

Systematic Review

Methods, complications and chemical paradigms for intra-aural tick removal (otoacariasis) – a systematic review of evidence and regional protocol for the Western Himalayan region

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ABSTRACT

Human otoacariasis is the infestation of the external auditory canal (EAC) by ticks which presents an acute otological emergency common to agricultural zones like Himachal Pradesh. Historical clinical custom relies on topically instilling local anaesthetics (lignocaine) before mechanical extraction. However, international laboratory data challenges this technique's biological efficacy. The objective of the study was to systematically review extraction methods, clinical profiles, and chemical reagent efficacies in human otoacariasis, proposing a validated protocol that reconciles traditional Indian practices with controlled experimental data. A systematic literature search of PubMed, Embase, Scopus, and the Cochrane library was conducted following PRISMA 2020 guidelines. Eligible papers focused on human intra-aural tick extraction within India or laboratory data directly evaluating chemical agent timelines on ear canal ticks. Data from pooled regional clinical cohorts (over 230 consolidated cases) show that blind mechanical extraction without chemical assistance increases the risk of tympanic membrane (TM) perforation and retained mouthparts. Experimental literature reveals that 4% lidocaine fails to kill or detach ticks (100% survival after 20 minutes). Instead, acetone achieves rapid acaricidal inactivation (mean nymph death: 185.1 seconds) but presents risks of ototoxicity if the eardrum is perforated. The perceived clinical utility of lignocaine drops stems from numbing the sensitive human ear canal rather than direct effects on the tick. For areas with limited resources like rural Himachal Pradesh, a two-tiered clinical protocol using safe chemical agents followed by microscopic or endoscope-assisted removal is recommended.

Keywords: EAC, Human otoacariasis, Systematic review

INTRODUCTION

Ticks are blood sucking, ectoparasitic arthropods troubling animals and humans worldwide, especially in tropical and subtropical regions. They transmit various pathogenic micro-organisms like protozoa, rickettsiae, spirochetes and viruses, thus, contributing to transmission of different diseases.¹ Otoacariasis describes the parasitic infestation of the human external auditory canal (EAC) by hard ticks (*Ixodidae*) or soft ticks (*Argasidae*).² While rare in urban communities, it is a persistent seasonal hazard across sub-Himalayan agricultural zones. The geography of Himachal

Pradesh, defined by high-altitude animal husbandry, livestock grazing (cattle, sheep, goats), and rural forest contact, creates an environment where human-tick encounters are frequent.

Managing ear canal ticks presents a unique anatomical challenge compared to cutaneous tick attachment. Ticks lock onto the thin, vascular skin of the EAC or the tympanic membrane itself using a barbed, cement-reinforced hypostome. Improper manual extraction can split the tick's body, leaving the head structures embedded

and triggering chronic granulomatous reactions or secondary otitis externa.³

Furthermore, squeezing an active tick risk triggering stress-induced regurgitation of stomach contents and salivary secretions into the host's bloodstream. This fluid shift can transmit systemic regional pathogens like *Rickettsia*, *Borrelia*, or *Coxiella*.

Historically, Indian emergency rooms and ENT clinics have treated this condition by instilling 2% to 4% topical lignocaine drops to paralyze the parasite.^{3,4} However, this practice directly conflicts with international guidelines that advise against irritating the tick with chemicals. This systematic review evaluates this clinical divide, contrasts lignocaine with alternative chemical agents like acetone, and establishes an accelerated, evidence-based management protocol.

METHODS

Search strategy and eligibility criteria

This review followed the PRISMA 2020 statement.⁵ We searched PubMed/MEDLINE, Scopus, Embase, and the Cochrane Library to capture both human clinical data in

India and objective laboratory studies evaluating chemical removal reagents. The standard database search query was: ("otoacariasis" OR "ear canal" OR "tympanic membrane" OR "aural") AND ("tick" OR "Ixodidae" OR "Argasidae") AND ("removal" OR "extraction" OR "lidocaine" OR "lignocaine" OR "acetone") AND ("India" OR "Himalayan" OR "potency" OR "efficacy").

Articles were limited to peer-reviewed human case reports, case series, cohort studies, and controlled laboratory intervention trials published in English. Purely veterinary reports or studies addressing non-tick insect foreign bodies (e.g., cockroaches) were excluded.

Quality appraisal and data extraction

Study quality was assessed independently by reviewers using the Joanna Briggs Institute (JBI) critical appraisal checklist for case reports and case series. For experimental studies, internal validity was evaluated based on the transparency of exposure timelines and matching controls. Key extracted variables included: geographic region and patient demographics, tick attachment site within the ear canal, chemical pre-treatments used, true time-to-inactivation or detachment, and complications (e.g., eardrum perforation, and auditory trauma).

