

# Therapeutic importance of leech and impact of leech in domestic animals

## Abstract

Leech therapy has been practiced for long time and it is still practiced in both human and Veterinary Medicine. Hirudotherapy is used in Veterinary Medicine, especially when traditional treatment is not effective, after surgery and when the tissue is threatened by venous congestion. The main objective of this seminar paper is to overview importance and prevalence of *Leeches* in Veterinary Medicine. The most common species of medicinal *Leech* are includes: *Hirudo medicinalis*, *Hirudo asiatica*, *Hirudomanellensis*, *Hirudo Orientals*, *Hirudo michaelsoni*, *Hirudo nipponia*, *Hirudo granulose* and *Macrobdelladecora*. Saliva of *Leech* contains various bioactive compounds such as: hirudin, hyaluronidase, calin, destabilase, apyrase, eglins, bdellins, decorsin, hirustatin, trypsin inhibitors, and histamine like substances, complement inhibitors, carboxypeptidase A- inhibitors and acetylcholine. Biochemical compound which secreted from saliva of *Leech* have various effects such as anticoagulant, vasodilator, thrombolytic, anti-inflammatory effect, analgesic properties, platelet inhibitory, increase blood flow, and thrombin regulatory functions, as well as matrix degradation and antimicrobial. Application of *Leech* therapy in Veterinary Medicine is primarily used to treat venous congestion during reconstructive surgery and to treat polycythemia. *Leech* therapy is not recommended for animals those are suffered from acute infection, anemia, and hemophilia, and immunosuppressant disease, cancer of skin, hypotension, pregnant animals and septic disorder. Prevalence of *Leech* infestation is higher in cattle followed by goats and sheep during dry season. Hirudiniasis is one of water associated disease which causes undetermined magnitude of socio economic losses in developing country. To sum up, *Leeches* are external parasite of animals which have therapeutic importance in both human and animal health, but also it has negative impacts on health of animals as well as human beings. Hirudotherapy have not been practiced in Ethiopia, therefore further studies should have to be applied on bioactive substance of *Leech* and its importance.

**Keywords:** Hirudotherapy, Hirudiniasis, *Leech*, Reconstructive Surgery, Venous congestion

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## Introduction

*Leech* therapy (Hirudotherapy) has been practiced for long time and it is known from the time of extreme antiquity and still practiced in both human and veterinary medicine.<sup>1</sup> Hirudotherapy is coined from Latin word which mean *Leech* therapy or treatment used by physician for patient.<sup>2</sup> Hippocrates introduced *Leech* therapy in Greece but the method was also known to ancient Mesopotamians, Egyptians and Aztecs, and Mayans. Medical *Leech* therapy is part of the concept of Greko-Arab Unani System of Medicine.<sup>3</sup> *Leeches* were named *Hirudo medicinalis* by Linnaeus in 1758.<sup>4</sup> Hirudotherapy is used in many countries such as; in German, America, China, Russia, England, Africa and ancient Egyptian from 1500 BC.<sup>5</sup> The bioactive substance present in mouth and throat of *Leech* was discovered by Hay craft (1857-1922), as he studied that the substance could prevented blood coagulation and it named this substance as hirudin in 1904.<sup>6,7</sup> Hirudin is still regarded as the most potent natural inhibitor of thrombin; it has high affinity for the protein.<sup>8</sup> Modern study of *Leech* therapy began in the 1960s, when medicinal *Leech* therapy achieved an international comeback, initially because of the spectacular results in plastic and reconstructive surgery for the treatment of postoperative venous congestion and graft rejections.<sup>9</sup> In recent years medical *Leech* therapy has gained increasing interest in reconstructive surgery and pain management and other medical fields.<sup>10</sup> Hirudotherapy is successfully used in Veterinary Medicine,

especially when traditional treatment is not effective, the effects of treatment are too slow, or after surgery, when the tissues threatened by venous congestion.<sup>11</sup> Saliva of medicinal *Leech* contains more than 100 bioactive substances which have therapeutic effects including anticoagulant, vasodilator, thrombolytic, anti inflammatory, analgesic and anesthetic effect.<sup>11,12</sup> As recently reported that, *Leech* have been used in Veterinary Medicine to treat diseases of domestic animals.<sup>11</sup> *Leeches* have negative influence on the health of domestic animals by infesting or sucking the blood and also occasional attacking humans.<sup>13</sup> Prevalence of *Leech* in domestic animals can occur when animals are drinking infected water with *Leech* from streams, pools and springs.<sup>14</sup> *Leech* infestation may cause serious complications like lethal dyspnea, haemoptysis or haematemesis. A *Leech* has been found in the nose, post-nasal space and oropharynx, but rarely in the hypopharynx or larynx of domestic animals and human beings.<sup>15</sup>

