Oesophageal corrosive injuries in children: a forgotten social and health challenge in developing countries

Sandro Contini,[a] Alim Swarray-Deen[b] & Carmelo Scarpignato[c]

Problem An unsafe environment is a risk factor for child injury and violence. Among those injuries that are caused by an unsafe environment, the accidental ingestion of corrosive substances is significant, especially in developing countries where it is generally underreported.

Approach To address this challenging, unmet medical need, we started a humanitarian programme in Sierra Leone. By reviewing the current literature from developing countries and our own experience in the field, we developed a flowchart for management of this clinical condition.

Local setting This injury is underreported in developing countries. Data available are heavily skewed towards well-resourced centres and do not reflect the entire reality of the condition. Late oesophageal strictures are usually severe. Parent's lack of knowledge, crowded living conditions and availability of chemicals in and around houses account for most ingestions. The widespread lack of any preventive measures represents the strongest risk factor.

Relevant changes Timely admission was observed in 19.5% of 148 patients studied. A gastrostomy was performed on 62.1% of patients, 42.8% had recurrent strictures and 19% are still on a continuous dilatation programme. Perforation and death rate were respectively 5.6% and 4%.

Lessons learned The majority of oesophageal caustic strictures in children are observed late, when dilatation procedures are likely to be more difficult and carry a significantly higher recurrence rate. Gastrostomy is necessary to maintain adequate nutritional status but mothers need training in feeding techniques. Both improvement in nutritional status and sustained oesophageal patency should be the reference points to a successful dilatation.

Une traduction en français de ce résumé figure à la fin de l'article. *Al final del artículo se facilita una traducción al español.* الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

An unsafe environment is a substantial risk factor for child injury and violence, therefore representing a significant cause of child death and disability especially in developing countries, where 95% of all child injury deaths occur.[1,2] Among those injuries that are caused by an unsafe environment, the accidental ingestion of corrosive substances is declining in high-income countries[3–5] but not in developing countries,[6] where it is quite significant, especially among illiterate people with poor socioeconomic status. Nevertheless, information about prevention, management and outcome of these common accidents in children of low- and lower-middle income countries is scarce.

The Italian nongovernmental organization, Emergency, is currently running five surgical centres in Afghanistan,[3] Cambodia[1] and Sierra Leone,[1] mainly for the surgical treatment of war and civilian trauma injuries. In the first years of Emergency's work in Sierra Leone, which began in November 2001, an unexpectedly high number of children were admitted after accidental caustic injuries, most of them having been treated at home or by local doctors, often resulting in oesophageal perforation and death. Between December 2005 and June 2008, 148 children were admitted to the hospital for accidental caustic soda ingestion. To meet this increasing medical need, at the end of 2005 the hospital was supplied with paediatric and adult upper gastrointestinal fibre-optic endoscopes and with dilatation devices (Savary bougies, balloon catheters) to manage these injuries either in the acute or in the late phase when severe oesophageal strictures can occur.[7] Stimulated by this high number of patients, a medical literature review was performed from 1990 to 2007 (inclusive) for papers about caustic ingestion coming from low- or lower-middle income countries.[8] The data sources included four independent databases: MEDLINE, EMBASE, SciELO and LILACS.

Situation analysis

Only 37 papers were found concerning corrosive ingestion in children of low- and lower-middle income countries. Ninety-four per cent were published by referral hospitals and 59% came from Africa. Only eight papers concerned the specific epidemiology of caustic ingestion. Children aged less than 5 years were most frequently injured (80%), and boys exceeded girls (70%). The most reported corrosive agent was caustic soda, followed by kerosene, sodium hypochlorite and generic household chemicals. The ingestion of acid was more common in India than in other countries. Corrosive ingestion accounted for 0.3% of paediatric admissions in the Gambia[9] and for 0.5% in Nigeria,[10] thus amounting to a 0.84% of total childhood mortality in that country. Death rates ranged

