

HUMAN LICE INFESTATION, DIAGNOSIS AND TREATMENT: A MINI-REVIEW

By

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Abstract

Three lice types infest man by contact or using infested tools: 1- Head louse (*Pediculus humanus capitis*), 2- Body louse (*P. humanus humanus*), & 3- Pubic louse or crab (*Phthirus pubis*), often spread by sexual contact, all races human worldwide are infested. Adult louse is about the sesame seed size, with 6 legs (each with claws), no wings and is tan to grayish-white, in persons with dark hair, louse appears darker. Females are usually larger than males and deposits up to 8 nits (eggs) per day. Adult lice can live up to 30 days on a human's head, feeding on his blood several times daily. Without blood meals, louse dies within 1 to 2 days off the host. Body lice are similar to head lice, reside on and lay eggs on clothing and fomites of infested person and migrate to his human body to feed. Pubic lice are tiny insects live on body hair, especially pubic hair around the penis or vagina. They're spread by close body contact, most commonly by sexual contact. Human lice are blood-sucking nuisances and of social embarrassment cause, especially among children. Epidemic typhus fever and epidemic relapsing fever primarily associated with disasters. Trench fever transmitted by body lice. Phthiriasis (pediculosis ciliaris) causes eyelids to become itchy with red and watery eyes, as pubic lice eggs cling to eyelashes.

Key words: Human lice, Epidemiology, Diagnosis, Treatment, A review

Introduction

There are three types of lice infesting humans: Head louse, body louse, and pubic louse or crab. Pubic lice (crabs) are most often spread from one person to another through sexual contact. Pubic lice can be found worldwide, affecting men and women of all races (CDC, 2006).

Review, discussion and Recommendations

1- Pubic lice: The pubic or crab louse is tiny and round. It can be difficult to see unless it is filled with blood from a recent feeding. It has crab-like claws that allow it to grasp tightly onto hair. Female lice lay up to 26 eggs (called nits) over a period of three to four weeks. The eggs hatch after about eight days (Leone, 2007). Although these lice primarily affect the pubic area, they can also be reported on other areas of the body (eyebrows, armpits, beard, and mustache), but usually are not found on the head-hairs (Morsy, 2012). Animals do not carry or spread pubic lice. However, pubic lice can move and spread from one person to another on cloth-

ing, bed-sheets, towels, or other shared items (Shakya *et al*, 2018).

Pubic lice symptoms: Most people infested with pubic lice have itching in the pubic or genital area. Other parts of the body, such as the armpits, can also be itchy if lice are present. There might be pale bluish spots on the lower belly, upper thighs, or buttocks from repeat feedings in the same area. Children of parents infested with pubic lice occasionally develop a lice infestation of the eyelashes or eyebrows. This can cause an itching or burning sensation in the eyes, and the eyelids might look red and irritated (Morsy and El Ghazali, 1999).

Pubic lice diagnosis: The doctor or nurse can diagnose pubic lice severe itching and by looking at the genital area for lice or their eggs (Paternotte *et al*, 2017). If pubic lice were diagnosed, which is a sexually transmitted, infested patient must be tested for other sexually transmitted infections, such as gonorrhea, chlamydia, syphilis, and/or HIV (Workowski *et al*, 2021)

Pubic lice treatment: Treatment recommended for pubic lice is a lotion or cream that is applied to the skin. The most commonly used treatments include: Permethrin (Nix, Rid), or Pyrethrin (A-200, Pronto, Tisit). Before using treatment, skin must be cool and dry so that it will not absorb the medicine, lotion or cream is apply to the skin and hair in pubic area and skin around the anus, but neither inside the vagina nor rectum. Other hairy areas, such as the underarms, chest, back, and thighs should also be treated. After 10 minutes, rinse the treatment off with water (CDC, 2019). After treatment, you can remove any lice that you see with your fingernails, a fine-toothed comb, or tweezers. Some people need a second treatment to get rid of public lice. Your doctor or nurse may ask you to return for an exam to see if any lice remain before doing a second treatment. Alternatively, a doctor or a nurse may ask the infested person to do a second treatment 9 to 10 days after the first treatment. If diagnosed with pubic lice, one should not have sex again until both are treated. Dry cleaning is another option for cleaning clothing. If there are items that cannot be washed or dry cleaned must be placed in a sealed plastic bag for two weeks (Leone, 2007).

Eyelash involvement: Eyelash infestation can occur in adolescents or adults who have pubic lice. The eyelashes can also become involved in children who are close contacts of adults with pubic lice. This condition may cause itching, burning, and eye irritation. Children with eyelash infestation may continually rub their eyes (Dornic, 1985). Children with the eyelashes infestation can be treated by applying petroleum jelly with a cotton swab at night (ask a pharmacist to find petroleum jelly that is safe to be use in the eyes as regular petroleum jelly may be irritating). Nurse or mother must apply the petroleum jelly to the eyelids twice a day for 8 to 10 days. Jelly will loosen the lice and nits so that she can pull them off with her fingers. In severe cases, family doctor may recommend the prescription treatment. Tang and Li

(2021) treated an old woman by removing the affected eyelashes, the crab lice, and nits completely. The eyelids were washed once with Povidone-Iodine[®] solution.

