EXHAUST SYSTEM-RELATED BURNS AFFECTING CHILDREN: A UK PERSPECTIVE AND LITERATURE REVIEW

BRÛLURES PÉDIATRIQUES PAR POT D’ÉCHAPPEMENT: DONNÉES AU ROYAUME UNI ET REVUE DE LA LITTÉRATURE

Vermaak P.V.,¹ Deall C.E.,² McArdle C.,¹ Burge T.¹

¹ Department of Plastic and Reconstructive Surgery, Frenchay Hospital, Bristol, United Kingdom
² Department of Plastic Surgery, University Hospitals of North Midlands, Stoke-on-Trent, United Kingdom

SUMMARY. Burns caused by exhaust systems in children may be associated with considerable morbidity. Current epidemiological data varies, but no data are available for the UK population. We aim to identify the pattern of exhaust-related burns affecting children who presented to a regional centre for paediatric burn care in the UK. Patients who sustained burns related to exhaust mechanisms between May 2005 and August 2012 were identified via the departmental database. Data collected included patient demographics, burn injury information, management and outcomes. Thirty-nine patients sustained 43 burns from contact with exhaust mechanisms, and the majority were less than 5 years of age. 77% of the patients were male. Burns affected critical areas such as the hands and feet in 26% of cases. Most burns involved a total body surface area of ≤1% and were partial thickness in depth. Thirty-three percent of patients required operative intervention. Time to heal was less than 3 weeks in 69% of cases and 3 patients healed with hypertrophic scarring. The majority of burns were small in size and partial thickness in depth. Most were treated conservatively and healed with low complication rates. More than 1 in 5 injuries involved critical burn areas, highlighting the potential for considerable morbidity. The age profile in our study contrasted with other results worldwide. Our study highlights the need for vigilant supervision of children around motorcycles. We recommend the wearing of protective long trousers when riding motorcycles and the fitting of external shields to motorcycle exhaust pipes.

Keywords: exhaust, muffler, paediatric, contact burn, UK

RÉSUMÉ. Les brûlures par pot d’échappement chez l’enfant peuvent être responsables d’une morbidité importante. Les données épidémiologiques actuelles sont variables, mais il n’y en a pas au Royaume Uni. Nous avons analysé les circonstances de survenue des brûlures par pot d’échappement touchant les enfants vus dans un CTE régional du Royaume Uni, entre mai 2005 et août 2012, retrouvés via la banque de données régionale. Les variables analysées étaient les données démographiques, le mécanisme précis de la brûlure, la prise en charge et le devenir. Trente-neuf patients ont subi 43 brûlures par ce mécanisme, la majorité ayant moins de 5 ans, 77% d’entre eux étant des garçons. Les brûlures atteignaient des régions sensibles (mains, pieds) dans 26% des cas, touchaient moins de 1% de SCF dans la pluspart des cas et étaient fréquemment intermédiaires. Trente-neuf pour cent des patients ont nécessité une intervention chirurgicale. Dans 69% des cas, la cicatrisation était obtenue en moins de 3 semaines, 3 patients ont développé une cicatrice hypertrophique. La majorité des brûlures touchent une petite surface et sont peu profondes, cicatrisant sans chirurgie ni séquelles. Plus d’une brûlure sur 5 touche des zones fonctionnelles, avec un potentiel morbose élevé. La classe d’âge touchée est contrastée avec les données retrouvées ailleurs et nécessite une vigilance accrue au profit des enfants lorsqu’ils sont autour de 2 roues à moteur. Nous recommandons de porter des pantalons longs et la mise en place de protections autour des pots d’échappement.

Mots-clés: pot d’échappement, silencieux, enfant, brûlure par contact, Royaume Uni

Introduction

The South West UK Children’s Burn Centre is a large regional paediatric burns service based in Bristol, UK, which provides burn care to more than 700 children a year. Contact burns are the second most common mechanism of burn injury presenting to this unit.

Motor vehicle numbers have continued to rise annually for decades. In the last 20 years there has been an increase of 69% in the number of licensed motorcycles.¹ Over the course of the 7 years relevant to this study, while the number of licensed motorcycles continued to rise initially, it fell back in the later years. Children may have a greater predisposition for burns related to exhaust systems, and Matzavakis et al. found that the incidence of such injuries in children is twice that of the adult population.² This may be due to their relatively short stature and thin dermis.³ Although the resulting burns are usually small in size, they often require surgical intervention and may be associated with considerable morbidity (Fig. 1). To date, epidemiological data has varied between Europe, Australia, the Far East and America, but no data is available for the UK population.

The aim was to identify the pattern of exhaust-related burns affecting children by epidemiological analysis of such injuries presenting to this Burns Centre.