[a] Department of Surgical Sciences, University of Parma, Via Gramsci 14, 43100, Parma, Italy.
[b] Emergency Surgical Center, Goderich, Sierra Leone.
[c] Department of Anatomy, Pharmacology and Forensic Sciences, University of Parma, Parma, Italy.
Correspondence to Sandro Contini (e-mail: sandro.contini@unipr.it).
(*Submitted: 16 September 2008 – Revised version received: 6 December 2009 – Accepted: 27 February 2009*)

from 0 to 11.9% (mean 4.1%) although the rate of late oesophageal strictures can reach 50% in the presence of early severe oesophageal lesions.[11,12]

This type of injury is largely unreported in developing countries and its true prevalence simply cannot be extrapolated from random articles or personal experience. The data available are heavily skewed towards well-resourced centres and do not reflect the entire reality of the condition. District hospitals probably observe most of these children, but their caseload is largely unknown. Sometimes children may not arrive at the hospital, either because they are too ill and die, they live too far away or their lesions are not severe. Occasionally families cannot afford the cost of long-term and complex therapies. With such a lack of data, it is hard to estimate, even roughly, the proportion of patients who do not seek medical care from hospitals.

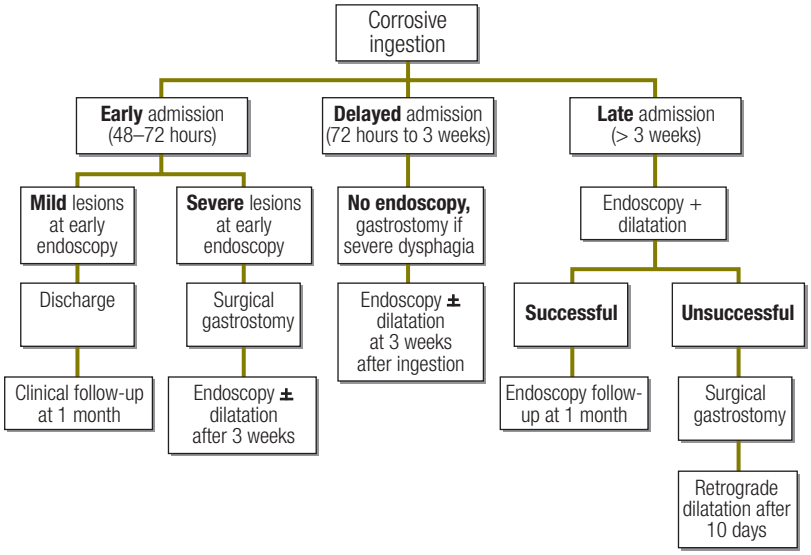
Most ingestions are due to parent's lack of knowledge of the hazards of corrosive substances kept in the house, crowded living conditions in slums and the availability of chemicals in and around the houses, combined with the natural curiosity of children. The widespread lack of any preventive measures is the strongest risk factor for these injuries.

Approach

All children admitted for caustic ingestion before December 2005, and still being followed up, were recalled to assess them endoscopically and to submit them to a dilatation, if needed. While the programme was aimed at treating children coming from areas nearby, a progressive increase in admissions was observed as patients were referred by international nongovernmental organizations from distant towns or villages.

Patients admitted soon after injury (48–72 hours after ingestion), and with absent or mild oesophageal lesions at endoscopy, were usually discharged. Children with more severe oesophageal findings or severe dysphagia were admitted and a second endoscopic examination/dilatation, was scheduled after 3 weeks. The most significant therapeutic option in the acute post-injury phase was a surgical gastrostomy, performed in children unable to swallow liquids or saliva, to achieve adequate nutritional support. When patients arrived at the hospital after a delay of 72 hours to 3 weeks after ingestion, endoscopy was not carried out due to the high risk of perforation. A gastrostomy was performed in the presence of severe dysphagia or after an unsuccessful dilatation attempt in children admitted late, i.e. at more than 3 weeks after the injury, with swallowing problems. The first dilatation was always carried out at least 3 weeks after ingestion. This management strategy is represented in Fig. 1.

