occur in part due to bacterial infections, which are thought to originate from the microbial community of the … crop. The incidence of infections in the literature ranges from 2 to 36% of cases."[15] In the post-operative use of leeches this is closely monitored and dealt with by use of an appropriate antibiotic. There appears to be no support for the theory that mouthparts left behind after forced removal of the leech causes this reaction.

In our own experience of leech bites the site of the wound can start to heal over, but after two to three days acquire an itch, become

[14] Australian Museum, https://australianmuseum.net.au/leeches retrieved 28 June 2017 2214.

[15] Host Matters: Medicinal Leech Digestive-Tract Symbionts and Their Pathogenic Potential Jeremiah N. Marden, Emily A. McClure, Lidia Beka and Joerg Graf
http://journal.frontiersin.org/article/10.3389/fmicb.2016.01569/full

inflamed and have a slight infection which can take up to two weeks to settle down, if left alone and not treated with antibiotics. They are more an irritation than a threat to health.

So, while there is no evidence to show that diseases are transmitted by the Great Southern Yellow Racing Stripe McGee Leech of Berowra, or even by the Australian Land Leech, or that bacteria from their mouth or crop directly cause wound infections (as distinct from you having an allergic reaction from them), if you are not sure, it's best to treat a leech bite as you would for any small open wound. Keep it clean. Cover it up to prevent entry of dirt. There is no need to take any antibiotic. Place a pad over it to help you resist scratching the wound, if that helps you manage avoiding the inclination to scratch the itch. A McGee style slap dance may also help.