The research showed the *Leech* infestation on animals can show some clinical sign on animals like coughing, blood through nose and mouth, breathing problem, highly emaciated and become anemic, high weight loss, reduced milk yield and is caused by a motile parasite in water during dry season.<sup>16</sup> Applications of traditional medicinal plants (tobacco, zingier and garlic), chemicals (ivermectin and levamisole), manual removal of the parasites, and water treatment are among control methods against *Leech* infestations.<sup>13,17-19</sup> Studies on *Leeches* in Ethiopia was conducted about 51 years ago, during this study only

some species of *Leeches* were reported such as *Theromyzoncooperi*, *Batrachobdella quadrata*, *Helobdella conifer* and *Parabdella garoui*.<sup>20</sup> However, in recently time no any species of *Leech* is reported from Ethiopia, this shows that as the limitation in studies of *Leech* species and its therapeutic importance is present in Ethiopia. Therefore, the objectives of this seminar paper are:

- I. To review bioactive substance in saliva of *Leech* and its therapeutic importance
- II. To highlight impact of *Leech* in domestic animals

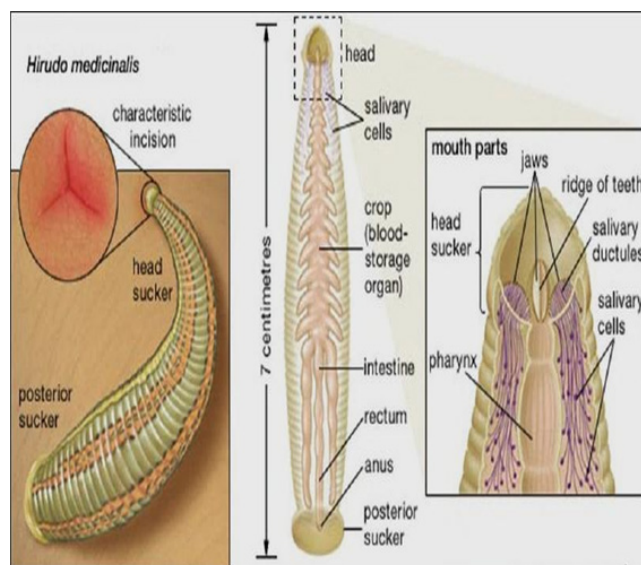
## Literature review

### Biology of Leech and bioactive substance in saliva of Leech

*Leech* is one of blood sucking external parasite which contribute to reduction in productivity of livestock in different part of the world, although *Leeches* have therapeutic important in treatment of animal and human diseases.<sup>21</sup> *Leech* can be classified in to phylum Annelida, class clitellata, order Arhynchobdellidae, family hirudinae and genus hirudo, which are distributed all over the world in a diversity of habitats as fresh water, seas, deserts and oceans.<sup>22</sup> The order of *Leech* is classified into Rhynchobdellidae (jawless *Leech*) and Gnathobdellidae (*Leech* which have jaw with teeth). Family hirudinidae is comprised of mainly blood sucking fresh water *Leeches* or medicinal *Leeches*; it includes about 60 hirudinids ranging across all continents except for Antarctica and from temperate to tropical area.<sup>23</sup> As recently reported that, about more than 650 species of *Leech* have been studied around the world.<sup>24</sup> Species of *Leech* which have therapeutic importance is belongs to Gnathobdella order.<sup>21</sup> Species of *Leech* which are important in medicine are *Hirudo medicinalis*, *Hirudo asiatica*, *Hirudomanellensis*, *Hirudo Orientalis*, *Hirudo michaelsoni*, *Hirudo nipponia*, *Hirudo granulose* and *Macrobodella decora*.<sup>25,26</sup> *Leeches* are cylindrical flattened invertebrates which are vary in color some being brown, dark green, and black with brown, orange and red striped lines on their body.<sup>27</sup> *Leeches* are one of the Annelida which lack of hard exoskeleton (chitin), but they have thin flexible cuticle this enforce them to be close associated with water.<sup>21</sup> They have about 34 external segments and the segments 9-11 form clitellum, the organ responsible for cocoon secretion which only visible in the summer months.<sup>21</sup> *Leeches* have two types of suckers; they are anterior and posterior suckers it is indicated in Figure 1. Posterior sucker is used for locomotion and attachment, while anterior sucker is used for sucking blood and it contain three or two jaws with sharp teeth which make Y and V incision respectively in the skin and tongue of the host,<sup>15,19,28-31</sup> *Leeches* are aquatic worm with a flattened body, tapering toward end with terminating in circular flattened discs. It swims with a vertical undulating motion in the water and outside of the water crawling or moves by mean of their posterior suckers, first fastening and stretching out and contracting of their body.<sup>32</sup> The mouth of *Leech* is placed in the anterior dick or sucker and furnished with three cartilaginous lens shaped jaws at entrance of alimentary canal.<sup>32</sup> *Leeches* have about 300 teeth on their jaws, each jaws contain about 10 teeth.<sup>33</sup>

