SHORT COMMUNICATION

Tick removal

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Key words

Tick • Bite • Removal • Tick borne diseases

Summary

Ticks are blood feeding external parasites which can cause local and systemic complications to human body. A lot of tick-borne human diseases include Lyme disease and virus encephalitis, can be transmitted by a tick bite. Also secondary bacterial skin infection, reactive manifestations against tick allergens, and granuloma's formation can be occurred. Tick paralysis is a relatively rare complication but it can be fatal. Except the general rules for tick bite prevention, any tick found should be immediately and completely removed alive. Furthermore, the tick removal technique should not allow or provoke the escape of infective body fluids through the tick into the wound site, and disclose any local complication. Many methods of tick removal (a lot of them are unsatisfactory and/or dangerous) have been reported in the literature, but there is very limited experimental evidence to support these methods. No technique will remove completely every tick. So, there is not an appropriate and absolutely effective and/or safe tick removal technique. Regardless of the used tick removal technique, clinicians should be aware of the clinical signs of tick-transmitted diseases, the public should be informed about the risks and the prevention of tick borne diseases, and persons who have undergone tick removal should be monitored up to 30 days for signs and symptoms.

Tick bite consequences

More than 800 tick species have been reported worldwide however only about 30 tick species feed on humans [1]. Two classes of tick are responsible for disease in humans, hard ticks of Ixodidae's family (more common, harder to remove and more likely to transmit disease) and soft ticks of Argasidae's family (more quickly transmission of pathogens) [2]. Ticks that typically live in grass, brush and wooded areas [3], are blood feeding external parasites of mammals, birds, and reptiles throughout the world. Tick bites consist in a seasonal event related to the spring and summer trips and to the increasing of outdoor activity that sun and warm weather allow, both for humans (especially children) and ticks [4]. A tick needs a blood meal from a host in order to molt, and to reproduce [5]. This feeding process continues for several days to a week until the tick is fully engorged with blood [5]. It then releases its hold on the host, drops off, and subsequently molts or lays eggs [5].
In Europe, more vector-borne diseases are transmitted to humans by ticks than by any other agent [6]. While tick-borne diseases are becoming an increasing and serious problem in Europe, tick-borne diseases are also responsible for major depressions in livestock production and mortality in sub-Saharan Africa, Latin America, Asia and Australia [7, 8]. If the tick is infected with pathogenic organisms, it can transmit the infection to the host during the feeding process [5]. Ticks transmit the widest variety of pathogens of any blood sucking arthropod, including bacteria, protozoa, and viruses [6, 9-11]. As the tick feeds, the pathogens multiply, migrate to the tick's salivary glands, and are carried into the wound site along with the saliva [5]. Some human diseases of current interest caused by tick-borne pathogens include Lyme disease, ehrlichiosis, babesiosis, Queensland tick typhus, African tick bite fever, Rocky Mountain spotted fever, tularaemia, and tick-borne relapsing fever [6, 9-13]. Tick-borne encephalitis is caused by viruses (Omsk haemorrhagic fever virus, louping ill virus, Powassan virus, Crimean-Congo haemorrhagic fever virus and Eyach virus) in Europe and in many parts of Asia [14-16].
Other manifestations can be associated to tick bite such as those ones caused by toxic products of the tick (ascending flaccid palsy), and the reactive manifestations against tick allergens [17]. Unlike the above tick-borne diseases, tick paralysis, a toxin-mediated cause of acute flaccid paralysis, is not caused by an infectious agent but rather, is induced by a chemical substance that attaches the nervous system [18-20]. This neurotoxin is secreted by the salivary glands of over 40 species of ticks as they feed [19]. Tick paralysis is relatively rare, but it can be fatal and the majority of cases occur in children [19]. There are very few reports of human anaphylaxis induced by tick bites [21].
Except of these systemic complications an attached tick bite can induce local wound complications. Tick bites cause a variety of acute and chronic skin lesions [17, 22] through physical trauma, salivary secretions, toxins, excretions, body parts, or by causing a host to scratch [22]. Skin lesions may be direct damage to human skin from mouthparts, fangs, stingers, etc., or indirect damage such as immune reactions to arthropod saliva injected upon biting [23]. The most frequent coetaneous lesion