Fig. 1. **Flowchart for the management of corrosive ingestions in children, adopted at the Emergency Surgical Center in Goderich, Sierra Leone**



Dilatations were performed at 7–10 day intervals, usually by means of rigid Savary bougies (93.6%), while balloon dilatation was employed only in a few patients (9.6%) that we treated at the beginning of our research project. Guide wires and dilators were preferably introduced through the gastrostomy (if performed) by a retrograde approach. The gastrostomy was removed after a period of at least 8–12 months without dysphagia. Mandatory reference points for a successful outcome were considered to be: a long-lasting oesophageal patency together with an improvement in nutritional status, assessed by weight-for-height parameters[13] (if < 80%, an increase to > 80%; if > 80, increase of 1 standard deviation). A training programme for gastrostomy and post-dilatation feeding was carried out with the patients' mothers to help meet these requirements.

Results

From December 2005 to July 2008, 148 children (aged 14 months to 15 years; mean 4.5 years; 58.4% males) were admitted for accidental caustic ingestion. Only 29 of these (19.5%) were admitted early; two of them (6.8%) with severe respiratory tract damage leading to death. Twenty showed mild or no lesions and were discharged. All other children (119) were admitted several days, weeks, even months after ingestion, complaining of severe dysphagia. Overall, 126 children were submitted to dilatation, with a mean of 4.9 (range: 1–23) procedures per child. A gastrostomy was done on 92 of 126 children (i.e. 73%).

Recurrent strictures were experienced in 54 of 126 (42.8%), and were significantly more frequent in late oesophageal narrowing.[14] Twenty-four (19%) children are still on a continuous dilatation programme. In 3 patients it was not possible to overcome the stricture and two of them were sent for oesophageal replacement elsewhere. Perforation was observed in seven patients (5.6%) with two deaths, both after balloon dilatation. Successful (as defined previously) dilatations were

obtained in 96 children (i.e. 76%). The total death rate was 4% (5/126).

Discussion

Corrosive ingestions by children in developing countries have some peculiar features (Box 1). The most frequently ingested substances, such as caustic soda, have a powerful solvent action that results in very serious injuries, as confirmed by 73% of children needing gastrostomy feeding, in sharp contrast with the 11% of severe injuries reported in a multicentric study from a high-income country.[15] Many injuries do recur, with one-fifth of patients still requiring a continuous dilatation programme. Unfortunately, long-term dilatation programmes are very challenging in low-income countries. Repeated hospital visits cost money, may result in loss of work for parents and neglect of other children at home. After the first few visits to the hospital, the parents may get exhausted and start feeling frustrated. These socioeconomic and psychological factors must then be taken into account in the long-term follow up.

Patients are frequently treated at home by traditional therapies, by witch doctors or by physicians working in district hospitals without specific expertise in the field. They may require several days of travel to reach the hospital, meaning timely evaluation and treatment of these accidents is unlikely. Furthermore, frequently children are admitted when the stricture is already well established. Late dilatations are more difficult and followed by a significantly higher recurrence rate than early procedures.[13] A delayed presentation and treatment has been considered a strong predictor for a future oesophageal replacement.[16]

Box 1. **Lessons learned**

The majority of oesophageal caustic strictures in children are observed late, when dilatation procedures are likely to be more difficult and carry a significantly higher recurrence rate.

Gastrostomy is necessary to maintain adequate nutritional status but mothers need training to feed their children this way.

Both improvement in nutritional status and sustained oesophageal patency should be the reference points to a successful dilatation.

Gastrostomy is necessary to feed patients and to keep them alive. However, feeding through gastrostomy or after dilatation may be followed by progressive malnutrition due to the inability of the families to nourish children properly and the lack of appropriate feeding solutions. Mothers should be trained and helped in feeding techniques. Moreover, gastrostomy is useful for a retrograde dilatation, as it is less risky and also provides the option to leave a string running through the stricture, from the gastrostomy through the nose. This is particularly helpful in cases of severe stricture that are difficult to overcome using guide wires.