*Leeches* live long in high humidity environment and can be influenced with temperature and food supply during their growth period.<sup>34</sup> Adult *Leech* can live about 18-27 years in suitable environment.<sup>21</sup> *Leeches* are poikilotherms and can survive in the temperature range 0°C- 30°C, but when temperatures is rapidly

changes they may stress to death.<sup>35</sup> *Leeches* are lack of lungs, but they can breathe water dissolved or atmospheric oxygen through their body surface.<sup>35</sup> *Leeches* have segmented hearts or two tubular which propel blood through closed circulatory system of medicinal *Leech*.<sup>36</sup> Blood is shunted by contractile later-dorsal arches from dorsal intestinal vessel into peristaltic heart in posterior segments 14 to 18.<sup>36</sup> *Leech* can ingest the blood of animals approaching 10 times their own weight and may not need feeding for up to one year after their last sucking.<sup>37</sup> Their feeding usually takes 40minutes about 10 to 15ml of blood per sucking. The ingested blood can bedigested by enzymes and mutual microorganisms such as *Aeromonas hydrophila* and *Pseudomonas hirudinia*.<sup>38</sup> *Leeches* are hermaphrodite which reproduce by reciprocal fertilization, but not by self-fertilization.<sup>39</sup> Two individuals meet line up with anterior part of each opposite to the posterior part of other, and then each *Leech* shoots a spermatophere into clitellar region (the place where sperm find female part). After copulation, eggs are laid between 1-9 months and clitellum start to secrete about four cocoons which is filled with albumen produced by clitellar glands.<sup>39,40</sup> Life cycle of *Leeches* involves egg, young *Leech* and adult stages. Most *Leeches* require 1-2 years to complete their life cycle, but it is related to feeding and temperature.<sup>39,41</sup> Each cocoons contain about 15 eggs and 60 offspring per year, complete embryonic development occurs within cocoon and composed of two life stages, crypto larva and juvenile.<sup>29,42</sup> The eggs in cocoon are deposited into the moist soil on shore of inhabited ponds, after leaving cocoon juvenile *Leech* feed a few days on yolk, and enter into water and grow up on feeding blood of aquatic animal.<sup>42</sup> The most important bioactive compound which used in medicine is present in the saliva of *Leeches*. The biologically active compounds which mainly present in saliva of *Leech* are proteins and peptides.<sup>43</sup> Saliva of *Leech* contains more than 100 bioactive compounds which have therapeutic importance including; anticoagulant (Hirudin), vasodilator, thrombolytic, anti-inflammatory, anesthetic and analgesic effect, inhibit adhesion and aggregation, anti-edematous, restores damaged vascular permeability of tissues and organs, eliminates hypoxia, relieves animals from infarct and strokes, detoxifies organism by antioxidant pathways, extracellular matrix degradation and antimicrobial effect.<sup>8,44-47</sup>



**Figure 1** Morphological structure of mouth and sucker of leech.

Source: (Thakur et al., 2016).

The most common bioactive substance which released from saliva of *Leech* includes as: hirudin, hyaluronidase, Calin, destabilase, Apyrase, Eglins (elastase cathepsin G inhibitors), Bdelins, Decorsin (antagonist glycoprotein, Inhibitor of platelet aggregation), Hirustatin, Piguamerin (inhibitor of plasma kallikrein), Platelet activation antagonist (antithrombic effect) Tryptase inhibitors, Chloromycentyn (antibiotic), Histamine like substances, complement inhibitors, Carboxypeptidase A inhibitors and Acetylcholine.<sup>8</sup> The most common bioactive substances which found in saliva of *Leeches* are mentioned in Table 1.