is a gross inflammatory papule or nodule [17]. The latter ranges from an inflammatory papule to a granulomatous lesion till to a gangrenous and then ulcerated lesion of various size [17]. Papules (small bumps), or thin plaques may form at the site of attachment within 1 to 3 days [22]. The lesions may feel hard and may be surrounded by redness. Mild swelling or blister formation can occur [22]. Other skin damages are tick-bite alopecia and T-cell/B-cell pseudolymphomas [24]. Finally, secondary wound infection by bacteria such as *Staphylococcus aureus* and Group A *Streptococcus*, may result from arthropod bites or stings (especially as a result of scratching) leading to impetiginous lesions [22, 23]. Retained tick material and host scratching may increase the likelihood of this complication [22]. People may develop hypersensitivity to salivary secretions as well, resulting in allergic reaction to bites [23]. However, systemic hypersensitivity reactions to arthropod bites are much less common (almost rare), tick bites may sometimes cause extensive swelling and rash [23].

Most ticks do not carry diseases, and most of the tick's bites do not cause serious health problems. They result only in benign coetaneous inflammatory reactions that may be pruritic for a few days [12]. While many people are concerned after being bitten by a tick, the risk of acquiring a tick-borne infection is quite low, even if the tick has been attached, fed, and is actually carrying an infectious agent. Ticks transmit infection only after they have attached and then taken a blood meal from their new host [25]. The likelihood of disease transmission from the bite of an infected tick is only 1% to 3% [26].The risk of acquiring Lyme disease from an observed tick bite is only 0,05% in population with a tick removed completely and professionally even in an area where the disease is common [27]. Even in population with positive or equivocal enzyme immunoassays after a tick bite is rare the presentation of clinical Lyme disease in endemic areas [28]. In spite of most tick bites are uncomplicated, tick-borne diseases are increasing in prevalence. However, ticks are best removed as soon as possible, because the risk of disease transmission increases significantly after 24 hours of attachment [29]. So, removing the tick completely, immediately once it has been identified [12], may help you avoid diseases such as Lyme disease that the tick may pass on during feeding or a skin infection where it bit you.

Tick removal

Nowadays, tick-borne diseases are increasing in prevalence because of a large increase in outdoor activities and a simultaneous drastic decrease of pesticides use [14], climatic disorders, changes in vector distribution [30], and the contact with animals such as goats-cows-sheep-deer-dogs-swine. Children, the elderly and immunocompromised persons may be at greater risk of infection. There are some general rules for prevention of tick bites in human population (Tab. I).

Furthermore, any tick found should be removed immediately [12]. It must be kept in mind that the risk of transmission of disease increases with the duration of attachment and generally requires greater than 24 to 48 hours [12, 31]. Also improvement of signs and symptoms of tick paralysis occur within hours and complete recovery within 24 hours of tick removal [20, 32]. In prevention of tick born disease it is important to urgent remove a tick, to use a correct procedure of removing and to remove the whole tick without any remnants [25]. It is preferable, a medical practitioner remove the tick in an organized room. Removing ticks may not be easy [12]. Numerous techniques of tick removal have been reported [17] (Tab. II). There is very limited experimental evidence to support most suggested tick removal strategies. There are small numbers of small studies, with great heterogeneity (very different population of humans or animals), with no statistical significance and anecdotal levels of evidence. This is probably related to the lack of an appropriate technique [17].

Removing ticks may not be easy [12, 17], because the teeth of the rostrum are oriented at acute angle towards the surface of the epidermis [17]. It is important to remove the tick completely, including the mouthpart and the cement the tick has secreted to secure attachment [29]. The long, central mouthpart which inserted in the skin is covered with sharp barbs, sometimes making tick's removal difficult and time-consuming [5]. Also most ticks secrete a cement-like substance during their feeding, which helps secure their mouthpart firmly in the flesh, further adding to the difficulty of removal [5]. Improper tick removal may cause mouthparts to break off in the skin, possibly leading to infection [33] or granuloma's formation [3, 33]. If any parts of the tick remain in the skin, these should be let alone; usually any mouthparts of the tick retained in the skin are eliminated uneventfully by the body [12]. The mouthparts alone generally cannot transmit disease because the tick can no longer pump saliva into the skin [15, 18]. However,

Tab. I. General rules for prevention of tick bites in human population.