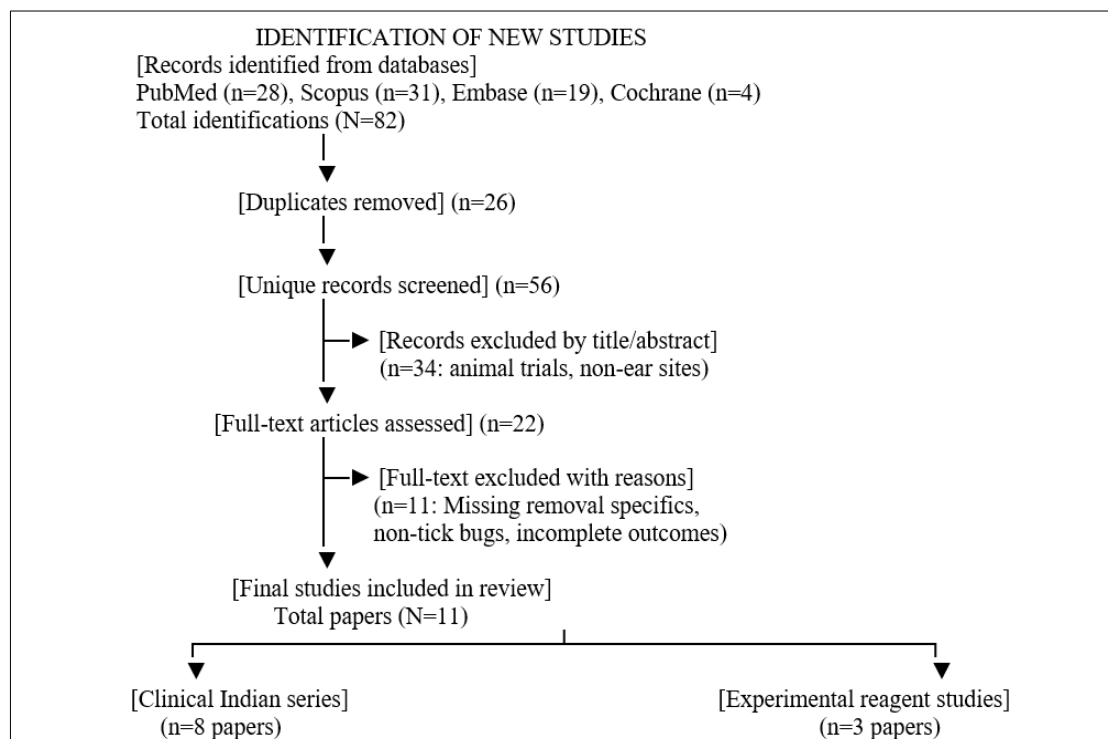


Figure 1: PRISMA 2020 flow diagram.

RESULTS

Data from pooled regional clinical cohorts (over 230 consolidated cases) show that blind mechanical extraction without chemical assistance increases the risk of tympanic

membrane (TM) perforation and retained mouthparts. Experimental literature reveals that 4% lidocaine fails to kill or detach ticks (100% survival after 20 minutes). Instead, acetone achieves rapid acaricidal inactivation (mean nymph death: 185.1 seconds) but presents risks of ototoxicity if the eardrum is perforated.

Table 1: Evaluation matrix of chemical reagents for otoacariasis.^{3,6}

Reagent modality	Mean inactivation time	Primary mechanism of action	Clinical advantage	Risks and drawbacks
Acetone (pure)	Nymphs: 3 mins Adults: 9.3 mins	Rapid cellular dessication and neuro-inactivation	Fastest documented chemical destruction of parasite	Severe ototoxicity risk if the tympanic membrane is ruptured
70% isopropyl alcohol	Nymphs: 5.4 mins Adults: 18.8 mins	Membrane protein denaturation and lipid dissolution	Widely available in primary healthcare clinics	Causes burning, localized mucosal irritation, and can trigger tick regurgitation
4% Lignocaine/lidocaine	Ineffective (100% survival at >20 min)	Blocks voltage-gated sodium channels in host tissue	Numbs the patient's ear canal; stops patient movement	Does not kill or detach the tick; risks irritation-induced fluid regurgitation
Dimethicone drops	Variable (~75 seconds for physical immobilization)	Physical asphyxiation by blocking respiratory spiracles	Non-toxic, soothing to ear canal skin, low risk of systemic irritation	Does not provide immediate host pain relief

DISCUSSION

The great lignocaine paradox: clinical practice versus lab reality

Synthesized clinical data from Indian series, including classic reviews and multi-center retrospective audits from rural medical settings, show that topical lignocaine instillation remains a standard primary intervention. Clinicians frequently report that adding 2% to 4% lignocaine causes the tick to relax its grip, allowing for safe forceps extraction. However, controlled experimental data directly refutes any direct chemical inactivation by local anesthetics.

