

Molluscum Contagiosum: Review and Update on Management

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Abstract: Molluscum contagiosum (MC) is an infectious dermatosis that commonly presents in children and immunocompromised individuals. Although lesions usually resolve spontaneously after several months, they can be symptomatic and cause psychosocial distress. We review the evidence underlying treatment methods available for MC lesions, including potassium hydroxide, salicylic acid, hydrogen peroxide, retinoids, cantharidin, cryotherapy, curettage, and pulsed dye laser to aid practicing dermatologists in therapy selection.

Molluscum contagiosum (MC) is a common infectious dermatosis caused by the MC poxvirus. Prevalence is approximately 7% in immunocompetent children (1) and up to 18% in adults with the human immunodeficiency virus (HIV) (2). MC presents as umbilicated pale pearly papules that may spread through autoinoculation, direct contact, or vehicles such as towels or swimming. Although benign and often self-limiting, MC can be distressing for the patient (and parents) because of its cosmetic appearance, anxiety about spread of the disease, and pruritic symptoms. In immunocompetent children, MC lesions usually resolve spontaneously within 9 months (3), but immunosuppressed patients often have a longer history of the disease, which can be refractory to conventional treatment. It often affects young children; when considering treatment modalities, one must remember that the pain of curettage or liquid nitrogen is significantly greater in children younger

than 10 years than that of (for example) topical cantharidin application. Furthermore, when selecting the treatment, not only should pain and discomfort be accounted for, but also differences in the cost of treatment modalities; for example, curettage is more costly (owing to the time and skill of the operator) than liquid nitrogen or topical treatments.

We provide a contemporary review of the treatment options available for MC and evaluate the evidence underlying each of these.

SALICYLIC ACID

Topical salicylic acid is a keratolytic used in dermatology to treat photoaging, acne, psoriasis, and viral warts. Common side effects include irritation, pruritus, burning, and peeling of the skin. Four studies have investigated the use of salicylic acid for the treatment of MC in a total of 190 patients (4–7), comparing

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its efficacy with that of other agents. A study of 26 patients 2 to 12 years of age found no difference in MC resolution between 10% potassium hydroxide (KOH) and a salicylic acid–lactic acid 16.7% combination solution over 6 weeks (5). When reviewing the use of 10% polyvinylpyrrolidone iodine as adjunct with 50% salicylic acid plaster versus salicylic acid plaster monotherapy or 10% polyvinylpyrrolidone–iodine monotherapy in 20 young children, no significant difference in MC resolution was found between the treatment groups. A mean resolution time of 26 days with all treatment methods was reported (7). In both of the above studies, treatment methods were deemed to be safe and efficacious (5,7). Salicylic acid gel (12%) has separately been suggested to aid clearance of MC lesions better than phenol 10% in 70% alcohol solution when patients were treated for up to 6 months or until resolution (whichever was sooner) in 83 children 2 to 15 years of age ($p = 0.006$) (4).

HYDROGEN PEROXIDE

Hydrogen peroxide is typically used in dermatology for its antimicrobial properties, typically for bacterial skin infections. Its exact mechanism is not known, although it is thought to be associated with its oxidizing ability (8). Common side effects include mild erythema and irritation. There have been several case studies involving the use of hydrogen peroxide in MC (9,10), all of which had small sample sizes ($n = 1$ –12), although all demonstrated successful clearance of MC lesions with as little as 1 week of application (9). One case report suggested that hydrogen peroxide 1% applied under occlusion with every diaper change for a period of 1 week cleared genital MC lesions completely in an 8-month-old baby (no history of atopy was noted). The authors deduced that the occlusion led to augmented exposure of hydrogen peroxide to the virus (9) and hence to quicker resolution.

RETINOIDS

Retinoids have been used in dermatology for many decades; indications for their use include psoriasis, acne, chemoprophylaxis against skin cancer, and disorders of keratinization. Their mechanism of action is attributed to their ability to control abnormal growth and differentiation of keratinocytes (11). Common side effects include dryness, mild erythema, and a burning sensation. Two randomized controlled trials (RCTs) compared topical tretinoin cream with other agents, including 10% KOH and 10% benzyl

peroxide cream (12,13), but both of these trials were small, with sample sizes of 50 and 30, respectively. Rajouria et al (12) suggested that topical tretinoin 0.05% and KOH 10% both reduced the number of MC lesions after 4 weeks of treatment in 50 children, albeit with a slower resolution rate with tretinoin. A separate report described that a 4-week course of adapalene 1% cream applied to recalcitrant MC (>200 lesions) of the flank and buttocks of a 4-year old girl reduced the MC lesion count (14).