## Therapeutic importance of Leech

*Leeches* are widely used in medicine for drawing of blood from swollen area and also to reduce fluid pressures in damaged tissues of animals.<sup>35</sup> Recently, *Leeches* have been used as therapy in Veterinary Medicine to treat disease of domestic animals.<sup>47</sup> The most common indication of *Leech* therapy are including diseases which concerned with inflammation, hip and elbow dysplasia, disease of tendons, ligament and fascia, disease of vertebrae and treatment of scar,<sup>47</sup> and also other indications of *Leech* therapy in domestic animals are detailed in Table 2.

**Table 1** The common important composition of leech's saliva

Chemical constituent	Mode of action
Hirudin	Inhibits blood coagulation by binding to thrombin.
Calin	Inhibits blood coagulation but blocking the binding of Von Willebrand factor to collagen, inhibit collagen mediated platelet aggregation.
Destabilase	It has glycosidase activity and monomerizing activity dissolves fibrins and also it has antimicrobial activity.
Hirustatin	Inhibits kallikrein, trypsin, chymotrypsin and neuropholic cathepsin G and also accelerates reperfusion and prevents reocclusion in a canine model of femoral arterial thrombosis.
Bdelins	Anti-inflammatory inhibits plasmin, trypsin and acrosin.
Hyaluronidase	It reduces the viscosity and renders the tissues more readily permeable to injected fluids, increasing the speed of absorption. This promotes resorption of excess fluids and extravagated.
Tryptase inhibitor	Inhibits proteolytic enzymes of host's mast cells.
Eglins	Anti-inflammatory, inhibits the activity of alpha chymotrypsin chymase, substilisin, elastase, cathepsin G.
Factor Xainhibitor	Inhibits the activity of coagulation factor Xa by forming equimolar complexes.
Carboxypeptidase A	Increase the inflow of blood at the bite site of inhibitors
Acetylcholine	Vasodilator.
Histamine like substance	A vasodilator increases the inflow of blood at the bite site.

**Table 2** The common indication of disorder for veterinary hirudo therapy

Horse	Cats	Dogs
Mud fever	Postoperative wound	Postoperative wound
Laminitis	Discopathies	Spinal osteoarthritis
Tendinitis	Eczema	Discopathies
Tenosynovitis	Abscesses	Caudalequina syndrome
Ataxias	Strained ligaments	Hip and elbow dysplasia
Myositis	Dysplasia of the knee	Neuritis
Spinal osteoarthritis	Neuritis	Eczema of the ear
Arthritis in the shoulder joint	Mastitis	Poor wound healing
		Post-surgical scars
		Tendinitis
		Tenosynovitis
		Mastitis

## Technique and procedure of Leech application

Before application of *Leech*, the skin of animals should be prepared by shaving densely hair from application site and stimulate blood flow and soften skin by hot sponge or hot water (non-chlorinated) which entice *Leech* to feed more quickly. Wetting skin with water may enhance attachment of *Leech* to body of animals and facilitate feeding. During shaving of skin, antiseptics should not be used because *Leeches* are sensitive to strong odors and may not bite the skin.<sup>49</sup> After application site is prepared, medicinal *Leech* is attached to wound area. Number of *Leech* needed for wound (one phase of treatment) depending on species of patient, its size and its clinical respond to treatment.<sup>50,51</sup> One *Leech* is applied per 10 kg of body mass of animals; while 5 to 15 *Leeches* are used per animals in case of horse.<sup>11</sup> A gauze barrier around the intended site will prevent the *Leech* from wandering away from the site where its attachment is desired. It can be carried to the site by hand, or it can be placed within a 5 cc plastic syringe (plunger removed) and then applied to the wound site, containing the *Leech* until it is attached.<sup>50,51</sup> Application of *Leech* therapy starts with initial bite which is usually painless and attachment period lasting 20 to 45 minutes, within this minutes *Leech* can suck about 5-15ml of blood.<sup>35</sup> Anatomically *Leech* has three rows of jaws with about 300 teeth within cranial sucker, while