2- Pediculosis *corporis*: Organisms causing pediculosis corporis (*Pediculus humanus humanus*, also known as *Pediculosis humanus corporis*) and pediculosis capitis (*Pediculus humanus capitis*) are closely related variants of the same species. While pediculosis capitis is typically restricted to the scalp, patients with pediculosis corporis present with widespread symptoms, frequently involving the truncal areas.

Pediculosis *corporis* is a significant problem in countries where poverty, crowding, and a low level of personal hygiene favor spread and multiplication of the parasite. The communal bed is a major factor in the perpetuation of infestation. In Europe and North America, pediculosis corporis is largely a problem of the homeless; mainly homeless individuals not residing in shelters and without access to bathing facilities (Arnaud *et al*, 2016).

Pediculus humanus humanus: The body louse (2 to 4mm in length) is a little larger, but similar in morphology, to the head louse. It lives in clothing and lays eggs along the seams. The louse visits the host's skin to feed, and can survive for up to three days without a blood meal (Ko and Elston, 2004)

Disease transmission: *Pediculus humanus humanus* serves as a vector for diseases such as epidemic typhus, trench fever (Raoult and Roux, 1999) and relapsing fever (El Bahnasawy *et al*, 2012a) *Bartonella quintana* transmission via louse infestation is linked to endocarditis (Bonilla *et al*, 2014).

Clinical manifestations: Itching is the chief complaint, although some individuals do not seem to be troubled by the infestation. Signs may be limited to linear excoriations of lice on trunk and neck along with post-inflammatory hyperpigmentation, sometimes with thickening or lichenification along the areas of the involved trunk (Do-Pham *et al*, 2014). Close inspection sometimes reveals hemor-

rhagic puncta or wheals from the fresh bites. Skin changes tend to be concentrated around the waist and in the axillary folds, areas where clothing seams contact the integument. Honey-like crusting and redness characteristic of secondary staphylococcal infection may also be present.

Diagnosis: This is made by the louse or its nits (louse eggs) identification in clothing, especially in the seams. Less often, lice are seen crawling or feeding on skin. Lice may be visible with the naked eye, but a magnifying lens is helpful for finding lice and eggs (CDC, 2016).

Pruritus (or itching) is prevalent in children with skin disorders associated with effects on mood, quality of life, sleep, scholastic performance, and family functioning (Fölster-Holst, 2016). The differential diagnosis often includes scabies, which can present with widespread pruritus and excoriations. Simultaneous infestation with body lice and scabies also occurred (Kenawi *et al*, 1993). The identification of scabietic burrows and erythematous papules in classic areas of involvement (e.g., web spaces of fingers, wrists, and male genitalia) suggested the diagnosis possibility (Morsy *et al*, 2003). Scabies mites are much smaller than lice, and are undetectable if examined with the naked eyes. A skin scraping or dermoscopy may be used to assist in the diagnosis. Systemic diseases and drug reactions are rare compared to adults. Itchy skin conditions in children also include eczema (especially atopic dermatitis), rashes, infections/infestations, urticaria/mastocytosis, autoimmune disorders, and hereditary dermatoses must be considered in differential diagnosis (Caffarelli *et al*, 2019).

Treatment: Patient should be bathed thoroughly. Infested clothing and bed linen must be heat washed (at least 149°F), dry cleaned, or discarded. Also, ironing clothing with particular attention to the seams will also kill lice on fabrics (Mikhail *et al*, 2007).

In most cases, the above methods are sufficient to manage *P. corporis*. Occasionally, a

few nits may be found on body hair. For these patients treatment with a topical pediculicide was recommended, a single 8 to 10 hour application of permethrin 5% cream to the entire body was also suggested (Stone *et al*, 2008). Lindane lotion should not be used as a first-line therapy due to the potential for severe adverse events with this drug.

A low potency topical corticosteroid cream applied to pruritic and irritated areas twice daily for a few days after elimination of lice provides symptomatic relief (Tab. 1).

Although oral ivermectin therapy was associated with a dramatic reduction in the prevalence of body louse infestation in a cohort of homeless men (28/33 men infested at day 0 versus 5/27 men at day 14), the effect was transient, but it was necessary to determine whether oral ivermectin treatment should be recommended (Foucault *et al*, 2006).

A randomized 45-day trial in which the effect of wearing permethrin-impregnated underwear was compared to placebo in 73 homeless individuals with pediculosis corporis found only transient benefit from the treated underwear (Benkouiten *et al*, 2014). Although the intent-to-treat analysis showed a greater likelihood of louse eradication at day 14 in permethrin group (28 versus 9%), the difference between the two groups was no longer statistically significant at day 45 (28 versus 27%). In addition, an increase in permethrin-resistant body lice was detected in the permethrin group at the end of the study.

