Occupational asthma: an assessment of diagnostic agreement between physicians

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Occup. Environ. Med. 2007;64;185-190; originally published online 9 Nov 2006; doi:10.1136/oem.2006.027722

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**ORIGINAL ARTICLE**

**Occupational asthma: an assessment of diagnostic agreement between physicians**

David Fishwick, Lisa Bradshaw, Mandy Henson, Chris Stenton, David Hendrick, Sherwood Burge, Rob Niven, Chris Warburton, Trevor Rogers, Roger Rawbone, Paul Cullinan, Chris Barber, Tony Pickering, Nerys Williams, Jon Ayres, Andrew D Curran

Objective: To investigate the levels of agreement between expert respiratory physicians when making a diagnosis of occupational asthma.

Methods: 19 cases of possible occupational asthma were identified as part of a larger national observational cohort. A case summary for each case was then circulated to 12 physicians, asking for a percentage likelihood, from the supplied information, that this case represented occupational asthma. The resulting probabilities were then compared between physicians using Spearman’s rank correlation and Cohen’s $\kappa$ coefficients.

Results: Agreement between the 12 physicians for all 19 cases was generally good as assessed by Spearman’s rank correlation. For all 66 physician-physician interactions, 45 were found to correlate significantly at the 5% level. The agreement assessed by $\kappa$ analysis was more variable, with a median $\kappa$ value of 0.26, (range $-0.2$ to $0.76$), although 7 of the physicians agreed significantly ($p<0.05$) with $\geq 5$ of their colleagues. Only in one case did the responses for probability of occupational asthma all exceed the “on balance” 50% threshold, although 12 of the 19 cases had an interquartile range of probabilities not including 50%, implying “on balance” agreement. The median probability values for each physician (all assessing the identical 19 cases) varied from 20% to 70%. Factors associated with a high probability rating were the presence of a positive serial peak expiratory flow Occupation Asthma SYStem (OASYS)-2 chart, and both the presence of bronchial hyper-reactivity and significant change in reactivity between periods of work and rest.

Conclusions: Despite the importance of the diagnosis of occupational asthma and reasonable physician agreement, certain variations in diagnostic assessment were seen between UK expert centres when assessing paper cases of possible occupational asthma. Although this may in part reflect the absence of a normal clinical consultation, a more unified national approach to these patients is required.
not be summarised (eg, serial PEF measures) were photocopied and added to the case summary.

The summaries were circulated to all participating physicians, who were invited to rate, using the information available to them, the probability of occupational asthma for each case. They were also asked whether they would report the case to SWORD. Physicians were asked to work independently, and to complete the task within 1 week.

Phase 2

The physicians caring for each of the 19 patients were asked to prepare a narrative summary that was then appended to the clinical summary above. These were recirculated to the panel physicians who were asked to repeat the rating process as above. The individual scores from phase 1 were made available. Ten of the original panel physicians took part in phase 2.

Data presentation and analysis

All data were entered into and analysed using SPSS for Windows V.12.0.1. The raw probabilities given for each case by each panel physician are presented, and a median and interquartile range for each case across all physicians, and for each physician across all cases has been calculated. Any missing data in cells were excluded from the calculation of the median.

The agreement between physicians was assessed using two statistical methods. Spearman’s rank correlation and Cohen’s $\kappa$ analysis.

Spearman’s rank correlation

All physician interactions over 19 cases were primarily assessed using a Spearman rank correlation coefficient. As all data were non-normal, this method of correlation assessment was used (SPSS V.12.0.1). All interactions were systematically assessed in this way, with a resulting correlation coefficient and $p$ value quoted.

Cohen’s $\kappa$ analysis

The $\kappa$ values were also calculated after categorising each probability scored by each physician as either high (>50) or low (<31). Each physician was then systematically compared with all other physicians in turn, generating a series of $\kappa$ values representing all physician interactions. The probabilities generated from phases 1 and 2 were separately analysed in this way.

All cases were objectively assessed for content (eg, presence of bronchial hyper-responsiveness, presence of atopy) by one observer (DF), blinded to the probabilities generated by each case. These objective markers of content were used, along with physician identity, in an attempt to identify key features associated with either low or high probability assessment by the physicians.