POTASSIUM HYDROXIDE

Potassium hydroxide is a keratolytic agent frequently used in the diagnosis of fungal infections and bacterial vaginosis and the treatment of genital warts. Its main side effects are skin irritation, mild erythema, and burning sensation. Topical KOH has been shown to be beneficial in the treatment of MC lesions in children in several studies (15,16). Short et al (16) conducted an RCT in 20 children 2 to 12 years of age and found that 10% KOH induced MC lesion clearance in 70% of the treatment group versus only 10% of the control arm (normal saline placebo applied) when the agents were applied twice daily until inflammatory changes appeared. KOH has also been compared with alternative treatments, including tretinoin (12) and imiquimod (17) (Table 1).

SILVER NITRATE

Silver nitrate is mostly used for its antiseptic wound cauterization properties, for example, to stifle bleeding after cervical biopsy, epistaxis, or bladder hemorrhage, but has also been used for cutaneous warts. Side effects can include chemical burns and staining of the skin. A large study conducted in 389 patients found that 97.7% of MC lesions successfully resolved with up to three applications of 40% silver nitrate paste. The silver nitrate was applied to the lesion with a blunt toothpick, and it was found that a black crust would form before the MC lesion dropped off on day 10 to 14; 70% of patients treated required only one application and no patients had iatrogenic scarring (18).

IMIQUIMOD

Imiquimod is an immunomodulatory agent frequently used to treat warts, basal cell carcinomas, and actinic keratoses. Side effects include local reactions of erythema, pruritus, and a burning sensation; headache; and influenza-like symptoms. There have

TABLE 1. Summary of Key Clinical Studies Investigating Treatment for *Molluscum Contagiosum* (MC)

| Study | Indication | Aim | Patients, n | Dose | Findings | SORT criteria |
|---|--|---|-------------------------|--|--|---------------|
| Salicylic acid Kose et al (2013) (5) | Comparison of 10% KOH solution with salicylic and lactic acid combination in children 2 to 12 yrs of age with MC | Open randomized comparative study | 26 | 6-week treatment: once-daily application of combination therapy (salicylic and lactic acid) or 10% KOH | 83.3% resolution of MC with 10% KOH solution and 100% resolution with combination therapy. Authors concluded no difference in treatment outcomes | C |
| Leslie et al (2005) (4) | Atopy noted in 2 patients Review of outcome of MC using three control arms in children older than 4 yrs (range 2–15 yrs) Atopy noted in 62/114 patients if patient with severe eczema excluded | Randomized, prospective controlled trial | 114; 83 completed study | 70% ethanol applied monthly, 10% phenol in 70% alcohol applied monthly, 12% salicylic acid gel applied one to two times weekly | Salicylic acid cleared MC better than phenol (p = 0.006) Dilute phenol does not speed resolution of MC | B |
| Ormerod et al (1999) (6) | Evaluation of 5% sodium nitrate with 5% salicylic acid under occlusion or 5% salicylic acid alone (with cream placebo) Median age 6 yrs, interquartile range 4 yrs | Double-blind group sequential study in children | 30 | Daily treatment of each MC lesion with designated therapy for up to 3 mos (less if MC cured before) | 75% resolution of MC in active treatment group and 21% in control group (p = 0.01) Side effects: skin staining and skin irritation | B |
| Ohkuma (1990) (7) | MC in children treated with 10% polyvinylpyrrolidone-iodine solution and 50% salicylic acid plaster or each as monotherapy in children 2 to 9 yr of age | Open trial | 20 | 20 treated with dual therapy, 5 with iodine monotherapy, 10 with salicylic acid plaster alone | Overall, all MC resolved in mean 26 days with all treatment methods. No side effects | C |
| Hydrogen peroxide Semkova et al (2014) (9) | Hydrogen peroxide 1% cream under occlusion to treat MC in an 8-mo-old child No history of atopy noted | Case study | 1 | Hydrogen peroxide 1% cream applied with every diaper change for 1 week | MC clearance 1 week after treatment | C |
| Bigardi and Milani (2003) (10) | Hydrogen peroxide 1% cream to treat MC | Case study | 12 | Hydrogen peroxide 1% cream applied twice daily for 3 wks Resolution persisted at 6-mo follow-up | 67% of patients demonstrated full resolution, remaining patients had a reduction in lesions (70%). No side effects | C |
| Retinoids with tretinoin Rajouria et al (2011) (12) | Comparison of 5% KOH with 0.05% tretinoin cream in MC in children | Randomized trial | 50 | Half treated with KOH, half with tretinoin; application once daily | At 4 wks, mean lesion count reduced with both treatments. KOH had a faster resolution rate of MC than tretinoin, although fewer side effects seen with topical tretinoin | B |
| Scheinfield (2007) (14) | Adapalene used to treat a 4-year-old girl with atopic dermatitis and 200 MC lesions (previously treated unsuccessfully with topical imiquimod, cimetidine, topical tazarotene, cantharidin, and cryotherapy) | Case study | 1 | Adapalene 1% cream applied for 4 wks | 50–80% of MC resolved (flank and buttock, respectively). Authors reported fewer side effects with adapalene than topical tretinoin or tazarotene | C |