¹ Corresponding author: Ciara Deall, 16 Butterfield Rd, Bassett, Southampton, SO16 7EE, UK. Tel.: +44 (0)7770 056767; email: ciara.deall@nhs.net
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Materials and methods

All patients who sustained a burn injury related to exhaust systems between May 2005 and August 2012 were identified via the computerised paediatric burns database. Cases were scrutinised and data captured retrospectively using a standardised data collection sheet. Data collected included patient demographics, incident information, burn characteristics, management and inpatient details, follow-up appointments and outcomes.

Results

In a series of 4,650 patients admitted to the unit over this time period, 1,458 presented with contact burns. Thirty-nine patients sustained 43 burns from contact with exhaust mechanisms. A seasonal variation was noted, with more patients suffering burns during the summer months (49%, n=19). The majority were related to the exhaust systems of motorcycles (72%, n=28), followed by that of scooters/mopeds (13%, n=5). The incidence of these burns, related to patient age and gender, is shown in Table I.

Nearly three-quarters of burns involved the lower limbs and 26% (n=11) affected critical burn areas such as the hands, feet and face. The distribution of burns is shown in Fig. 2. 58% (n=25) of burns were partial thickness in depth and 53% (n=23) involved a total body surface area (TBSA) of less than 1% (Fig. 3).

Twenty-five patients were managed conservatively with debridement of the burns and application of dressings. Operative intervention was required in 33% (n=13) of cases and of these, 77% (n=10) needed tangential excision and split thickness skin grafting of their burns (Fig. 4). Median length of stay following operative intervention was 2.5 days (range 1-19 days). One patient was lost to follow up and therefore their data was not included in the cohort. Overall, the time to heal was less than 3 weeks in 69% (n=27) of patients; details are noted in Table II. The median number of clinic appointments for patients managed conservatively and operatively was 2 (range 1-7) and 3 (range 1-8) respectively. Three patients healed with hypertrophic scarring.

Discussion

Previous studies have found that motorcycles accounted for between 6.5% and 9%\(^5\) of burns arising from motor vehi-
cicle accidents. Contact burns are a common cause of burn injury presenting to this unit and burns from exhaust mechanisms add to the large number of these injuries. Epidemiological data for this mechanism of injury exists in the USA, Europe, Far East and Australia, but has not been reported on in the UK.

Data from Greece published by Matzavakis et al. showed that the incidence of exhaust mechanism injuries in patients under 15 years of age was greatest in females. They noted that the majority of burns affected the right leg and were partial thickness in depth in 70% of cases. In all the cases treated, 43% were followed up.

In Taiwan, Lai et al. reported that burns related to this mechanism of injury affected mostly the lower legs of young females. They found that these burns were related to the density of motorcycles on the road during peak traffic hours, and that patients sustained most burns to the lateral aspects of their legs, as they were stationary in traffic or walking in between parked motorcycles. In an experiment, they measured the temperature of motorcycle exhaust pipes at different time intervals and found that the temperature was highest 5 minutes after stopping the engine. The majority of burns sustained were partial thickness in depth and 11.5% required tangential excision and split skin grafting. As a preventive measure, they fitted commercially available external shields to the exhaust pipes and found that the temperature of the shields reached no higher than 60°C. From previous studies, we know that the critical temperature for collagen contraction is 63-66°C, proving this to be an effective preventative intervention.

In Brisbane, it was reported that these injuries commonly involved male patients with a median age of 8 years and predominantly affected the right lower limb. There was an equal split between partial and full thickness burns, and 54% of patients required operative intervention.

In Sydney, Rajan et al. saw a peak of exhaust burns in males under the age of 5 years. Two thirds affected the lower extremity and 60% involved a TBSA of less than 1%. A third of cases required surgical intervention and most healed in approximately 20 days. Hypertrophic scarring was seen in 12.5%.

Nelson et al. published their experience with these injuries in Gainesville, Florida, USA. The injuries were seen most often in male patients with a mean age of 7 years. The average burn involved a TBSA of 5%, with 70% affecting the lower extremity.

**BIBLIOGRAPHY**


Contact burn injuries are common and burns associated with exhaust systems are a preventable mechanism of injury. Importantly, this data demonstrates that more than 1 in 5 injuries involved critical burn areas such as the hands and feet, highlighting the potential for considerable morbidity. The aim is to raise awareness of this mechanism of injury and suggest the following preventive measures:

- vigilant supervision of children around motorcycles;
- use of appropriate protective gear when riding motorcycles (including long trousers, Fig. 5a);
- fitting of external shields to motorcycle exhaust pipes (Fig. 5b).

**Conclusions**

Two-thirds of the burns were full thickness in depth and 91% required surgical intervention, of which 76% of cases had tangential excision and split skin grafting. Their findings were markedly different from previous studies in that TBSA was much higher and consequently more patients required excision and grafting of their burns.

Unlike the findings from units in Taiwan and America, the majority of burns in our cohort affected young boys, were small in size and partial thickness in depth. The greater part of these injuries were treated conservatively and healed with low complication rates, similar to the findings from Sydney, Australia.

This data was presented at the British Burn Association (BBA) annual meeting (Liverpool, May 2013) and has been forwarded to the BBA prevention committee.

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