When evaluating the outcome of treatment, both an improvement in nutritional status and sustained oesophageal patency, with an adequate lumen to guarantee normal food intake for growth and development, should be the reference points to a successful dilatation. Defining risk factors and groups at risk, providing appropriate education and enforcing regulations for manufacturers of household products would certainly help to reduce significantly the number of fatalities. Governments should play their role in educating people, but their efforts (if any) may be unsuccessful due to the high rate of illiteracy and to poorly resourced health systems. Even humanitarian organizations could make efforts in this direction but, again, there has not yet been enough focus on the seriousness of the problem. ■

Acknowledgements

This work has been possible thanks to the skilful cooperation of the staff of the Italian nongovernmental organization Emergency either at the Emergency Surgical Center in Goderich (Sierra Leone) or at the Milan (Italy) HQ.

Funding: The programme of treatment of corrosive injuries at the Emergency Surgical Center in Sierra Leone was financially supported by the Fondazione della Cassa di Risparmio di Parma, Parma, Italy.

Competing interests: None declared.

Résumé

Lésions corrosives de l'œsophage chez l'enfant : un problème social et sanitaire oublié dans les pays en développement

Problématique Vivre dans un environnement dangereux est un facteur de risque de traumatismes ou de violence pour les enfants. Parmi les traumatismes pouvant résulter d'un environnement dangereux, l'ingestion accidentelle de substances corrosives tient une place importante, en particulier dans les pays en développement où elle fait généralement l'objet d'une sous-notification.

Démarche Pour faire face au défi que représente ce besoin médical non satisfait, nous avons lancé un programme humanitaire au Sierra Leone. En examinant la littérature provenant actuellement des pays en développement et l'expérience que nous avons acquise dans ce domaine, nous avons mis au point un organigramme pour la prise en charge de cette situation clinique.

Contexte local Ce type de traumatisme est insuffisamment notifié dans les pays en développement. Les données disponibles sont fortement biaisées par la présence de centres disposant de ressources satisfaisantes et ne reflètent pas complètement la réalité de ce problème de santé. Les sténoses œsophagiennes tardives sont habituellement graves. Le manque de connaissances des parents, la vie dans des conditions de surpeuplement et la disponibilité de produits chimiques à l'intérieur et autour des maisons sont responsables de la plupart des ingestions. L'absence totale de mesure préventive un peu partout est le facteur de risque le plus important.

Modifications pertinentes Une admission en temps utile a été observée pour 19,5 % des 148 patients étudiés. Sur l'ensemble des patients, 62,1 % ont subi une gastrotomie, 42,8 % ont présenté des sténoses récurrentes et 19 % étaient encore soumis à un programme de dilatation continue. Les taux de perforation et de mortalité étaient de 5,6 % et 4 % respectivement.
Enseignements tirés La majorité des sténoses œsophagiennes d'origine caustique s'observent tardivement chez l'enfant, lorsque les procédures de dilatation deviennent probablement plus difficiles et sont associées à un taux de récurrence significativement plus élevé. La gastrotomie est nécessaire pour maintenir un état nutritionnel normal, mais il faut apprendre aux mères les techniques d'alimentation. L'amélioration de l'état nutritionnel et une perméabilité œsophagienne durable doivent être pris comme points de référence pour juger du succès de la dilatation.