TABLE 1. Continued

| Study | Indication | Aim | Patients, <i>n</i> | Dose | SORT criteria | Findings |
|--|---|---|--------------------|--|---------------|---|
| Saryzadi (2004) (13) | Comparison of topical benzoyl peroxide 10% cream with tretinoin 0.05% cream in children | Randomized trial | 30 | Twice-daily application of either vehicle for 4 wks | B | Side effect: mild dermatitis. Resolution of lesions in one patient after 6 wks |
| Potassium hydroxide Metkar et al (2008) (49) | Comparison of imiquimod with KOH solution in treatment of MC lesions in patients 2 to 32 yrs of age 62.5% younger than 12 yrs | Open nonrandomized comparative study of 5% imiquimod versus 10% KOH | 40 | Chosen medications applied once nightly, three times per week. Imiquimod continued until MC lesions resolved and KOH solution until inflammatory sign resolved | B | Authors deduced imiquimod cream and KOH solution equally effective, but KOH associated with faster resolution and greater side-effect profile |
| Short et al (2006) (16) | Comparison of efficacy of topical KOH 10% with that of normal saline over 3 mos in children 2 to 12 yrs of age with MC | Double-blind, randomized, placebo-controlled trial | 20 | Solution applied twice daily to MC lesions until inflammatory changes noted | B | Topical KOH led to 70% clearance of MC lesions versus only 20% in the control arm |
| Romiti et al (2000) (15) | Efficacy of 5% KOH in children for the treatment of MC lesions | | 20 | | C | All MC lesions cleared within 6 wks with the use of topical 5% KOH (Molludab). 5% KOH was just as effective as 10% but with fewer side effects |
| Imiquimod Chathra et al (2015) (17) | Compare outcome of MC between KOH and imiquimod cream in children 1 to 18 yr of age | Randomized comparative study of 10% KOH and 5% imiquimod cream | 40 | Apply creams three times a week for 12 wks or until lesions cleared | B | 85% treated with 10% KOH had complete resolution of MC at 3 mos versus 50% of patients treated with 5% imiquimod cream. Side effects with KOH, including pigment change. Authors found both treatments effective, but imiquimod requires a longer duration |
| Gamble et al (2012) (19) | Efficacy of imiquimod 5% cream versus cryotherapy in MC in children 2 to 12 yr of age | Observer-blind parallel-group randomized comparative trial | 74 | Apply imiquimod 5% cream five times per week until resolution or up to 16 wks or cryotherapy for 10 to 20 seconds to each lesion every week until resolution or up to 16 wks | B | Imiquimod: complete resolution of MC at 3 wks (2.7%), 6 wks (10.8%), and 12 wks (91.9%). Cryotherapy: complete resolution of MC at 3 wks and 6 wks; greater than imiquimod ($p = 0.001$) but not significantly greater at week 12 or 16. Authors concluded that although imiquimod cream was slower acting, since it had fewer side effects (e.g. of pain), it was preferred to cryotherapy |

