ABSTRACT

Purpose. To evaluate the effect of calamine lotion in reducing skin irritation in children with cast immobilisation and to identify factors correlating with skin irritation.

Methods. 250 children aged 6 to 15 years who underwent cast immobilisation for limb fractures were assigned into calamine (n=122) and non-calamine (n=128) groups. Data were collected at the time the cast was applied and removed. Potential confounders (gender, age, race, medical history, drug allergy, cast type, duration of casting, and extent of itch prior to casting) were identified. Each patient graded his levels of itch, sweat, and heat using a 5-point scale (with 5 indicating most severe). The on-duty plaster technician recorded the presence and type of skin lesions (blisters, wounds, or others) during cast removal.

Results. Children in the calamine group were less likely to develop skin lesions (1 vs. 9, odds ratio [OR]=0.115, p=0.009), had less itch during casting (mean difference=0.74, p<0.0001), had a greater decrease in the itch level (mean difference=0.84, p<0.0001), and had lower sweat levels (p=0.048). After adjusting for confounders, the chance of developing skin lesions remained lower in the calamine group (OR=0.063, p=0.003). Being an older child and having shorter duration of casting were associated with presence of skin lesions. The odds for having skin lesions increased by 39.2% per year increase in age (OR=1.392, p=0.04) and decreased by 9.4% per day increase in casting duration (OR=0.906, p=0.03). The decrease in itch level remained significantly greater in the calamine group after adjusting for confounders (p<0.0001).

Conclusion. Calamine lotion may reduce skin irritation in children with full casts.

Key words: calamine, phenol drug combination; casts, surgical; child; fracture healing; pruritus; skin; sweat

INTRODUCTION

Skin irritation during cast immobilisation is a...
common complaint, especially for patients in humid tropical regions. It may lead to patient and caretaker stress, cast breakdown, and skin complications. Calamine lotion is a widely used topical agent to soothe skin irritation. This study evaluated the effect of calamine lotion on reducing skin irritation (in terms of presence of skin lesions and levels of itch, sweat, and heat) in children with cast immobilisation and identified factors correlating with skin irritation.

**MATERIALS AND METHODS**

Ethics approval was obtained from the centralised institutional review board, and informed consent was obtained from the parent of each patient. 180 boys and 70 girls aged 6 to 15 (mean, 10) years who underwent cast immobilisation for fractures of the supracondylar humerus, distal radius, radio-ulnar shaft, tibia, and other limb parts were assigned into the calamine (n=122) and non-calamine (n=128) groups. Categorisation was based on the day of presentation (even vs. odd); each week the groups were swapped to balance the numbers of patients. Patients younger than 6 years or having pre-existing skin lesions, moderate or severe atopic eczema or asthma, or multiple drug allergies were excluded.

Calamol lotion containing calamine BP 15% (ICM Pharma, Singapore), which is a mixture of zinc oxide and 0.5% ferric oxide, and excipients such as glycerol, bentonite, sodium citrate, phenol, and purified water, was applied to the would-be-enclosed skin surface prior to casting. For both groups, cotton stockinet as a protective sleeve adjacent to the skin was pulled over the area to be casted. Soffban Plus (BSN Medical, Germany) cotton undercast padding was then applied. Scotchcast Plus (3M Health Care, Germany) fibreglass cast was then layered over the cotton padding and moulded to fit the fracture region. Routine cast care instructions were given.