3- Pediculosis *capitis* is a common condition caused by infestation of the hair and scalp by *Pediculus humanus capitis* (the head louse), one of three distinct varieties of lice specifically parasitic for humans (Ko and Elston, 2004). *P. capitis* occurs worldwide and in persons of all socioeconomic backgrounds (Roberts, 2002), school-aged children are mostly infested (Morsy *et al*, 2001). Males may be less susceptible to lice infestations than females (Downs *et al*, 1999) and in the United States; black children are infested much less frequently than white child-

ren and others (Leung *et al*, 2022). The reasons for these findings are uncertain. Studies investigating the impact of long hair length on the risk for infestation have yielded conflicting results (Suleman and Fatima, 1988). The lower incidence in black children in the United States may be related to a low prevalence of lice that are capable of grasping the shape or width of certain types of hair (Counahan *et al*, 2004).

Life cycle: Female life span is about a month, during which she lays 7 to 10 eggs/day, cementing them firmly to the base of a host hair. Eggs, commonly called "nits," are oval capsules that hatch in eight days, releasing nymphs that require another eight days to mature. After hatching, egg cases become white and more visible.

Adult head lice are gray-white, 2 to 3 mm in length, and equipped with mouth parts adapted to sucking blood and legs adapted to grasping hairs. Adults feed both on the scalp and adjacent areas of the face and neck. Adult lice can survive up to 55 hours without a host (Chunge *et al*, 1991), but probably dehydrate and become nonviable long before death (Lambiase and Perotti, 2019).

Transmission: Direct contact with the head of an infested person is the primary mode of transmission of pediculosis *capitis* (Willems *et al*, 2005). Lice are wingless insects, don't jump, fly, or use pets as vectors (Burkhart and Burkhart, 2007).

The contribution of inanimate objects to the spread of *P. capitis* is controversial (Canyon and Speare, 2010). While a study performed in an experimental setting suggested that use of hair dryers, combs, or towels could lead to louse transmission (Takano-Lee *et al*, 2005), other studies investigating the prevalence of lice on hats, bedding, and floors after exposure to an infested individual have not supported these routes as important modes of lice transmission (Speare and Buettner, 2000).

Clinical manifestations: Pruritus occurs as an allergic reaction or even asthmatic bronchitis to lice saliva injected during feeding

(Abou-Gamra *et al*, 1992). In a patient without prior infestation, the onset of itching may be delayed until sensitization occurs after four to six weeks (Devore and Schutze, 2015). In addition to lice and nits, excoriations may be visible on the scalp, neck, and postauricular skin. Infrequently, secondary staphylococcal infection occurs with associated cervical or nuchal lymph node enlargement.

Diagnosis: Pediculosis *capitis* should be suspected in patients with scalp pruritus, particularly in children. Persistent pyoderma around the neck or ears should also stimulate an evaluation for pediculosis *capitis*.

The diagnosis is confirmed by the visualization of live lice. Systematically combing wet or dry hair with a fine-toothed nit comb (teeth of comb 0.2 mm apart) better detects active louse infestation than visual inspection of the hair and scalp alone (Pilger *et al*, 2008). In a comparison study, a wet-combing technique resulted in a sensitivity of 91% for the detection of live lice, compared with a sensitivity of 29% observed with visual inspection, and that wet combing is the most sensitive diagnostic technique but, wet combing and dry combing have not been compared directly in clinical studies (Jahnke *et al*, 2009)

To perform wet combing, a lubricant such as a hair conditioner is applied to hair before the following steps, which are also used for the dry-combing method (Gavazzoni Dias, 2015): 1-Hair is brushed or combed to remove tangles. 2- A fine-toothed comb is inserted near the crown until it gently touches the scalp, after which it is drawn firmly down and examined for lice after each stroke, & 3- The entire head is combed systematically at least twice.

The nits are often more easily recognized than nymphs and adult lice, which are elusive. Unlike seborrheic scales, hair casts, and hair spray residue, nits are cemented securely to the hair shaft and are difficult to dislodge. Light microscopy can be used to confirm a nit. Examination with a Wood's lamp

causes nits to fluoresce a pale blue and can facilitate harvest for microscopic examination. However, the finding of nits without adults or nymphs does not confirm active infestation, as nits can persist after successful treatment (Amanzougaghene *et al*, 2020). Active infestation is suggested by the finding of many nits within one-quarter inch (6.5 mm) of the scalp; nits further from scalp are almost always nonviable (CDC, 2015). However, even this criterion results in overdiagnosis, in a study in which 1729 elementary school children were screened for lice, 28 (1.6%) had active lice while 63 (3.6%) had nits without lice, of whom 50 completed follow-up (Mumcuoglu *et al*, 2001). During two weeks of follow-up, only 9 of the 50 children who initially had nits alone (18%) converted to an active infestation. Having ≥ 5 nits within one-quarter inch of the scalp was associated with a higher conversion rate than fewer nits (32 versus 7%).

The diagnosis of lice is traumatic for some patients and parents and can lead to concern for continued infestation even after cure is complete. Tact, reassurance, and empathy on the part of the clinician are helpful.