*Leech* is attached to host with its cranial sucker the wound produced by *Leech* is characteristic Y shaped skin incision.<sup>21</sup> After attachment, *Leech* releases powerful bioactive compound which facilitate flow of blood and inhibit blood coagulation and also histamine like substance is released to wound area from saliva of *Leech* to prevent collapse of adjacent capillaries.<sup>21</sup> After a minute, *Leech* commences to sanguisuction process to decrease venous blood by destroying coagulation of congestion blood and increase blood flow into wound to facilitate healing.<sup>52</sup>

### Anticoagulant effect

Coagulation cascade is a chain reaction which inhibits bleeding of blood, however bioactive molecules in *Leech* secretions have effect at various point to inhibit the action of coagulation cascade. Bioactive substance can inhibit coagulation by breaking coagulation cascade, lysis of fibrin, inhibition of thrombin and inhibition of coagulation factors.<sup>35</sup> The most powerful chemical from saliva of *Leech* is called as hirudin; hirudin is a protein which inversely binds to thrombin that causes consumption of active thrombin and result in ant thrombin activity.<sup>38,53</sup> Hirudin, antistatin and gelin are bioactive substances which are acts as thrombin inhibitors and breaks chain reaction by inhibiting of coagulation factor Xa factor.<sup>35,54</sup> Hirudin is the most common chemicals required in treatment of patients with disseminated intravascular coagulation syndrome (ant thrombin III deficiency) and platelet abnormalities because hirudin has no immune effects on red blood cells.<sup>55</sup> Factor Xa inhibitor has direct anticoagulation effect because it breaks coagulation cascades and it has critical role in treatment of human osteoarthritis and rheumatoid arthritis.<sup>35,44</sup>

Bioactive substances like ghilanten, LDTI, C1 inhibitor and eglins have great role directly or indirectly inhibition of coagulation factors.<sup>54</sup> Destabilase is an enzyme with glycosidase activity which present in saliva of *Leech*. It has a various isoforms with different capabilities and degradation action on stabilized fibrin, therefore it evaluated as an anticoagulant agent.<sup>56,57</sup> Monomerizing activity of destabilase has ability to dissolve stabilized fibrin via isopeptidolysis of  $\alpha$  and  $\gamma$  fibrin chains bound by  $\epsilon$  ( $\gamma$  Glu) Lys isopeptide bonds.<sup>56</sup> To conclude that, anticoagulant effect of bioactive substance have great role in treatment of animal and human disease which associated with anticoagulant deficiency.

### Antimicrobial, analgesic and anti-inflammatory effect

Bioactive substances (Chloromycetin and Destabilase) which secreted from salivary gland of *Leech* have antimicrobial activity because it can destroy bacterial cellular components.<sup>37</sup> Destabilase is a protein compound which found in the saliva of *Leech*, it has beta glycosidase activity which directly disrupts beta 1-4 bonds that are important in the peptidoglycan layer in bacterial cell walls.<sup>8,58</sup> As one research reported that, denatured form of destabilase showed a dose dependent bacteriostatic effect on *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*.<sup>59</sup> Kinin-kallikrein system is connected to coagulation cascade which have great role in inflammatory response.<sup>60</sup> Kallikreinkinni system is a complex system produced in various organs which include kininogen (precursor of kinin), kallikreins and bradykinin which is considered either proinflammatory.<sup>61</sup> Kinin system, coagulation cascade and fibrinolytic system is interconnected and activated by coagulation factor XII.<sup>60</sup> The function of bradykinin is to increase vascular permeability which cause vasodilatation and

promote pains.<sup>60,61</sup> Therefore, the chemical from saliva of *Leech* has the ability to act as analgesic and anti-inflammatory effect. The chemical kinases and antistatin may inhibit kinin-kallikrein mechanism which is a major noiceceptor rout.<sup>53</sup> Mast cell tryptases are serine protease in cell granules and their release causes inflammatory reactions in animals, these effects are strongly related to kinin-kallikrein system, chemotaxis, leukocyte activation, vasoactive actions and pain generating interactions.<sup>62</sup> The chemicals release from granule of mast cell can cause allergic and inflammatory disease such as asthma, anaphylaxis and arthritis.<sup>62</sup> However, bioactive substance which released from saliva of *Leech* can inhibit the action of tryptase. *Leech* derived tryptase inhibitor (LDTI) is serine protease inhibitor which inhibits proteolytic enzyme of mast cell.<sup>63</sup>