**Table 1**

Comparison of the calamine and non-calamine groups

| Variable                  | Calamine (n=122) | Non-calamine (n=128) | Statistical test† | df | p Value |
|---------------------------|------------------|----------------------|-------------------|----|---------|
| Patient age (years)       | 10.31±2.76       | 9.85±2.87            | -1.29             | 248| 0.198   |
| Itch level prior full casting | 2.57±1.25       | 2.46±1.21           | -0.68            | 246| 0.500   |
| Duration of casting (days) | 22 (1–385)       | 26 (1–245)           | -2.718            | -  | 0.007   |
| Sex                       |                  |                      |                   |    |         |
| Male                      | 88 (72.1)        | 92 (71.9)            |                   |    |         |
| Female                    | 34 (27.9)        | 36 (28.1)            |                   |    |         |
| Race                      |                  |                      |                   |    |         |
| Chinese                   | 76 (62.3)        | 74 (58.3)            |                   |    |         |
| Malay                     | 23 (18.9)        | 29 (22.8)            |                   |    |         |
| Indian                    | 21 (17.2)        | 16 (12.6)            |                   |    |         |
| Others                    | 2 (1.6)          | 8 (6.3)              |                   |    |         |
| Medical problem           |                  |                      |                   |    |         |
| Nil                       | 114 (95.0)       | 112 (88.9)           |                   |    |         |
| Asthma/eczema             | 6 (5.0)          | 14 (11.1)            |                   |    |         |
| Drug allergy              |                  |                      |                   |    |         |
| Nil                       | 118 (98.3)       | 123 (98.4)           |                   |    |         |
| Present                   | 2 (1.7)          | 2 (1.6)              |                   |    |         |
| Fracture                  |                  |                      |                   |    |         |
| Supracondylar             | 50 (43.1)        | 57 (46.3)            |                   |    |         |
| Distal radius             | 47 (40.5)        | 53 (43.1)            |                   |    |         |
| Radio-ulnar shaft         | 7 (6.0)          | 2 (1.6)              |                   |    |         |
| Tibia                     | 0 (0)            | 3 (2.4)              |                   |    |         |
| Others                    | 12 (10.3)        | 8 (6.5)              |                   |    |         |
| Cast                      |                  |                      |                   |    |         |
| Above elbow               | 63 (55.8)        | 60 (48.8)            |                   |    |         |
| Below elbow               | 39 (34.5)        | 49 (39.8)            |                   |    |         |
| Above knee                | 2 (1.8)          | 2 (1.6)              |                   |    |         |
| Below knee                | 8 (7.1)          | 9 (7.3)              |                   |    |         |
| Others                    | 1 (0.9)          | 3 (2.4)              |                   |    |         |

* Data are presented as mean±SD, median (range), or no. (%) of patients; the sum of percentages may not total 100 due to missing data

† Likelihood ratio Chi-square test, t test, and Mann-Whitney U test are used for testing variables presented in no. (%) of patients, mean±SD, and median (range), respectively
Data were collected at the time the cast was applied and removed. Potential confounders (gender, age, race, medical history, drug allergy, cast type, duration of casting, and extent of itch prior to casting) were identified. Each patient was asked to grade his levels of itch, sweat, and heat using a 5-point scale (5 indicating most severe). The on-duty plaster technician recorded the presence and type of skin lesions (blisters, wounds, or others) during cast removal.

The 2 groups were compared using the likelihood ratio Chi-square test, t test or Mann-Whitney U test. When necessary, the Satterthwaite adjustment was applied to the t test. To account for confounders on treatment effect, multiple logistic regression of outcome measures on treatment group and confounders was also conducted. The adjusted treatment effects were estimated, and the effect of each confounder was tested using the SAS type III sums of squares. To test for difference in detection of skin lesions in different skin colours, the presence of skin lesions was compared across races using the likelihood ratio Chi-square test. To test whether the duration of casting differed across cast types and to examine whether cast type was associated with the itch level, the Kruskal-Wallis test was used. A p value of <0.05 was considered statistically significant.

RESULTS

The median duration of casting was 24 (range, 1–385) days; it was shorter in the calamine than non-calamine group (22 vs. 26 days, p=0.007, Table 1). This could confound the effect of calamine on outcomes, and thus warranted adjusted comparisons of outcomes. All other baseline characteristics did not differ significantly between the 2 groups.

Patients in the calamine group were less likely to develop skin lesions (1 vs. 9, odds ratio [OR]=0.115, 95% confidence interval [CI]=0.014–0.922, p=0.009), had less itch during casting (mean difference=0.74, 95% CI=0.53–0.95, p<0.0001), had a greater decrease in the itch level (mean difference=0.84, 95% CI=0.47–1.21, p<0.0001), and had lower sweat levels (p=0.048). The marginal difference in the latter was 0.06, which was not clinically important in a 5-point scale (Table 2).

After adjusting for confounders, the calamine group remained less likely to develop skin lesions (OR=0.063, 95% CI=0.001–0.559, p=0.003) and had a greater decrease in the itch level (p<0.0001) [Table 3]. Being an older child and having shorter duration of casting were associated with the presence of skin lesions. The odds for having skin lesions increased by 39.2% per year increase in age (OR=1.392, 95% CI=1.014–1.911, p=0.04) and decreased by 9.4% per day increase in casting duration (OR=0.906, 95% CI=0.831–0.988, p=0.03).

The likelihood of skin lesions did not differ significantly across races ($\chi^2=2.18$, df=3, p=0.54). The duration of casting $\chi^2=1.40$, df=4, p=0.84) and itch levels ($\chi^2=4.98$, df=4, p=0.29) did not differ significantly among different cast types (Table 3).