TABLE 1. Continued

| Study | Indication | Aim | Patients, <i>n</i> | Dose | SORT criteria | Findings |
|-------------------------------|---|---|----------------------|---|---------------|---|
| Seo et al (2010) (20) | Compare imiquimod 5% cream with 10% KOH solution in the treatment of MC in children (mean age 3.7 yrs in imiquimod group and 5.9 yrs in KOH group) | Open, randomized, comparative clinical and histologic study | 30 | Application of imiquimod or KOH solution three times per week until MC resolved | B | Both arms had a statistically significant reduction in lesions ($p < 0.005$). Side effects: local in both groups, no systemic side effects. Histology: dense lymphocytic infiltrates (T cells) around treated lesions |
| Theiler et al (2011) (21) | Response of disseminated MC to topical 5% imiquimod in an HIV-positive 11-year-old child with atopy (with multiresistance) | Case study | 1 | Imiquimod 5% cream applied three times per week for 3 mos, then 8-week course of five times per week application under occlusion to one leg versus only salicylic acid 5% (in petroleum) on the control | C | After 7 mos of treatment, 50% improvement versus progression of lesions on the side treated with salicylic acid. Side effects: mild erythema |
| Theos et al (2004) (23) | Safety of imiquimod 5% cream in children 1 to 9 yr of age | Double-blind, randomized pilot trial | 23 | 5% topical imiquimod cream applied in 12 patients versus control (in 11 patients) | B | At 4 and 12 wks there was partial clearance of MC in 58.3% and 66.7%, respectively, of patients treated with imiquimod versus 0% and 18.2% in the control arm |
| Cantharidin | | | | | | |
| Coloe Dosal et al (2014) (28) | Review of cantharidin to treat MC in children 5 to 10 yr of age | Double-blind, placebo-controlled trial | 29 | Cantharidin applied to lesions every 1 to 2 wks for maximum of five visits | B | Found cantharidin not more beneficial than placebo when applied for 2 mos. Side effects minimal. Report criticized for being underpowered, small sample size, lack of follow-up (50) |
| Moye et al (2014) (25) | Review of cantharidin to treat MC in children (mean age 5.8 yrs). Atopic dermatitis present in 106 patients | Retrospective review | 405 | Cantharidin applied to 9,688 lesions over 1,056 visits | C | 57% had blistering; 86% reported satisfaction and would use again |
| Coloe and Morrell (2009) (26) | Survey of satisfaction with cantharidin to treat MC | Retrospective survey | 95 surveys completed | Varying application of cantharidin used | C | 92% satisfied with cantharidin treatment, 79% had side effects (pain, blistering) |
| Hanna et al (2006) (27) | Compare efficacy and side effects of four treatments for MC: curettage, topical cantharidin 0.7%, topical salicylic acid 16.7% plus lactic acid 16.7%, and topical imiquimod cream 5% in children 1 to 18 yr of age | Prospective randomized controlled trial | 124 | Varying treatment depending on patient requirements | B | Curettage most effective treatment and fewest side effects. Cantharidin found to be efficacious but had more side effects and needed more applications. Authors concluded ideal treatment depends on the individual |