Eglin C is bioactive substance which found in saliva of *Leech* which causes decreasing levels of free oxygen radical in neutrophils and prevents tissue inflammation and destruction.<sup>8</sup> Complement component (C1) has important role in classical pathway of complement system.<sup>64</sup> *Leech* salivary gland secretion contains complement C1 inhibitor which inhibits both coagulation cascade and kinin-kallikrein system.<sup>54,65</sup> Complement inhibitors (C1 inhibitor) is required when the patients are exposed with deficiency of natural inhibitors, this inhibitors can counter with unwanted complement activation occurs in anaphylactic shock and chronic inflammation.<sup>7</sup> Enzyme carboxypeptidase participate in kinin degradation which causes bradykinin related inflammatory response, because it agonist to bradykinin receptors.<sup>60</sup> Bradykinin receptors B1 and B2 are related to chronic inflammation and acute inflammation respectively.<sup>66</sup> The bioactive substance of *Leech* act by inhibition of carboxypeptidase by preventing of B1 receptors, then after prevention of B1 receptors no more pain or inflammatory problem is within animals.<sup>66</sup>

### Facilitate wound healing and Vasodilator effect

Skin wound healing has three phases such as inflammatory, proliferative and maturation phase,<sup>67</sup> In the inflammation phase, the leukocytes such as neutrophils and macrophages migrate into wound site. In proliferative phase, the migration and proliferation of keratinocytes, fibroblasts and endothelial cells result in re-epithelialization and tissue granulation. In the maturation phase, excess collagen in the wound site is degraded by several proteolytic enzymes, leading to the completion of tissue repair.<sup>68</sup> During healing of wound perfusion is one of the factors which accelerating healing of wound, therefore bioactive substance which present in saliva of *Leech* can accelerate healing of wound via its ability of perfusion.<sup>69</sup> Salivary gland of *Leech* secretes a vasodilator, histamine like substance and carboxypeptidase-A inhibitors which increase inflow of blood to bite area and reduce local swelling.<sup>44,70</sup> Therefore, bioactive substance from saliva of *Leech* can remove accumulated blood (congested blood) in the wound which inhibit flow of fresh oxygenated arterial blood from entering area and supplying wound with oxygen and nutrients, then tissue surrounding wound will be supplied with oxygenated blood and nutrients.<sup>70</sup> Hyaluronidase is an enzyme which exist in saliva of *Leech*, known as spreading factor, it degrade or digestion of tissue hyaluronic acid and also act as antimicrobial activity which means it increases viscosity of interstitial walls leading to antibiotic effects,<sup>7,52</sup> thus facilitating the infiltration and diffusion of remaining ingredients of *Leech* into deep tissue or congested tissues,<sup>8,38,44</sup> Acetylcholine is one of the components in salivary secretion of *Leech* which have the ability to make endothelial muscle relaxation and vasodilatation, this

lead to microcirculation of fresh oxygenated blood to affected area (wound) to restoration of normal circulation.<sup>71</sup> Then healing process is fast and without complications.<sup>52</sup>

### Inhibit platelet function

In normal animals when the wall of blood vessel is suffered from damage (cut), damaged wall of blood vessels causes to release and spread collagen particles which targets for free vWf.<sup>72</sup> After collagen particles are released complex binding between vWf and glycoprotein (GpIb) is formed as bridge, then after bridge is formed up regulatory mechanism occurs with ADP and GpIIb-IIIa and fibrinogen, platelets bind to each other to make a plug in order to stop bleeding.<sup>64,73</sup> Further chain is continuous to form bridge by releasing substances such as thromboxane A<sub>2</sub>, platelet activation, and coagulation cascade.<sup>73</sup> The formation of bridge is one of haemostatic mechanism which can inhibit bleeding, however bioactive substance which present in saliva of *Leech* such as saratin, calin, decorsin and apyrase can react against different parts of bridge or chains.<sup>35,44</sup> Calin have the ability