Differential diagnosis: Nits should be distinguished from hair casts, white *pie*dra, and black *pie*dra (Keipert, 1986). 1- Hair casts (also known as pseudonits) are white to yellow, 2 to 7 mm, keratinous, tubular sheaths that encircle hair shafts. Hair casts may be idiopathic (primary hair casts) or may occur in association with a scalp condition such as seborrheic dermatitis or psoriasis, but unlike nits, hair casts slide easily along the hair shaft (França *et al*, 2011). 2- Piedra: Nits also should be distinguished from white and black *pie*dra, fungal infections most commonly found in tropical areas that present with white to beige (white *pie*dra) or brown to black (black *pie*dra) concretions on hair shafts (Bonifaz *et al*, 2020) The concretions may reach up to a few millimeters in length. White and black *pie*dra are hair superficial fungal infections caused by *Trichosporon beigelii* and *Piedraia hortae*, respectively.

They more commonly occur in tropical climates and manifest as soft concretions attached to scalp hair, but they also can occur in the axilla, pubis, and beard areas (Veasey *et al*, 2017). In addition to pediculosis *capitis*, scalp pruritus may occur in multiple other scalp disorders, such as seborrheic dermatitis and atopic dermatitis, but nits or live lice distinguishes pediculosis *capitis* (Abou El-Ela *et al*, 2000).

Treatment of pediculosis *capitis* is recommended, with three fundamental effective options; topical pediculicides, wet combing, and oral therapy, but spraying or fogging a home with insecticides or pediculicides was not recommended (Nutanson *et al*, 2008).

Topical pediculicides are the most common initial treatments. Manual removal of lice (wet combing) is sometimes used as an alternative to topical pediculicide therapy. Oral ivermectin is an option for the treatment of head lice infestation, especially in individuals who have experienced a treatment failure (Sanchezruiz *et al*, 2018). Regardless of the treatment selected, the presence of living lice should be confirmed prior to treatment, patients with nits, but neither nymphs nor adults have active infection if nits are only found <6.5mm on scalp. They don't require treatment (CDC, 2017).

Many patients with nits less than 6.5mm from the scalp and no detectable nymphs or adult lice also do not have active infestation (Williams *et al*, 2001). Clinician approaches to these patients vary. Whereas some clinicians elect to treat based upon the possibility of missing live lice during the examination, others follow patients clinically for signs of active infestation to avoid unnecessary treatment.

First-line treatment: Multiple topical pediculicides are accepted first-line treatments for pediculosis *capitis*. Wet combing is the alternative intervention that is primarily used for very young infants and patients who prefer to avoid pediculicides.

Topical pediculicides: Some effective topical pediculicides were given (Tab. 1): Pyret-

hroids (pyrethrins, permethrin), malathion, benzyl alcohol, spinosad and topical ivermectin. Topical pediculicides must be applied according to the package instructions. Basic principles for treatment include: 1- Hair conditioners should not be used prior to application; these products may result in reduced efficacy (Lebwohl *et al*, 2007). 2- Rinsing of topical pediculicides must be performed over a sink rather than in a shower or bath to limit skin exposure (Speare *et al*, 2003) 3- Rinsing with warm water are preferred over hot water to minimize vasodilation and systemic absorption. Topical lindane is not recommended as a first-line treatment for pediculosis *capitis* because of safety concerns.

Selection: Pediculicide resistance, particularly to pyrethroids and malathion, is a growing concern. Because there is marked geographical variability in the prevalence of pediculicide resistance, the selection of a topical pediculicide should involve consideration of local resistance patterns (Yoon *et al*, 2003). Consideration of agent-specific side effects, patient age, and treatment cost further influence treatment selection (Kasai *et al*, 2009).

Resistance: A mutation in louse *kdr* allele that results in decreased sensitivity of neuronal voltage-gated sodium channels was proposed as the primary mechanism for pyrethroid resistance (Soderlund, 2008) Rates of *kdr* resistance appear to be high in the United States based upon a study in which over 14,000 lice were collected from 138 collection sites in 48 states and analyzed with quantitative sequencing for *kdr* mutations (Gellatly *et al*, 2016). But, the clinical relevance of *kdr* mutations is brought into question by a study that found a poor correlation between mutations in *kdr* and treatment failure (Bialek *et al*, 2011).

Malathion is a broad-spectrum organophosphorus insecticide widely used in agriculture and in public health pest control programs, such as mosquito and other insect-vectors (Morsy *et al*, 1993). In one *in vitro* study in Britain, fewer lice died after four hours of

exposure to malathion 0.5% in isopropanol than after 30 minutes of exposure to the United States product; 42 versus 96% (Downs *et al*, 2005). As side effects, malathion requires longer application times than other pediculicides and is malodorous (El-Bahnasawy *et al*, 2012b). Also, it has the potential for flammability and cause respiratory depression if ingested. Unlike malathion, benzyl alcohol has a mildly pleasant odor, with safety data for use in young children. Besides, malathion is in the carcinogenic, listed as a Class III (slightly hazardous) chemical (WHO, 2019). Benzyl alcohol mechanism of action (louse asphyxiation) makes it to be less susceptible to develop resistance than malathion topical neurotoxic agents (Velásquez-Salazar *et al*, 2022). The higher cost of spinosad and topical ivermectin, the most expensive topical pediculicide agents, may be prohibitive for some patients, since both are the least expensive topical agents (Taplin and Meinking, 1990).