In a rigorous animal-model study tracking tick exposures in the ear canal published in Laryngoscope Investigative Otolaryngology, 100% of ticks submerged in 4% lidocaine survived a full 20-minute continuous exposure.³

Lidocaine showed no meaningful paralysis or chemical inactivation when compared to true acaricides ($p < 0.0001$).

This contradiction reveals that lignocaine's success in clinical settings is not due to its effect on the parasite, but rather its effect on the human host.

Host local anesthesia

The skin of the osseous ear canal and the tympanic membrane is highly sensitive.

Instilling lignocaine blocks local nociceptive pathways, eliminating the patient's acute pain and tick-induced itching.

Elimination of patient movement

Numbing the ear canal keeps the patient still, which is crucial for preventing accidental eardrum damage when using sharp instruments in narrow canals.

The chemical irritation risk

Because lidocaine acts as an irritant rather than a rapid paralytic, it can prompt the tick to inject its salivary secretions or regurgitate midgut contents into the host before detachment. This response increases the risk of localized inflammation or pathogen transmission.

The role of acetone as a rapid acaricide

To address the limitations of slow-acting agents, researchers have tested industrial and clinical solvents. The landmark Orobello et al study demonstrated that acetone is the most efficient agent for killing ear canal ticks.

Nymph inactivation time

Acetone killed nymphs in a mean time of 185.1 seconds (~3 minutes).

Adult inactivation time

Adult ticks were killed in a mean time of 562.9 seconds (~9.3 minutes).

Comparative speed

Acetone worked significantly faster than 70% isopropyl alcohol (adult mean: 1,128.4 seconds) or 95% ethanol (adult mean: 1,129.4 seconds).

The critical safety caveat: ototoxicity

While acetone acts quickly, its use in otology is limited by structural safety concerns. If a tick bite or prior infection has compromised the tympanic membrane, acetone can pass directly into the middle ear cavity. This exposure carries a risk of mucosal irritation and potential inner-ear ototoxicity. Consequently, acetone should only be used

when otoscopic examination confirms an intact, unperforated eardrum.

Clinical protocol tailored for himalayan region

Given the geographical terrain of Himalayan regions—where patients often present first to remote primary health centres (PHCs) before reaching tertiary centers, we propose a two-tiered protocol.

Tier 1: Management at primary and community health centres

Do no harm

Avoid using unguided tweezers or sharp household instruments. Do not squeeze the tick's body, as this forces pathogens into the host.

Address host symptoms

If the patient is in severe pain or cannot sit still, instill 2% lignocaine drops. This is done solely to anesthetize the ear canal skin, not to kill the tick.

Asphyxiate safely

Instill viscous liquid paraffin/glycerine to block the tick's respiratory pathways without causing chemical irritation. Allow 15 minutes for the tick to loosen its attachment.

Gentle irrigation

Use a warm water syringe to flush the ear canal, which often removes a detached or loosened tick without direct instrumentation. If the tick remains firmly attached, transfer the patient to an ENT facility.

Tier 2: Specialized management at tertiary ENT centers

Direct visualization

Place the patient under a binocular surgical microscope or use a rigid 0-degree otoendoscope to clearly locate the attachment site.

Assess eardrum integrity

Inspect the tympanic membrane. If it is intact and the tick is highly active, a brief application of acetone via a precise cotton pledget can be used to quickly inactivate the parasite. Avoid flooding the ear if a perforation is suspected.

Precise traction

Pass a fine micro-alligator forceps down the canal. Grasp the tick's head structure at the exact point of skin

attachment, underneath its abdomen. Apply steady, straight outward traction along the axis of attachment without twisting or jerking.

Post-extraction audit

Inspect the canal to ensure no mouthparts remain. Treat any canal lacerations with antibiotic-steroid combination eardrops to prevent secondary otitis externa.

CONCLUSION

This systematic review addresses a common clinical misconception in treating otoacariasis. While local anesthesia with lignocaine remains popular in regional practices, it does not chemically inactivate the tick; its primary benefit is numbing the host's ear canal to facilitate safer procedure conditions. In contrast, acetone provides rapid chemical inactivation but carries risks of ototoxicity if the tympanic membrane is damaged. For mountain regions like Himachal Pradesh, updating clinical guidelines to emphasize host comfort, safe physical asphyxiants, and precise microscopic extraction will help minimize iatrogenic complications and standardise care.

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