Resumen

Lesiones corrosivas del esofágio en los niños: un problema social y sanitario desatendido en los países en desarrollo

Problema Un entorno inseguro es un factor de riesgo de violencia y lesiones para los niños. Una causa importante de ese tipo de lesiones es la ingestión accidental de sustancias corrosivas, sobre todo en los países en desarrollo, donde muchos de esos casos no se notifican.
Enfoque A fin de responder a esa necesidad médica desatendida, pusimos en marcha un programa humanitario en Sierra Leona. Analizando la bibliografía actual relativa a los países en desarrollo y nuestra propia experiencia en ese campo, elaboramos un diagrama de flujo para el manejo de este cuadro clínico.
Contexto local Este tipo de lesiones no se notifican lo suficiente en los países en desarrollo. Los datos disponibles están muy sesgados hacia los centros ricos en recursos y no reflejan toda la realidad de esa enfermedad. Las estenosis esofágicas tardías son por lo general graves. La falta de conocimientos de los progenitores, el hacinamiento y el acceso a productos químicos en los hogares y en sus alrededores explican la mayoría de las ingestiones. La falta generalizada de cualquier medida preventiva es el mayor factor de riesgo.
Cambios destacables El 19,5% de los 148 pacientes estudiados fueron ingresados a tiempo. En un 62,1% de los casos se practicó una gastrostomía, el 42,8% presentaron estenosis recurrentes, y un 19% siguen todavía un programa de dilatación progresiva. Las tasas de perforación y de mortalidad fueron respectivamente del 5,6% y el 4%.
Enseñanzas extraídas La mayoría de las estenosis esofágicas por sustancias cáusticas en los niños se observan tardíamente, cuando los procedimientos de dilatación suelen ser más difíciles y se asocian a una tasa de recaídas considerablemente mayor. Se requiere una gastrostomía para mantener un estado nutricional adecuado, pero hay que adiestrar a las madres en las técnicas de alimentación. La mejora del estado nutricional y una permeabilidad esofágica sostenida deben ser los criterios de referencia para determinar el éxito de la dilatación.

ملخص

إصابات ائتكال المريء لدى الأطفال: تحد اجتماعي وصحي منسي في البلدان النامية

المشكلة: تعد البيئة غير المأمونة مصدر خطر يعرض الطفل للإصابة والعنف، ومن بين الإصابات التي تنجم عن البيئة غير المأمونة هناك حوادث ابتلاع المواد الأكّالة، ولاسيما في البلدان النامية حيث يهمل عادة الإبلاغ عنها.
المنهج: سعياً لمواجهة هذا التحدي، ذي الحاجة الطبية غير المستوفاة، بدأ الباحثون برنامجاً إنسانياً في سيراليون. وبعد الاطلاع على المراجع الحالية من البلدان النامية وبالاعتماد على الخبرة الميدانية للباحثين، أعد الباحثون مخططاً للتدبير العلاجي لهذه الحالة السريرية.
الوضع المحلي: هذه المشكلة تعاني من قلة الإبلاغ في البلدان النامية، والبيانات المتوفرة تميل ميلاً كبيراً نحو المراكز الجيدة الموارد ولا تعكس الحقيقة الكاملة عن الوضع. وعادة ما يكون التضييق الذي ينجم في المريء وخيماً. وتعود أغلب حوادث الابتلاع إلى عدم معرفة المرضى بطبيعة هذه المواد ، والأحوال المعيشية المكتظة، ووجود المواد الكيميائية في المنازل وحولها. ويشكل النقص الواسع النطاق لأي تدابير وقائية أقوى عوامل الخطر.
التغيرات ذات الصلة: لوحظ وقت إدخال المرضى في 19.5% من 148 مريضاً جرت عليهم الدراسة. وأجري فغر المعدة في 62.1% من المرضى، وكان لدى 42.8% من المرضى تضيّق راجع، ومازال 19% يخضعون لبرنامج توسيع مستمر. وكانت معدلات الثقب والوفاة على التوالي هي 5.6% و 4%.
الدروس المستفادة: تشاهد أغلب حالات ضيق المريء الناجم عن المواد الكاوية لدى الأطفال متأخراً، حينما تكون إجراءات التوسيع أكثر صعوبة وتنطوي على معدلات مرتفعة للانتكاس. ويُعد فغر المعدة ضرورياً للحفاظ على الحالة الغذائية ولكن تحتاج الأمهات إلى تدريب على أساليب التغذية. ويجب أن يكون كل من تحسن الحالة الغذائية واستمرار سالكية المريء هي النقاط المرجعية لنجاح التوسيع.