Avoid areas with a lot of ticks during the spring and summer Wooded and bushy areas with high grass and a lot of leaf litter
Avoid contact with animals-hosts Rabbit, cow, goat, sheep, etc.
Use tick collars for pets Dogs
Take extra precautions (workers/campers/hikers/ travelers in endemic rural areas) Avoid placing jackets and other clothing on the ground Wear light colored clothing Wear a long-sleeved shirt and long pants Pants tucked into socks Remove-wash-dry clothing Carefully inspect the body (children, pets) Repellents Vaccinations

Tab. II. Reported tick removal techniques.

Application of substances (petroleum jelly, fingernail polish, 70% isopropyl alcohol etc.)
Application of a hot kitchen match
Tick's body puncture with hot needle
Tweezers or forceps (twisting, pulling steadily or jerking straight up, or pulling parallel with the skin).
Tick removal devices
To rotate the tick counterclockwise without traction
Passing suture needle through the tick
The knot method
Subcutaneous injection of local anesthetic agents
Surgical removal by punch biopsy needle
En-block the tick-skin junction and the parasite with incision

Tab. III. What not to do during the tick removal attempt.

To use sharp forceps
To pull back sharply
To use force or pressure
To grasp the tick by the body
To crush, puncture or squeeze tick's body
To apply substances such as petroleum jelly, alcohol, etc.
To apply heat
To freeze tick's body
To use a twisting or jerking motion
To rotate the tick
To handle the tick with unprotected hands

to prevent secondary infection from germs that may be on the mouthparts, you can remove them as you would a splinter [5, 18]. You can remove them with a small punch biopsy [3]. Generally, is difficult to detect and localize the presence of a small tick-remnant into the skin. The inspection, with a magnifying glass, of the removed tick and the bite site in the skin may be helpful. Attempts to remove these parts may result in significant skin trauma. These attempts are usually blind, painful, and ineffective, and can be responsible for secondary skin infection. A granuloma is always surgically resected in second time, but this is an extra procedure which every patient would like better avoid.

Many methods of tick removal that have been reported in the literature have proved to be unsatisfactory in daily medical practice. Few of them have scientific support, and some of them may even cause harm by inducing the tick to salivate and regurgitate into the host [29].

Some methods that are not recommended include applying a hot match or nail to the tick body, covering the tick with petroleum jelly, nail polish, alcohol or gasoline, using topical injected agents (lidocaine with or without epinephrine, chloroprocaine), or passing suture needle through the tick, etc. [34-47] Although there is conflicting evidence as to whether the removal technique influences infection rates [36, 42, 43], killing the tick in situ may increase the risk of regurgitation by the tick and the transmission of infectious agents [12, 33, 36].

Although the use of some tick-removal (Fig. 1) devices left mouthparts in the skin less often, were recommended over tweezers for tick removal [44]. There are a number of commercially available tick-removal devices, but no studies have evaluated their usefulness [29]. So they look like to be more useful for pets. Also no tool removed nymphs without damage [44]. These tools are not commonly found in most offices or hospital emergency departments.

Although no technique will remove completely every tick, the most commonly recommended and successful tick removal method seems to be until now the manual extraction of the tick with a blunt, medium-tipped angled forceps or fine point tweezers [33, 34, 36, 37, 43, 45, 48, 49]. Current evidence suggests that a straight slow method is best for removal without leaving the mouthparts [50]. The forceps are used to grasp the mouthparts of the tick as close as possible to the skin, and then the tick is pulled upward, perpendicular to the skin, with a continuous and steady action [12] (Figs. 2a-2b).

Surprisingly, general knowledge about safe and correct tick removal practices is still fairly limited. Many messy and dangerous methods are frequently attempted, such us the use of force, pulling, burning the tick, or even worse lead to tearing ticks apart, leaving parts imbedded and making the situation worse instead of better. The exertion of excessive pressure (difficult to be objectively measured) by forceps or a device is dangerous too. Table III includes the most important rules you must avoid during the attempt of tick removal, making this ineffective or dangerous. In an organized medical room, with a limited skin excision of the entire area, around the tick mouth, after a subcutaneous xylocaine injection, someone could remove en-block the tick-skin junction with the parasite in full [51]. Miyamoto and Hashimoto recommended trials to surgical operation for tick removal on passing over 24 hours after infestation [52].

Fig. 1. Tick removal devices.