to inhibit collagen mediated platelet aggregation and adhesion and also inhibiting von Willebrand factor dependent platelet adhesion to collagen in the vessel walls,<sup>7</sup> and it also mentioned in Figure 2. Adenosine diphosphate (ADP) has critical role in platelet aggregation by activating collages (GpIIb-IIIa) receptors and increasing affinity of platelets to vWf.<sup>64</sup> The enzyme apyrase from saliva of *Leech* can convert ADP to adenosine monophosphate, and then platelet aggregation becomes blocked due to indirect inhibiting action of apyrase on collagen receptor and ADP relationship.<sup>8</sup> Thrombin has strong effect on platelet activation and ADP release; however thrombin inhibitor is produced from saliva of *Leech* which has indirect negative impact on platelet functions.<sup>64</sup> Another bioactive substance is saratin which can affects initial stage of platelet adhesion and inhibits collagen vWf reaction competitively.<sup>74</sup> In generally, the chemical substances which are secreted from *Leeches* can be useful in inhibition of platelet aggregation by destroying collagen particles (collagenase enzyme from saliva of *Leech*) and inhibition of platelet receptor vWf. This mechanism can treat the formation of micro thrombi which occurs during post-surgical operation of animals.

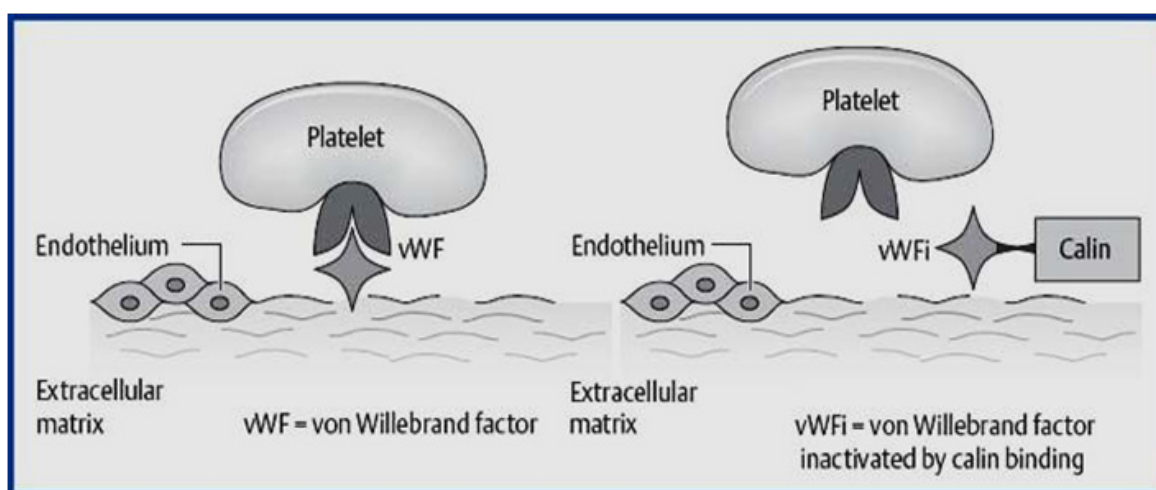


Figure 2 Inhibition effect of calin on Willebrand factor

### Importance of Leech in reconstructive surgery

Therapeutic importance of *Leech* comes after the *Leech* is removed from attachment.<sup>75</sup> *Leech* therapy are primarily used after reconstructive surgery to treat venous congestion in skin grafting and also to treat polycythemia (abnormal increase of red blood cells), and also used to remove stagnant blood (accumulated) pooling in wounds which may lead to increase venous blood pressure and inhibit flow of fresh blood in tissues.<sup>76-78</sup> Hyaluronidase can cause lysis of hyaluronic acid which increase removing of fluid from accumulated in the wound, *Leech* is able to decrease venous congestion in virtue of components of its saliva including antithrombotic, thrombolytic, hypotensive, anti-inflammatory and bacteriostatic agents.<sup>7,56,79</sup> The major indications of venous congestion (impaired venous circulation) can be includes edema, slow capillary refill time, slow bleeding response when pin pricked, darker or slightly cyanotic skin color and problems with blood supply at time of surgery.<sup>78</sup>

### Complication and contraindication of Leech therapy

Every therapy have its own side effect or complication with body of host, it is true that *Leech* therapy have complications following application by persistent and prolonged bleeding at site of detachment due to release of anticoagulant.<sup>80</sup> Bleeding can be treated by well-padded and compressive bandage.<sup>81</sup> There also some infection by bacterial *Aeromonas* is common in human medicine, for this infection antibiotic therapy is recommend.<sup>81</sup> Leech therapy never be recommended for animals those in danger with hemophilia and blood clotting problems, anemia, acute infections, immunosuppressant disease, cancer of skin and fungal diseases, hypotension, septic disorder, known allergic reaction to active ingredients of the *Leech* saliva (hirudin, hyaluronidase, destabilase). As well as pregnancy and lactation are contraindication due to risk of infection and bleeding.<sup>11,82</sup>

