

preoperatively. Iron treatment was associated with an increase in Hb levels ( $P = 0.026$ ) comparing patients with  $[0.3 \text{ (IQR } -0.2\text{--}0.9) \text{ g dL}^{-1}]$  and without  $[-0.2 \text{ (-}0.9\text{--}0.5) \text{ g dL}^{-1}]$  treatment and was associated with non-significant reductions of transfused RBC intra-operatively ( $2.03 \pm 0.44$  vs  $0.92 \pm 0.27$  units;  $P = 0.055$ ) and postoperatively ( $3.12 \pm 0.84$  vs  $1.06 \pm 0.27$ ;  $P = 0.191$ ) (Fig. 1). The total numbers of patients receiving RBCs were slightly reduced  $[17/49 \text{ (35\%)} \text{ vs } 34/74 \text{ (46\%)}; P = 0.215]$ . To evaluate the effect of time of treatment,  $\Delta\text{Hb}$  was  $-0.2 \text{ (IQR } -0.9\text{--}0.5) \text{ g dL}^{-1}$  in patients without treatment and  $0.2 \text{ (IQR } -0.3\text{--}0.7) \text{ g dL}^{-1}$  in patients with therapy between 0 and 14 days and  $1.3 \text{ (IQR } 0.4\text{--}2.8) \text{ g dL}^{-1}$  in patients with therapy  $>14$  days before surgery ( $P = 0.02$ ).

Our results are in line with other studies showing Hb levels increased by  $0.8\text{--}3 \text{ g dL}^{-1}$ ,<sup>6–9</sup> and reduced transfusion rates.<sup>8–10</sup> One limitation of our study is the small number of treated patients. Also, other causes of anaemia, such as anaemia from inflammation or chronic renal disease, were not addressed in this pilot project. In conclusion, our pilot data proved the feasibility and possibly efficacy of implementing a preoperative clinical protocol for management of IDA. A simple patient pathway and creation of awareness are possibly the key steps to increase interdisciplinary compliance with the new standard of care.

### Declaration of interest

PM and KZ received honoraria from the following companies for conducting a large clinical cohort trial in the field of Patient Blood Management: Vifor Pharma Deutschland GmbH, Muenchen, Germany; B. Braun Melsungen AG, Melsungen, Germany; CSL Behring, Marburg, Germany; and Fresenius Kabi, Bad Homburg, Germany. All other authors have no COI.

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## Determining the probability of a foreign body aspiration from history, symptoms and clinical findings in children

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Editor—Life-threatening events with an acute airway obstruction require immediate intervention. Nevertheless, most cases of foreign body aspiration (FBA) result in expectoration or dislodgment into a main-stem bronchus, with subsequent normalization of breathing and non-specific respiratory symptoms occurring days or even weeks after the FBA, often not recognized by health care providers<sup>1</sup> or parents.<sup>2</sup> Bronchoscopy is a potentially harmful procedure requiring specialist expertise in small children.<sup>3</sup> Therefore, simple and reliable identifiers for the probability of actual FBA would be highly desirable.

All patients who underwent bronchoscopy at the Cologne Children's Hospital, a tertiary paediatric referral centre, during a

4-year period were identified and patient records categorized into numerical and categorical data. Medical history, clinical findings including vital signs and results from diagnostic investigations were coded per an a priori fixed scheme and entered into a database for ad hoc analysis. The following data were included: presence of coughing, dyspnoea, cyanosis, pathological auscultation, fever, salivation, findings on chest X-rays (infiltrations, densifications, overinflations, mediastinal shift or any pathology) or a witnessed event as dichotomous variables and the measured value of oxygen saturation by pulse oximetry as a metric variable. During the 4-year period a total of 197 bronchoscopies were performed for suspected FBA.