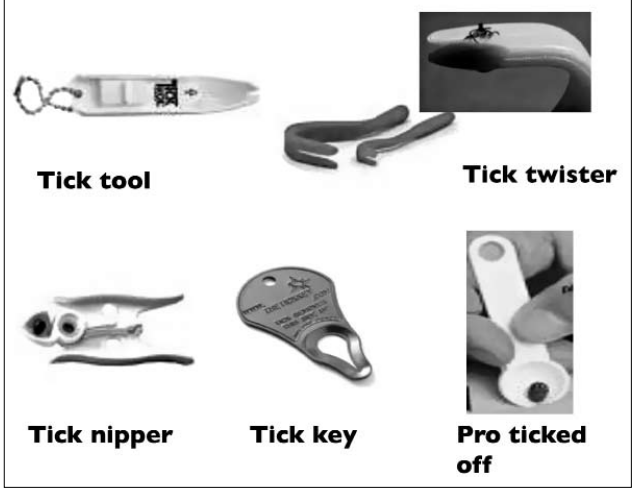
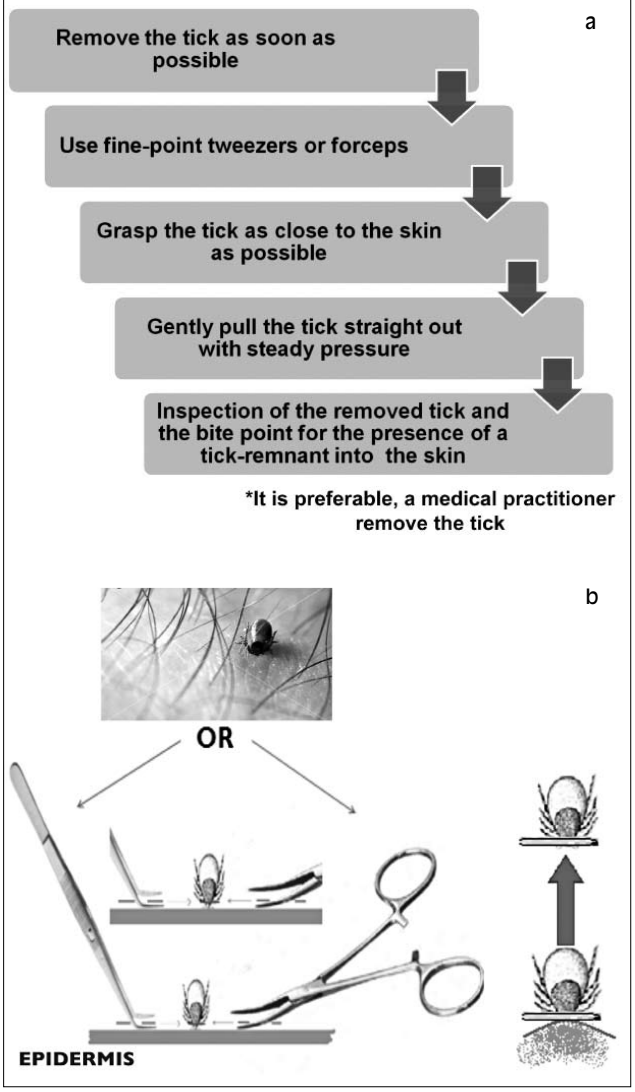


Fig. 2. **a**. The most commonly recommended and successful tick removal method until now; **b**. Tick removal steps.



Conclusions

The most effective tick removal method must secures the completely removal of the tick (intact and alive) without any possibility of infective fluids regurgitation and transmission into the human body during the procedure. It must minimize the possibilities of topical skin infection, and exclude the granulomas by pincer remnant development, too.

Someone could be more operative, when the tick is presented smashed or crashed because of previous failed removal attempt or is a small nymph, and it's completely removal is difficult.

Regardless of the used tick removal technique, clinicians should be aware of the clinical signs of tick-transmitted diseases, because morbidity and mortality as a result of these diseases increases substantially if there are delays in diagnosis and treatment [12]. Antibiotic use may be considered in patients living in areas endemic to tick-borne disease, in a patient who presents erythema around the tick bite point, has multiple tick bites or if a tick's attachment is known to have lasted at least 72 hours. The public should be informed about the risks of disease in tick-infested areas and the means of preventing infections [12]. Persons who have undergone tick removal should be monitored up to 30 days for signs and symptoms of tick-borne diseases [53], such as the occurrence of a skin lesion at the site of the tick bite or a temperature > 38°C.

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