Pyrethroids are well-tolerated and inexpensive treatments that have a long history of use for *P. capitis* and are preferred choice for initial therapy in areas where resistance to such products was not proved (Frankowski and Weiner, 2002). They are a natural chrysanthemum extract, pyrethrins (a synthetic pyrethroid) are neurotoxic to lice killed the lice in 10-23 min, but with very low mammalian toxicity, often combined with piperonyl butoxide, an ingredient that inhibits pyrethrin catabolism in the lice with good efficacy (Clark, 2022). The applied to dry hair must be saturated with the pediculicide, which remains on the hair for 10 minutes before rinsing off with water; a second treatment is indicated on 9th day. It caused lice-free rates of 83% on day 2, decreased to 46% on day 8 before a second treatment, and increased to 78% on day 9 after second one and remained at 78% on day 15 (Meinking *et al*, 2002a). But, pyrethroids have extremely very low mammalian toxicity (Speare *et al*, 2002). However, pyrethroid poisoning is common in clinical practice. It may cause

breathing difficulties in patients with ragweed allergy, and not recommended in patients who are allergic to chrysanthemums. Skin irritation is a potential side effect (Ramchandra *et al*, 2019). Pyrethrins were used for patients ≥ 2 years of age. Permethrin can be used for patients ≥ 2 months of age. In areas where resistance to pyrethroids was documented, or in patients who have failed to respond to appropriately administered treatment with a pyrethroid, other pediculicides (such as malathion, benzyl alcohol, spinosad, and topical ivermectin) are appropriate treatments. In the United States, all of these products are available only by medical prescription (Mohammadi *et al*, 2021).

Malathion is an organophosphate cholinesterase inhibitor that exerts neurotoxic effects on lice. The agent has both pediculicidal and ovicidal properties. In comparison with pyrethroids, malathion is more expensive, has an additional side effect of flammability, and requires a longer time of application. One in vitro study found that malathion 0.5% with terpineol was most effective at killing head lice, compared with pyrethroids and lindane (Meinking *et al*, 2002b). Malathion lotion is applied to dry hair and the scalp and left in place for 8 to 12 hours before washing off with a non-medicated shampoo, hair must be left uncovered, and heat sources should not be used to dry the hair. A single application of malathion was sufficient for most patients. If live lice were visualized seven to nine days after treatment, a second treatment is indicated (Frankowski, 2004). Shorter application times may also be effective (Takano-Lee *et al*, 2004). In an investigator-blinded, randomized trial, lice were eradicated in 98% of patients treated with one or two 20-minute applications of malathion with terpineol (Meinking *et al*, 2004). However, malathion is malodorous, and its vapor is irritating to the eyes. The potential flammability of the product due to high alcohol content has also been a concern. There is a theoretical risk for respiratory depression from accidental ingestion. It is contraindicated in chil-

dren under the age of two, and studies of the safety of malathion in children under the age of six are limited. One randomized trial involving topical malathion therapy found no evidence of systemic acetylcholinesterase inhibition in children as young as two years of age (Meinking *et al*, 2007).

Benzyl alcohol 5% lotion involves the asphyxiation of lice, after component paralyzes the louse respiratory spiracles in an open state; mineral-oil-containing vehicle obstructs spiracles. Benzyl alcohol 5% lotion was applied to dry hair and rinsed off with water after 10 minutes. Treatment is repeated after seven days, Meinking *et al*. (2010) in randomized controlled trials revealed greater efficacy of benzyl alcohol over placebo for the eradication of live lice (76 versus 5%, & 75 versus 26%). Common side effects of benzyl alcohol lotion may rarely include irritation of skin, scalp, and eyes, and numbness at the site of application, but use in premature infants could lead to serious respiratory, heart- or brain-related adverse events such as the seizure, coma, or even death (Geier *et al*, 2022)

Spinosad (Merative, Micromedex[®]) is the fermented product of the soil bacterium *Saccharopolyspora spinosa* that compromises the central nervous system of lice by interfering with nicotinic acetylcholine receptor, resulting in neuronal excitation and paralysis as well as used for scabies infestations (McCormack, 2011). Two manufacturer-sponsored phase III, multicenter, randomized trials compared the efficacy and safety of spinosad 0.9% cream rinse with permethrin 1% cream rinse & nit combing (Stoug *et al*, 2009). Patients who had residual live lice seven days after an initial treatment were instructed to repeat application of the same therapy. After spinosad, approximately 85% of spinosad-treated subjects were lice-free, compared with about 44% of those treated with permethrin (Popescu and Popescu, 2012). Individuals treated also less likely to require a second application. Spinosad is supplied as a 0.9% topical suspension to completely cover

the dry hair and scalp. After application, spinosad must be left on for 10 minutes. Subsequently, the scalp and hair should be thoroughly rinsed with warm water to completely remove the product. Shampooing of the hair can be performed at any time after treatment. Treatment should be repeated if live lice remain seven days after the initial application. Nevertheless, spinosad therapy causes skin irritation. Also, it has a potential risk to human health by inducing the cytotoxic effects, and not recommended for use in children under six months of age (Zhang *et al*, 2019)