RESULTS

Table 1 shows the clinical content of each case summary; these were highly variable. Only the documentation of a work-related respiratory symptom and the lack of specific allergen challenge test were common to all cases. Two cases seemed to have a clear latency consistent with acute irritant-induced asthma (previously referred to as reactive airway dysfunction syndrome, cases 12 and 14), and all others but one had a clear latency between the onset of relevant exposures and the onset of work-related respiratory symptoms. Documented exposures were generally represented in the top current UK causes, but other exposures included solvents and thinners (case 4), tea dust (case 8) and latex (case 18).
Phase 1
Table 2 depicts the probability of occupational asthma for each case as individually rated by each panel physician in phase 1. In addition, this table notes whether each case was thought to represent occupational asthma by the attending physician. With regard to specific features of the case summaries that dictated a consistent probability rating, no clear consistent pattern emerged. Of the four case summaries (cases 6, 8, 11 and 14) with a median probability rating of \( \geq 70\% \), all had documented airway hyper-reactivity, three with demonstrable variability between periods of work and rest. Of the four, two had an Occupation Asthma SYStem-2 (OASYS-2) serial PEF chart, both of which noted a work effect index \( > 2.5 \). The remaining two cases had no serial PEF data. Three did not list a commonly reported cause of occupational asthma in the occupational history. The remaining case mentioned exposure to isocyanate.

Of the four case summaries (cases 4, 5, 10 and 16) with median probability ratings of 25% or lower, none had evidence of hyper-reactive airways (although it was measured in three). Only one case had an OASYS-2 serial PEF assessment, and this chart had a work effect index of 2.5, generally considered as being evidence of a relevant work relationship.\(^5\) Again, three of the cases did not list a commonly reported cause of occupational asthma in the occupational history, and the remaining case mentioned exposure to isocyanate.

There seemed to be little influence of latency on probability ratings, although those with low probability tended to have longer latency periods documented. Only one individual underwent a workplace challenge (which was positive), and therefore any influence on the probability assessment of a specific bronchial challenge could not be assessed in this study.

The highest median probability was reported for case 11, whose summary documented a latency period of 2 years, a positive OASYS-2 chart, and sequential relevant changes in airway reactivity associated with periods of work and rest.

There was clear variation in the range of probability scored for each case. For example, case 16 (whose case summary is reproduced in box 1) generated a range of probabilities between 1% and 85%, with a median of 15%. By contrast, cases 3 and 11 generated narrow ranges (with a range width of 45% in each case).

It was also evident that certain physicians consistently reported either generally high probabilities (physicians 5, 6 and 10) or generally low probabilities (physicians 3 and 9).

Nevertheless, when agreement was assessed for all 66 physician–physician interactions, 45 of these were found to be significant to a value of \( p \leq 0.05 \). All but one Spearman rank correlation coefficient was positive. All but one physician agreed significantly with \( \geq 5 \) of their colleagues.

When probability ratings were stratified to above or below the arbitrary cut-off of 50%, to assess agreement with the \( \kappa \) analysis, agreement was worse. The median \( \kappa \) value for all 66 physician interactions was 0.26 (range \(-0.2 \) to \( +0.76 \)). In all, 24 of these interactions, as judged by individual \( \kappa \) coefficients were significant (\( p < 0.05 \)): 7 of the 12 physicians agreed significantly with \( \geq 5 \) of their 11 colleagues.

To assess whether the amount of information provided increased the absolute probability, or increased agreement between the physicians, ranges of probability for each case were compared between the 13 cases, where either bronchial responsiveness measures or OASYS-2 serial PEF measures were measured and supplied for the case summary, denoted good information, and the 6 cases where these data were absent (or just a single negative airway reactivity measure was documented) denoted limited information. There were no clear differences in the ranges of probability between those cases with good or limited information. Specifically, the geometric mean difference between maximum and minimum probability rated for the 6 cases with limited information was 64.8 compared with 63.7 for cases with good information. If the three cases with neither bronchial responsiveness nor OASYS-2 data were compared with the 16 with some data, the geometric mean of the range was 69.3, compared with 63 for the rest. Both these comparisons were not statistically different at the 5% level.

With regard to the individual study physicians, a differing background did not seem to influence the rated probabilities. In particular, the three physicians not currently working as consultant respiratory physicians (but all with considerable experience of occupational lung disease) had median probabilities for all 19 cases of 35%, 60% and 60%, within the range of median probabilities for all physicians, 20–70%. Furthermore, although none of these three individuals agreed with \( \geq 5 \) of the remaining study physicians significantly as assessed by \( \kappa \) analysis, this was also true for two of the respiratory physicians. The extremes of the \( \kappa \) value range (\(-0.2 \) and \( +0.76 \)) were also not determined by these three physicians, as these interactions were both between respiratory physicians.