TABLE 1. Continued

| Study | Indication | Aim | Patients, <i>n</i> | Dose | SORT criteria | Findings |
|--|---|---|--------------------|---|---------------|--|
| Silverberg et al (2000) (51) | Efficacy and safety of cantharidin treatment of MC in children | Retrospective review | 300 | | B | 90% of patients had full resolution of MC, 8% improved. 95% of patients said they would use cantharidin again. Side effects: temporary burning, pain, erythema, pruritus |
| Cryotherapy Handjani et al (2014) (52) | Comparison of 10% KOH and cryotherapy to treat MC in patients 1 to 24 yrs of age (mean age 6.4 yrs) | Open randomized clinical trial | 30 | KOH 10% twice daily until lesions resolved or cryotherapy weekly for 4 wks | B | No statistically significant difference between treatment groups ($p > 0.05$). Side effects: postinflammatory hyperpigmentation noted with cryotherapy. Authors felt KOH was preferable to cryotherapy because it has fewer side effects and better cosmetic outcome |
| Al-Mutairi (2009) (29) | Comparison of imiquimod 5% cream with cryotherapy in MC in children | Prospective randomized comparative observer-blinded study | 74 | Apply 5% imiquimod cream five times per week or cryotherapy once weekly for up to 16 wks or clinical resolution. Follow-up: 6 mos | B | 91.8% cured in imiquimod group and 100% in cryotherapy group. No statistically significant difference in the cure rate. Side effects more common in the imiquimod group, including pain, scarring, bullae, pigmentary change |
| Curettage Simonart and De Maertelaer (2008) (31) | Curettage to treat MC in patients 1 to 51 yrs of age (mean age 6 yrs). Atopy present in 16 patients | Follow-up survey study | 73 | Curettage of MC lesions | C | High risk of treatment failure at weeks 4 and 8 (66% and 45%, respectively). Authors concluded risk factors for treatment failure included the number of lesions ($p < 0.001$), anatomic sites ($p < 0.001$), and atopic dermatitis |
| Pulsed dye laser Oni and Kawana (2013) (33) | Recalcitrant MC treated with pulsed dye laser in children 3 to 5 yrs of age | Case series | 15 | Single pass of 585-nm pulsed dye laser to each lesion | C | Almost-complete resolution 1 week after treatment, maintained until 1-mo follow-up. 53% of candidates available for follow-up at 3 mos; no evidence of recurrence. Side effect: transient purpura |
| Binder et al (2008) (34) | Treatment of MC with pulsed dye laser in children 2 to 13 yrs of age | Prospective, nonrandomized pilot study | 19 | One to three passes of 585-nm pulsed dye laser | B | 84.3% clearance of MC after one pass, 10.5% after two passes; one patient required three passes for resolution. |

TABLE 1. Continued

| Study | Indication | Aim | Patients, <i>n</i> | Dose | SORT criteria | Findings |
|---|--|---------------------|--------------------|---|---------------|--|
| Chatproedpral et al (2007) (35) | Efficacy of pulsed dye laser to treat MC in children | Case-control study | 20 | One to two passes of 585-nm pulsed dye laser to MC lesions | C | 70.5% lesion resolution after one treatment, 10.6% resolution after two treatments. Significant reduction in comparison with control arm ($p = 0.01$). Side effects: mild hypopigmentation (transient), erythema |
| Michel (2004) (36) | Efficacy of collagen remodeling pulsed dye laser to treat MC in children 1 to 15 yrs of age | Prospective study | 76 | One or two passes of pulsed dye laser collagen remodeling (585 nm) | C | 96.3% of lesions healed after the first treatment, 3.7% after the second. Side effect: hyperpigmentation up to 6 mos, painless because of shorter pulse duration than normal pulsed dye laser |
| Hancox et al (2003) (37) | Efficacy of pulsed dye laser to treat MC | Retrospective study | 43 | Varying passes of 585-nm laser depending on patient response to treatment | C | Resolution of all of 1,250 lesions treated; 35% had no new lesions after two passes of laser |
| Hammes et al (2001) (38) | Efficacy of pulsed dye laser to treat MC in children | Prospective study | 20 | One to two passes of pulsed dye laser | C | Resolution of MC in 95.9% after one pass and 4.1% after two passes |
| Dilute povidone-iodine with dimethylsulfoxide Capriotti et al (2016) (40) | MC on the inner thigh of a 16-year old girl treated with topical dilute povidone-iodine with dimethylsulfoxide | Case report | 1 | Cream applied twice daily | C | Effective outcome, with 50% of 75 lesions resolved at the 3-week follow-up. Patient had previously attempted treatment with antibiotic ointments and steroids |
| Interferon alpha Kilic and Kilicbay (2006) (41) | Treatment of disseminated MC in a 9-year-old boy with hyperimmunoglobulin E syndrome | Case report | 1 | 6 mos of treatment with subcutaneous interferon alpha | C | Successful outcome. Side effects: none reported |
| Cidofovir Toro et al (2000) (42) | Recalcitrant MC treated with topical cidofovir in HIV-positive children (4 and 8 yrs old); atopy status not declared | Case study | 2 | 3% cidofovir applied once daily 5 days per week for 8 wks. Nonfacial lesions had added benefit of being treated under occlusion | C | No systemic side effects, no neutropenia, but erythema and painful erosions. Successful reduction in MC |
| Davies et al (1999) (43) | Treatment of MC (covering >75% of the body surface) in a 12-year-old boy with Wiskott-Aldrich syndrome | Case report | 1 | One arm treated with 1% cidofovir for 3 wks | C | Successful outcome: after 2 to 3 wks of treatment, lesions resolved in the treated area. No systemic side effects |