Topical ivermectin functions by binding to glutamate-gated chloride channels in lice, thereby inducing paralysis and death (Atif *et al*, 2019). Topical ivermectin is used as a single application to dry hair. As with malathion, a single application is sufficient. Lotion is applied to thoroughly coat the hair and scalp and is rinsed off with water after 10 minutes. It was supported by two randomized trials that found that a single 10-minute application was superior to a placebo lotion for the lice eradication (Pariser *et al*, 2012). Primary efficacy endpoint in both was the number of index patients (youngest household member with at least three live lice detected on examination) who were louse-free at days 2, 8, & 15. A combined analysis of the trial results revealed that among the index patients, 131 of 138 (95%) treated with topical ivermectin and 46 of 147 (31%) treated with the placebo lotion were free of live lice on day 2. By day 15, live lice were absent in 74 & 18% of patients, respectively. Also, patients in the topical ivermectin group were more likely to be free of pruritus on day 2; 67 versus 43% denied pruritus. Adverse events were infrequent and occurred at similar rates in both groups.

Topical ivermectin generally is well tolerated. Potential adverse effects may include ocular irritation, dry scalp, and a burning sensation on skin (Pariser *et al*, 2012). However, it should neither be used in the children weighing less than 15kg nor in the pregnant wo-

men (CDC, 2019).

Wet combing: Mechanical removal of lice by wet combing is an alternative for patients who are too young for pediculicide treatment or who desire to avoid pediculicide therapy (Meister and Ochsendorf, 2016). However, time and care required to use wet combing and the need for multiple sessions are deterrents for some patients. The relative effectiveness of wet combing and medical therapy is uncertain. In the United Kingdom, wet combing was only half as effective as with malathion cure was in 38 versus 78%, respectively (Roberts *et al*, 2000). Hill *et al*. (2005) found that wet combing was much more effective than a single treatment with either malathion or permethrin cure was in 57 versus 13%. But, there were significant methodology issues with this latter study, including unblinded allocation of patients, use of an inadequate pediculicide, and different lengths of follow-up in two arms (Dawes, 2005). Combing is performed with a fine-toothed comb; hair must be wet, with an added lubricant such as hair conditioner (Lapeere *et al*, 2014). Combing is done until no lice are found in each time, with repeat sessions every three to four days continuing for two or three weeks after any session where a large, adult louse is found and don't share combs, brushes, or towels, before disinfection in hot water (at least 55°C) for 5-10 minutes (CDC, 2019). The procedure may take 15 to 60 minutes depending on the thickness/length of hair. The most common causes of treatment failure are lack of adherence to treatment and continued contact with other infested individuals, and specific topical resistance is a problem in some locations (Frankowski and Bocchini, 2010a)

If a patient didn't respond to an appropriate course of a topical pediculicide and reinfestation does not appear to be a factor, switching to an alternative topical pediculicide that has not been associated with local resistance is the typical next step. Oral ivermectin is an option for patients who fail topical therapy (Ameen *et al*, 2010). In a randomized, dou-

ble-blind trial (n=812), patients who failed home therapy with a pyrethroid or malathion were treated with either malathion 0.5% lotion applied by study staff or oral ivermectin; 400 mcg/kg (Chosidow *et al*, 2010). Participants in both groups were given two treatments separated by one week. Ivermectin therapy was associated with a significantly higher rate of eradication of head lice; 95 versus 85% of them were cured of infestation. Incidence of adverse effects was similar in both (Pilger *et al*, 2010). Lower ivermectin doses (200mcg/kg) were used more commonly and also effective (Burkhart and Burkhart, 2006) In a randomized trial of 80 children with pediculosis capitis, treatment with ivermectin (200 mcg/kg) was compared with malathion 0.5% lotion (Nofal, 2010). Patients were given a single treatment of ivermectin or malathion, which was followed by a second treatment on day 8 if live lice were detected. For difficult-to-treat head-lice infestation, oral ivermectin, given twice at a 7 days interval, had superior efficacy as compared with topical 0.5% malathion lotion (Chosidow *et al*, 2010). Ivermectin is well tolerated when used for pediculosis capitis; most serious adverse effects occurred during treatment of scab mites and biting lice (Morsy *et al*, 2001). Ivermectin is an important drug in veterinary and human medicine to control of parasitosis and was the joint focus of the 2015 Nobel Prize in Medicine (Laing *et al*, 2017). Ivermectin has been assigned to pregnancy category C by FDA. Animals' showed evidence of teratogenicity, but at doses that were also maternotoxic to pregnant female, but the manufacturer considers ivermectin contraindicated during pregnancy.

Other therapies have been effective for *P. capitis*, such as dimethicone, lindane, trimethoprim-sulfamethoxazole, 1,2-octanediol, a synthetic detergent cleanser, and many physical methods (Verma and Namdeo, 2015). Olive oil, butter, petroleum jelly are sometimes used for suffocating lice (Takano-Lee *et al*, 2004). Gasoline and kerosene are highly flammable and should not be used for pe-

diculosis capitis (Kimemia *et al*, 2020).