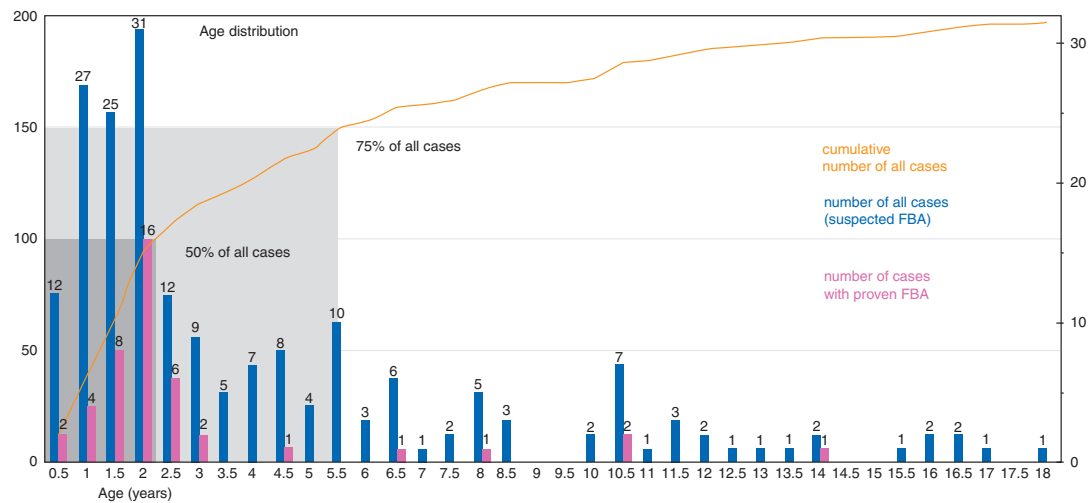


Fig 1 Age distribution of cases. Bronchoscopy for a suspected FBA was performed (blue and orange cumulative); cases with proven FBA (pink).

The age distribution was comparable with other studies<sup>4</sup> (Fig. 1). A foreign body was confirmed and removed in 44 of 197 patients (22%). A total of 102 (52%) children had a chest X-ray, of which 77 (75%) had a documented abnormality. The results of bronchoscopy ('FBA confirmed' or 'no FBA') were set as the binary dependent variable, on which a logistic regression analysis of all dichotomous (yes/no) variables was performed. Forward stepwise selection of predictor variables ( $P_{in}=0.10$ ,  $P_{out}=0.05$ ) resulted in three variables with independent contributions to the FBA event. The Nagelkerke's  $R^2$  was 0.554, indicating that the model achieved satisfactory prediction of FBA. A witnessed event was associated with a 43-fold increased probability for FBA [95% confidence interval (CI) 13–140;  $P < 0.001$ ]. Abnormal lung auscultation at hospital admission was associated with a 6.9-fold increased probability (CI 2.6–18;  $P < 0.001$ ) of finding FBA during bronchoscopy. Hypersalivation (drooling) resulted in a 6.3-fold decreased ( $0.16/1 = 6.25$ ) likelihood [odds ratio 0.16 (CI 0.04–0.7);  $P = 0.013$ ] of detecting FBA. No other variable tested (including radiological findings) improved the predictive ability of an FBA.

When an event was witnessed, auscultation of the lung was abnormal and no drooling was observable, the combination of such markers resulted in a sensitivity of 66% and a specificity of 94% to predict an FBA. The positive predictive value for a single prognosis in this sample is 74% and the negative predictive value is 90%. We are unable to explain why hypersalivation as a pre-hospital symptom decreases the probability of an FBA. A hypothesis is those children might have experienced an event with a foreign body at the larynx, irritating the laryngeal and hypopharyngeal structures.

With the limitations of this study (analysing retrospective data of a single-centre experience), it remains impossible to

reliably predict FBA using a single or combination of clinical and investigational variables. The approach of multivariable analysis is promising to assess new diagnostic tools in the evaluation of large cohorts and to assess their potential as predictive variables. In all cases with any clinical doubts, bronchoscopy should be performed in order to achieve unambiguous diagnosis and treatment. A chest X-ray is not useful to predict or exclude FBA.

## Declaration of interest

None declared.

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