References

1. Mock C, Peden M, Hyder AA, Butchart A, Krug E. Child injury and violence: the new challenge for child health. *Bull World Health Organ* 2008;86:420. PMID:18568265 doi:10.2471/BLT.08.054767
2. Murray CJ, Lopez AD. Mortality by cause for eight regions of the world: global burden of disease study. *Lancet* 1997;349:1269-76. PMID:9142060 doi:10.1016/S0140-6736(96)07493-4
3. Watson WA, Litovitz TL, Rodgers GC Jr, Klein-Schwartz W, Reid N, Youniss J, et al. 2004 Annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *Am J Emerg Med* 2005; 23:589-666. PMID:16140178 doi:10.1016/j.ajem.2005.05.001
4. Christesen HB. Epidemiology and prevention of caustic ingestion in children. *Acta Paediatr* 1994;83:212-5. PMID:8193505 doi:10.1111/j.1651-2227.1994.tb13053.x
5. Nuutinen M, Uhari M, Karvaki T, Kouvalainen K. Consequences of caustic ingestion in children. *Acta Paediatr* 1994;83:1200-5. PMID:7841737
6. Strengthening poison prevention and treatment programme. In: *World Health Organization's regional workshop, Kathmandu, Nepal, 1999*.
7. Contini S, Tesfaye M, Picone P, Pacchione D, Kuppers B, Zambianchi C, et al. Corrosive oesophageal injuries in children. A shortlived experience in Sierra Leone. *Int J Pediatr Otorhin* 2007;71:1597-1604. doi:10.1016/j.ijporl.2007.07.007
8. *World development indicators*. Washington, DC: The World Bank; 2006. Available from: http://devdata.worldbank.org/wdi2006/contents/cover.htm [accessed on 2 September 2009].
9. Bickler SW, Sanno-Duanda B. Epidemiology of pediatric surgical admissions to a government referral hospital in the Gambia. *Bull World Health Organ* 2000;78:1330-6. PMID:11143193
10. Ogunleye AO, Nwaorgu GB, Grandawa H. Corrosive oesophagitis in Nigeria: clinical spectrums and implications. *Trop Doct* 2002;32:78-80. PMID:11933901
11. Ake-Assi MH, Timite-Konan AM, Adonis-Koffy LY, Ehua-Amangoua ES, Coulibaly RF, Assé VK. Inquiry of knowledge, attitudes and practice of accidental acute poisoning in children of Yopougon (Abidjan, Cote d'Ivoire) [in French]. *Bull Soc Pathol Exot* 2002;95:45-6. PMID:12012964
12. Adejuyigbe EA, Onayade AA, Senbanjo IO, Oseni SE. Childhood poisoning at the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria. *Niger J Med* 2002;11:183-6. PMID:12955997
13. *WHO child growth standards*. Geneva: World Health Organization. Available from: http://www.who.int/childgrowth/standards/en/ [accessed on 2 September 2009].
14. Contini S, Garatti M, Swarray-Deen A, Depetris N, Cecchini S, Scarpignato C. Corrosive oesophageal strictures in children: outcomes after timely or delayed dilatation. *Dig Liver Dis* 2008; 10.1016/j.dld.2008.07.319. PMID:18801710
15. Betalli P, Falchetti D, Giuliani S, Pane A, Dall'Oglio L, de'Angelis GL, et al. Caustic Ingestion Italian Study Group. Caustic ingestion in children: is endoscopy always indicated? The results of an Italian multicenter observational study. *Gastrointest Endosc* 2008;68:434-9. PMID:18448103 doi:10.1016/j.gie.2008.02.016
16. Panieri E, Rode H, Millar AJ, Cywes S. Oesophageal replacement in the management of corrosive strictures: when is surgery indicated? *Pediatr Surg Int* 1998;13:336-40. PMID:9639611 doi:10.1007/s003830050333