Dimethicone: Topical dimethicone (known as dimeticone) is widely used for pediculosis capitis in Europe. It is a non-pesticide, silicone-based material believed to work by co-ating lice and disrupting their ability to manage water (Burgess *et al*, 2005).

Efficacy of dimethicone is documented (Ihde *et al*, 2015). In a randomized, open-label trial in the United Kingdom (n=90), a single 15-minute application of dimethicone 4% gel was superior to two 10-minute applications of permethrin 1% cream rinse; 70 versus 15% treatment rate of success (Burgess *et al*, 2013). A separate assessor-blinded the United Kingdom trial (n= 73) that compared two eight-hour or overnight applications of dimethicone 4% lotion with two 12-hour or overnight applications of malathion 0.5% liquid also found dimethicone more effective (Burgess *et al*, 2007) A Brazilian-blinded randomized trial (n=145) reported two eight-hour applications of 92% dimethicone superior to two 30-minute applications of a permethrin 1% lotion (Heukelbach *et al*, 2008).

Lindane: Lindane is an organochlorine insecticide that inhibits neurotransmission in parasitic arthropods and death was reported in humans following topical lindane therapy (Vale *et al*, 2003). Lindane shampoo is not recommended for treatment for *P. capitis* as it has been associated with some rare neurologic adverse effects and widespread resistance (Frankowski and Bocchini, 2010b). The US/FDA placed a Black Box warning on drug labels, cautioning that lindane shampoo and lotion should only be used as a second-line treatment in patients who cannot tolerate or have failed other therapies for treatment of scabies or lice. Lindane is contraindicated in patients with skin disorders that may lead to increased systemic absorption as atopic dermatitis, psoriasis (Humphreys *et al*, 2008). If used, lindane was given only as single application; retreatment must be avoided. Other measures to minimize toxicity include: 1- Prescribe one ounce of lindane lotion or shampoo to treat an average adult; but

no more than 2 ounces must be prescribed, 2- Shampoo prescribed for pediculosis *capitis* must be washed off after four minutes, and 3- Caregivers applying the drug to patients must wear gloves that are less permeable to lindane (nitrile, latex, neoprene, or sheer vinyl). Natural latex gloves should not be re-used. Caregivers should thoroughly wash their hands after application.

Trimethoprim sulfamethoxazole: Combination therapy with topical permethrin and trimethoprim-sulfamethoxazole was more effective than permethrin treatment alone (Pollack, 2001). The mechanism of trimethoprim-sulfamethoxazole action may involve the death of symbiotic bacteria in the louse gut that produce B vitamins necessary for louse survival (Gleckman *et al*, 1981). The combination of topical permethrin (1%, applied for ten minutes with a repeat application after one week if necessary) with oral trimethoprim-sulfamethoxazole (10mg/kg/day trimethoprim in two divided doses for ten days) was compared with either drug alone in a randomized trial of 115 children (Hipolito *et al*, 2001). Compared with topical permethrin alone, dual therapy was associated with a higher success rate at four weeks (93 versus 72%). Trimethoprim-sulfamethoxazole alone gave a best rate of 78%. However rarely, potential adverse effects of trimethoprim-sulfamethoxazole include Stevens-Johnson syndrome, neutropenia, hemolysis, and renal impairment. They concluded that the dual therapy should be reserved only for the resistant cases.

1, 2-octanediol: Data from randomized trials suggested that topical preparations containing 1, 2-octanediol, an agent that disrupted cuticular lipids on the head lice and their eggs, were beneficial for treating and preventing the *P. capitis* (Burgess *et al*, 2014).

Synthetic detergent cleanser: Two prospective studies of a synthetic detergent cleanser applied to head and then dried, with a goal of suffocating lice, reported a 96% cure rate (Pearlman, 2005). The studies had significant flaws, including lack of a control group,

lack of blinding, and potentially inappropriate diagnostic criteria (Roberts and Burgess, 2005).

Physical methods: 1-Shaving hair is anecdotally reported as a method of eradicating the head louse infestation (Lwegaba, 2005). However, studies evaluating this method of treatment have not been performed, and the procedure may be psychologically distressing for some patients. 2- A comb that uses an electric current generated by an AA battery to electrocute lice is marketed for the treatment of head lice, but there are anecdotal reports of successful treatment with the device (Resnik, 2005). 3- Heated air reported louse eradication with high-volume heated air blown at the scalp for 30 minutes (Goates *et al*, 2006). Few patients overall received high-volume heated air treatments, but patients less than six years were excluded. While awaiting results of larger controlled trials compared methods of delivering heat and assess cure, safety, training, and costs, such treatment was not recommended.

Medicinal herbs were tried. The Neem extract gave pediculocidal activity (Morsy *et al*, 2000). Also, El-Basheir and Fouad (2002) used cream from *Lawsonia alba* (*henna*). *Trigonella faenum-gracatum* (fenugreek), *Hibiscus cannabinus* (hibiscus) and *Artemisia cina* (worm-seed) and recommended the *henna* mixed with aqueous extract of *sheah* (100%) or *helba* (75%) or *karkadah* (50%). Moreover, Abdel-Ghaffar *et al*. (2010) used grapefruit extract to eradicate head lice.