### Table 2

| Outcome                  | Calamine (n=122) | Non-calamine (n=128) | Mean difference or OR (95% CI) | Statistical test† | df | p Value |
|---------------------------|------------------|----------------------|--------------------------------|-------------------|----|---------|
| Itch during casting       | 1.28±0.62        | 2.02±1.01            | 0.74 (0.53–0.95)                | 6.98              | 212 | <0.0001 |
| Decrease in itch levels   | -1.29±1.42       | -0.45±1.51           | 0.84 (0.47–1.21)                | 4.51              | 246 | <0.0001 |
| Level of sweat            | 1.02±0.13        | 1.08±0.32            | 0.06 (0.00–0.12)                | 1.99              | 167 | 0.048‡  |
| Level of heat             | 1.13±0.42        | 1.16±0.58            | 0.03 (-0.10–0.16)               | 0.47              | 232 | 0.639‡  |
| Presence of skin lesion   |                  |                      | 0.12 (0.01–0.92)                | 6.835             | 1   | 0.009   |
| None                      | 114 (99.1)       | 118 (92.9)           | -                               | 13.334            | 2   | 0.001   |
| Present                   | 1 (0.9)          | 9 (7.1)              | -                               |                   |     |         |
| Type of skin lesion       |                  |                      | -                               |                   |     |         |
| None                      | 114 (99.1)       | 118 (92.9)           | -                               |                   |     |         |
| Blisters                  | 0 (0)            | 9 (7.1)              | -                               |                   |     |         |
| Wounds                    | 0 (0)            | 0 (0)                | -                               |                   |     |         |
| Others                    | 1 (0.9)          | 0 (0)                | -                               |                   |     |         |

* Data are presented as mean±SD or no. (%) of patients
† Likelihood ratio Chi-square test and t test are used for testing variables presented in no. (%) of patients and mean±SD, respectively
‡ Test of equal variances rejected; the Satterthwaite method used
DISCUSSION

In the current study, calamine lotion reduced the risk of developing skin lesions and the extent of itch in children with casts. However, the duration of casting was significantly shorter in the calamine group. This could confound the effect of calamine on outcomes, and thus adjustments were made. The duration of casting depended on the time of bone union. The decision for cast removal was independent of cast type or the child’s complaint of skin irritation.

Being an older child and having shorter casting duration were associated with a greater chance of developing skin lesions. This may have been due to the fact that older children are more likely to devise means to relieve itch by scratching (although skin lesions can develop de novo) and that longer casting duration enables development of itch tolerance and enough time for resolution of skin lesions.

Prior to full casting, a plaster-of-Paris slab was worn for up to a week. This may have contributed to pre-cast itch, as it was thicker and heavier than fibreglass casts, and was applied without a protective stockinet wrap to line the skin. In addition, after the period of the temporary plaster-of-Paris slab, the children may have become more receptive and better adjusted to full casting, and more tolerant of the lighter fibreglass cast. Thus, the itch levels in both groups were lower during full casting than temporary plaster-of-Paris casting.

Under the semi- or non-permeable cast material, circulation of air is minimal and perspiration vapour cannot readily evaporate from the enclosed skin. The build-up of moisture, body oil, skin squames, and bacteria may result in skin problems that may manifest as itch, warmth, and moisture (or sweating), odour, and skin maceration. Scratching may cause abrasions, secondary skin ulcerations, and abscess formation.2

Diverse materials are used in the production of cast liners to improve its waterproof quality and ‘breathability’ such as Gore-Tex fabric, cool air blown into the cast, and ingestion of anti-histamines to alleviate itch.3,4 Calamine lotion, known for its anti-pruritic, anti-septic, and astringent properties, is a safe topical agent for the relief of itch and minor skin irritation. Its anti-itch property is attributed to its phenol content through its cooling effect upon evaporation from the surface of the skin. The anti-pruritic effect is thought to be most marked during evaporation and drying. The importance of skin care after casting is emphasised. If the skin becomes wet, drying within the cast is difficult.

One limitation of this study was that a sham lotion was not used in the control group, which would have enabled blinding of the children, parents,
and plaster technicians. Nonetheless, the presence of skin lesions is an objective outcome measure. In addition, the 3 plaster technicians were not blinded and their casting techniques may have varied slightly. Moreover, younger children may have had difficulty comprehending the 5-point scale, and grading of the outcomes by children may not have been in a common time frame. Other factors that may have affected outcomes (e.g. patient activity level, air-conditioning, use of anti-histamine medication) were not taken into account. Calamine is most effective during evaporation from skin shortly after application, hence its longer-term effect from a single application lasting throughout the duration of casting needs to be ascertained.

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**DISCLOSURE**

No conflicts of interest were declared by the authors.

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