Phase 2
After reassessing of each case in light of the new case summary, the median \( \kappa \) was essentially unchanged at 0.28 (range \(-0.05 \) to \( +0.75 \)).

DISCUSSION
This study has documented current diagnostic practice between six centres assessing relatively large numbers of potential cases of occupational asthma. The cases were selected purposefully from a larger observational cohort, recruited into each of the centres over a 12-month period. The cases were not intended to be highly investigated textbook examples of occupational asthma, but a range of cases reflecting the practice of each study centre. Transcription of the information from the original case notes produced summaries that were variable in their content.

The primary outcome measure used during the probability assessment was the rating of likely occupational asthma between 0% and 100%. This format was chosen so that the ratings could be treated as continuous variables, or dichotomised to assess levels of agreement.

It was thought appropriate to include all 12 physicians in the final analysis, including the single specialist registrar and two legislators. All had contributed to the study design and their inclusion allowed assessment of a range of opinions. Although the opinions of these three raters differed in some respects, they were broadly similar in range and median to the respiratory physicians. Neither did the inclusion of these physicians increase the extremes of \( \kappa \) values noted for all physician–physician interactions.

Each case generated a wide interquartile range of probabilities, although certain cases seemed to generate particularly disparate ratings. Those cases rated highly seemed to have a combination of features, including bronchial responsiveness measures and OASYS-2 style PEF charts. Although there were relatively low numbers of cases for further group analysis, there did not seem to be an influence of the amount of information supplied to the physician, with equally wide ranges of opinion in cases with good data.

Agreement as assessed by non-parametric correlation was generally good, with 11 of the 12 physicians agreeing with \( \geq 5 \) of their colleagues significantly. Agreement assessed by \( \kappa \) analysis was predictably less good.
Few studies have specifically addressed diagnostic reasoning in occupational asthma, and the potential reasons for differences in agreement.

A recent study has dealt with the agreement between expert assessments of serial PEF charts. Similar in design to this

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Phase one: probabilities of each case representing occupational asthma</th>
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<tr>
<td>Case</td>
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Box 1 Case 16 as shown to the assessing physicians

| Male |
| 32 years old |
| Refrigeration company |
| Engineer, making refrigerators |
| Exposures: polyol, isocyanate, fibre glass, wax, dust |
| Has worked at this site since 1993. For the first 2–3 years he was a stores controller, handing out products through a hatch, no exposure to foam. Also worked on electrical sump assembly line with occasional exposure to soldering fumes. He then worked for the last 2–3 years on a foam injection line as a metal fabricator making the outer casings of fridges/deep freezes, which entails assembling the outer casing of fridges on a jig using galvanized or stainless steel. Liquid isocyanate is piped from a central tank, unheated to a spray gun, which sprays isocyanate and polyol into a mould. The above process takes place under an extracted hood. The operator wears an external, air-fed visor during the procedure and for 5 min thereafter. He also wears gloves and overalls. He first reported symptoms to his general practitioner as he has never seen an occupational health physician at work. He continues to work in the same job. He was referred to secondary care by a general practitioner. |
| Social history: never been a smoker |
| Treatment: not taking any current medication |
| Medical history: asthma in childhood, not problematic until the 1980s |
| Documented work-related symptoms  Wheezing: onset 1 November 2000  Cough: onset 1 November 2000 (worse at night) |
| Documented lung function:  6 September 2001: FEV₁ 3.78 (3.99); FVC 4.96 (4.73)  30 November 2001: FEV₁ 3.58; FVC 4.74  18 October 2002: FEV₁ 3.88; FVC 5.02 |
| Documented bronchial responsiveness, 18 October 2002: PD₂₀ >4800 μg methacholine, 14% fall in FEV₁, no symptoms |
| Documented specific bronchial challenge: not done |
| Documented immunological assessment: 6 September 2001 Skin tests: positive to house dust mite 22 October 2001 Specific IgE to isocyanates: TDI, MDI, HDI, all negative |
| Chest x ray normal |
Making an accurate diagnosis of occupational asthma is important, and of equal importance is avoiding mislabelling workers without this condition. Although UK-based physicians with particular interest in occupational asthma broadly agree with one another about diagnosis when assessing paper summary cases, areas of disagreement exist.

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