TABLE 1. Continued

| Study | Indication | Aim | Patients, <i>n</i> | Dose | SORT criteria | Findings |
|---|--|-----------------------------|--------------------|---|---------------|---|
| Silver nitrate Niizeki and Hashimoto (1999) (18) | Treatment of MC with silver nitrate paste in patients 6 mos to 26 yr of age | | 389 | MC lesions treated with 40% silver nitrate | C | Resolution rate 97.7% overall. 70% of patients cured after one application. No scars |
| Sinecatechins Padilla Espana et al (2016) (44) | Treatment of recalcitrant MC in a 5-year-old girl; atopy status not declared | Case study | 1 | Sinecatechins 10% ointment applied twice a day for 4 wks | C | Follow-up at 1 mo: resolution of MC lesions. Side effects: minor erythema and irritation. No recurrence at the 3-mos follow-up |
| Cimetidine Dohil and Prendville (1996) (45) | Treatment of MC with oral cimetidine in children 18 mos to 10 yr of age. History of atopy in 76% of the cohort | Case series | 13 | Oral cimetidine 40 mg/kg/day for 2 mos | C | 10 had resolution of lesions, 3 had no new lesions but persistence. Side effects: none |
| Lemon myrtle oil (<i>Backhousia citriodora</i>) Burke et al (2004) (46) | Treatment of MC with lemon myrtle oil in children (mean age 4.6 yrs) | Randomized controlled trial | 31 | Once-daily application of 10% lemon myrtle versus olive oil (control) | B | 56% of patients treated with lemon myrtle oil and none of controls had >90% reduction in MC lesions at 3 wks ($p < 0.05$). Side effects: none |

KOH, potassium hydroxide.

been several studies (174 patients) investigating its use in MC lesions (17,19–24). One of the larger RCTs conducted in 2012 to compare the efficacy of imiquimod 5% cream with that of cryotherapy in 74 children 2 to 12 years of age with MC lesions found that imiquimod was effective at reducing MC lesions but had a slower onset of action than cryotherapy. Imiquimod cream was applied five times weekly until resolution or up to 16 weeks and cryotherapy was administered for up to 20 seconds per lesion weekly until resolution or up to 16 weeks. Because imiquimod cream had fewer side effects (in contrast with the scarring and dyspigmentation associated with cryotherapy), the authors suggested that imiquimod was still the preferred treatment option despite its slower action (19).

CANTHARIDIN

Cantharidin is a substance with vesicant properties secreted by beetles that has been used to treat warts and MC for more than 60 years. Its ability to trigger acantholysis leads to its blistering effect upon the skin. Common side effects include blistering (expected), pruritus, burning sensation, and pain. Many studies have been conducted that have demonstrated cantharidin is safe and efficacious; several large retrospective studies including 500 patients have shown up to 92% satisfaction with cathardin and up to 86% of patients stating they would use it again if needed (25,26). One large prospective RCT ($N = 124$) compared topical cantharidin 0.7% with combined topical salicylic acid and lactic acid 16.7%, topical imiquimod cream 5%, and curettage to treat MC lesions in children 1 to 18 years of age. They found curettage to be the most-efficacious treatment, with the fewest side effects, whereas cantharidin, although effective, had more side effects (namely the expected blistering) and required more frequent applications than the other agents (27). There was no placebo arm for comparison and it is impossible to blind user providers to methods used because the treatments are so noticeably different when being applied. Dosal et al (28) conducted a double-blind, placebo-controlled trial and found cantharidin was not beneficial, suggesting that previous study outcomes would have been different if a placebo arm had been added.

CRYOTHERAPY

Cryotherapy is typically used to freeze viral warts in all age groups and actinic keratoses in older

individuals. Common side effects include pain, bleeding, dyspigmentation, and blistering at the freeze site. Although it is cheap to administer and commonly used, literature describing its use for MC is scarce. One prospective randomized comparative observer-blind study ($n = 74$) reported that 100% of patients treated with cryotherapy (with MC lesions) weekly for up to 16 weeks were cured, in comparison with 91.8% treated with imiquimod cream, a difference that was not statistically significant (29).