### Impact of Leech in domestic animals

*Leech* infestation also known as hirudiniasis, it is water-associated disease which causes cattle ill health leading to undetermined

magnitude of socio economic losses in developing country.<sup>16,39</sup> *Leech* infestation is reported to be common in rural areas of Africa and Asia, which is highly endemic during dry or hot season where there is dwelling of water pools for cattle to drink.<sup>39,83,84</sup> *Leech* can infect all domestic, but *Leech* infestation is not common in equine animals. Prevalence of *Leech* is higher in cattle followed by goats and sheep.<sup>85,86</sup> Prevalence of *Leech* in Ethiopia is rises during dry season (from December to early June), but prevalence of *Leech* infestation is low during rainy season.<sup>16</sup> The increment of *Leech* prevalence and intensity in domestic animals during dry months are due to increased proportion of number of domestic animals with the increase of water temperature during summery (hot) months.<sup>86</sup> As one research reported that, animals are usually infected with *Leeches* through mouth during drinking water, after which *Leeches* attach themselves on throat below tongue and nostrils.<sup>18,29</sup> The common predilection sites of aquatic *Leeches* in domestic animals are mucosal membranes of nostrils and mouth.<sup>13,87</sup> Prevalence of *Leech* is not only reported from domestic animals, but also reported in humans. In Eastern Africa, *Leech* infestation in human has been reported in Tanzania, Kenya and Ethiopia.<sup>15</sup> Prevalence of *Leech* in human is occurred when humans are drinking infected water with *Leech* and also it is very common in rural area of developing country which manifests in children.<sup>15,88</sup>

The most common *Leech* species causes severe infestation and diseases in animals are *Limnatisnilotica* and *MyxobdellaAfricana*.<sup>12</sup> The most common clinical signs observed from infected animals and human are including dyspnea, neck extended and mouth is held open, edematous in parotid and intermandibular regions, coughing up blood and death may rise from asphyxia.<sup>12,13,89</sup> Prevalence of *Leech* can be controlled by keeping environmental clean (keeping lakes and ponds clean where animals are drinking water) and administration of anthelmintic such as; ivermectin, levamisol and also by applying traditional plant which against *Leeches* as *Nicotinum* plant, *Alluvium sativum*, *Phytolaccadodecandra* and lit cigarette to infected animals.<sup>90,91</sup>

## Conclusion and recommendations

Hirudotherapy is in generally defined as therapeutic importance of *Leech* in treatment of animal and human after constructive surgery and in inflammation diseases. *Leech* is one of the parasites which have advantages and disadvantages in health of animals and human beings. The benefit of *Leech* in medicine has been practiced for long period of time. Nowadays, *Leech* therapy is applying in treatment of wound after postoperative surgery and skin grafting in dog, cat and horse. The saliva of *Leech* is the primary part of *Leech* which needed for medicinal value due to its bioactive substances. From bioactive substances of *Leech*, hirudin is the most potent anticoagulant which has similar action as heparin. In place of heparin hirudin is the most common anticoagulant used in collection of blood samples for laboratory diagnosis. The other bioactive substance have activity in facilitating wound healing and treatment of abnormal diseases concerned with blood such as; diabetic, Disseminated intravascular coagulation syndrome and polycythemia. Even if, *Leech* has therapeutic importance, it has great impacts on health of domestic animals which lead to decrease productivity and production of animals and socio economic failures of developing country. Study on therapeutic importance of *Leech*, identification of *Leech* species and prevalence of *Leech* infestation have great limitation in Ethiopia. Based on above mentioned conclusion the following points should be forwarded:

- I. The researcher should have to undertake further study on therapeutic importance of *Leech* in domestic animals
- II. Identification of *Leech* species and evaluation of bioactive substances in saliva of *Leech* should have to be studied in Ethiopia.
- III. The species of *Leech* which are not present in Ethiopia should be imported.
- IV. Therapeutic importance of *Leech* should have to be applied in Ethiopia.

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## Conflicts of interest

The authors declare no conflicts of interest.

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