Return to school: Policies requiring exclusion from school and treatment for all children with nits alone are likely excessive. The infested children should avoid direct head contact with other individuals and must be treated promptly with a topical pediculicide or wet-combing session (Mumcuoglu *et al*, 2021). Control of outbreaks in schools may be facilitated by examination of teachers and pupils who may have had the close head-to-head contact with an affected child and by assigning students individual wall hooks or lockers for storing the caps and/or

the coats (FDA, 2010).

The household recommendations: Household members must be examined and treated if the lice or nits infested on scalp detected; bedmates should be treated prophylactically (Mazurek and Lee, 2000). Machine wash and dry clothing, bed linens, and other items that an infested person wore or used during the 2 days before treatment using the hot water (130°F) laundry cycle and the high heat drying cycle. Clothing and items that are not washable can be dry-cleaned or sealed in a plastic bag and stored for 2 weeks (CDC, 2019).

Vacuum the floor and furniture, particularly where the infested person sat or lay. However, the risk of getting infested by a louse that has fallen onto a rug or carpet or furniture is very small. Head lice survive less than 1-2 days if they fall off a person and cannot feed; nits cannot hatch and usually die within a week if they are not kept at the same temperature as that found close to the human scalp (CDC, 2019).

Recommendations

Pediculosis *corporis* is caused by body louse. Unlike both pediculosis *capitis* and pediculosis *pubis*, it lives on clothing, rather than on the skin of infested persons. This louse can serve as a vector for epidemic typhus, trench fever, and epidemic relapsing fever.

Patients with *P. corporis* often complain of pruritus. Excoriations and post-inflammatory hyperpigmentation are typical signs of infestation. Diagnosis is by the visualization of lice or nits on clothing or skin.

Treatment of *P. corporis* involves discarding, laundering (in hot water), or ironing infested clothing and bedding. These methods are often sufficient for eradication of the infestation. For patients presented with a few nits on the body hair, another treatment with permethrin 5% cream was suggested, rather than management of bedding and clothing alone (Grade 2C).

Pediculosis *capitis* (head lice) is a scalp infestation that most frequently occurs in chil-

dren. Affected individuals may be asymptomatic or may complain of scalp or neck pruritus, diagnosed by the visual examination. In active infestation, louse eggs are found on hair shafts, and crawling nymphs and adult are present. Wet combing is a useful to locate the adults or nymphs. But, the presence of nits alone don't confirm active infestation. Several topical pediculicides are available. Resistance to topical agents that kill lice via neurotoxic mechanisms has been increasingly reported and varies geographically. The selection of a topical agent should be based upon local resistance patterns and consideration of adverse effects and patient age. Lindane is not recommended due to neurologic side effects and the drug's relatively low efficacy.

First-line treatment options for *P. capitis* include pyrethroids, malathion, benzyl alcohol, spinosad, and topical ivermectin. Safety, low cost, and easy availability of pyrethroids have led to the widespread use of these drugs as initial agents. In areas in which pyrethroid resistance is not likely, a pyrethroid as the first-line therapy was suggested (Grade 2A). Malathion, benzyl alcohol, spinosad, and topical ivermectin are effective alternative ones.

Treatment failure may occur secondary to lack of adherence to treatment or reinfestation. Clinicians should consider these factors, in addition to the possibility of resistance, when evaluating patients with an apparent lack of response to therapy.

Besides, don't share a bed, clothes, or personal tools with someone who has head and/or body lice, and don't having sex with your partner who having pubic lice.

Children infested with the *Pediculus capitis* don't need to be excluded from the school. But, the household members and his/he close contacts should be critically examined for lice infestation. Individuals who share bedding with the infested person should be treated prophylactically.

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Table 1: Topical drugs for (head lice) pediculosis *capitis*

Pediculicide	Action	Age group	Regimen	Precautions/side effects
Pyrethrins & piperonyl butoxide	Neurotoxin	≥2 years	Leave on hair for 10 minutes, then rinse; repeat on day 9	Skin irritation
Permethrin (1%)	Neurotoxin	≥2 months	Leave on hair for 10 minutes, then rinse; repeat on day 9	Skin irritation; may induce breathing difficulties with rag-weed allergy; avoid in patients with chrysanthemum allergy
Malathion	Neurotoxin	≥6 years; contraindicated in < 2 years; not safe in 2 to 6 years	Leave on hair for 8 to 12hrs, wash without medicated shampoo; a single application may be effective; repeat in 7 to 9 days if live lice	Malodorous, flammable, skin irritation, theoretical risk for respiratory depression if ingested
Benzyl alcohol	Asphyxiation	≥6 months	Leave on hair for 10 minutes, rinse; & repeat after 7 days	Skin and eye irritation, transient skin numbness
Spinosad	Neurotoxin	≥6 months	Leave on hair for 10 minutes, rinse; & repeat in 7 days if live lice seen	Skin irritation
Ivermectin	Neurotoxin	≥6 months	Leave on hair for 10 minutes, & rinse	Skin or eye irritation