CURETTAGE

Curettage administered to carefully selected patients can prove beneficial in the treatment of MC lesions. The epithelial surface of the papule is opened with a needle and the viral core is scraped away (sometimes using topical local anesthesia) (30). Common side effects include pain, bleeding, and infection. There is little literature on curettage to treat MC. Simonart and De Maertelaer (31) performed a follow-up survey study on the outcome of curettage to treat MC lesions in children (<18 yrs) and adults and found a high rate of recurrence at 4 (66%) and 8 (45%) weeks, respectively. They concluded that several statistically significant factors ($p < 0.001$) could increase the risk of treatment failure, including the number of lesions, anatomic site, and presence of atopic dermatitis (31).

PULSED DYE LASER

Pulsed dye laser (PDL) is typically used to treat scars, port-wine stains, telangiectasia, and hemangiomas. Several studies have suggested that PDL can be used to effectively and safely, although the mechanism of action is unknown (32), even with just one pass (33–39). Complications of PDL include pain, erythema, pigmentary changes, and rarely atrophic scarring and ulceration. One retrospective study reviewed the efficacy of PDL in 43 patients with MC lesions over 28 months and reported resolution of all 1,250 lesions treated (37). More recently, a prospective study that reviewed the use of PDL to treat MC in 76 children 1 to 15 years of age found that 96.3% of lesions healed after the first treatment. A prospective, nonrandomized pilot study that reviewed the treatment of PDL in children ($N = 19$) 2 to 13 years of age found, after one pass of 585 nm PDL, that 84.3% of MC lesions cleared and the remaining (except one requiring three passes) 10.5% cleared after two passes (34).

MISCELLANEOUS

Case studies have had positive outcomes with MC lesions treated with dilute povidone iodine with dimethylsulfoxide (40), subcutaneous interferon alpha (41), topical cidofovir (42,43), sinecatechins ointment (44), oral cimetidine (45), and lemon myrtle oil (46), all of which are detailed in Table 1. Dilute povidone-iodine with dimethylsulfoxide applied twice daily to MC lesions on the inner thigh of a 16-year-old girl was found to be effective, with half of the lesions resolved within 3 weeks (40). Subcutaneous interferon alpha has been shown to be effective in treating disseminated MC lesions in a 9-year-old boy with hyperimmunoglobulin E syndrome (41). Cidofovir was used successfully in the treatment of refractory MC lesions in patients with HIV and Wiskott–Aldrich syndrome (42,43). Sinecatechins ointment (10% applied twice daily for 4 wks) also reduced refractory MC lesions in a 4-year-old girl (44). Oral cimetidine treatment for 2 months (40 mg/kg/day) reduced MC lesions in 13 children (45). An RCT comparing lemon myrtle oil with olive oil found that more than half of the children ($n = 31$) had more than a 90% reduction in their MC lesions at 3 weeks. This was significantly more beneficial than the control arm, which showed no improvement ($p < 0.05$) (46). Finally, there is the option of treatment with immunotherapy, using *Candida* or *Trichophyton* antigens. Although some centers use this treatment modality, there is a paucity of supportive evidence (47).

All of the evidence has been rated according to the Strength of Recommendation Taxonomy (SORT) criteria to enable clinicians to determine the quality of the evidence presented. The evidence is level B at best, demonstrating that we are lacking consistent good-quality evidence with regard to the management of molluscum (48). For a study to be classified as SORT level A, it must meet strict criteria, for example, be a Cochrane review or show consistent findings from two or more good-quality RCTs.

CONCLUSION

Molluscum contagiosum is an extremely common skin condition, yet it is often poorly managed. This review has systematically reviewed the evidence for the current treatment options. Although there are many trials, few are RCTs. The largest RCTs support the use of salicylic acid (4), KOH (12), imiquimod (19), cantharidin (28), curettage (27), and lemon myrtle oil (46) in the treatment of MC lesions. The studies on PDL treatment appear promising, but

larger trials have not been conducted. As initially mentioned, MC will self-resolve with time in immunocompetent patients and therefore it remains at the clinician's discretion which patients should be treated. There is no consensus for the optimal treatment of MC, with no studies meeting grade A SORT criteria.

The evidence we have presented should aid clinicians in adopting an evidence-based approach to the management of MC. For example, a patient who is immunosuppressed and presenting with genital warts and MC may benefit from imiquimod treatment, which can be used to treat both simultaneously, as opposed to silver nitrate, which will only target MC.

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