Barriers to Diagnosis of Occupational Asthma in Ontario

Naveen Poonai, MSc, MD
Sean van Diepen, BSc, MD
Aditya Bharatha, BSc, MD
Marosh Manduch, MSc, MD
Tom Deklaj, BSc, MD
Susan M. Tarlo, MBBS, FRCPC

ABSTRACT

Background: Occupational asthma (OA) refers to asthma caused by workplace-specific substances. A longer duration of symptoms while continuing to be exposed has been associated with a worse prognosis. Evidence suggests a significant period of time exists between symptom onset and diagnosis of OA, the reasons for which have not been investigated. The purpose of this study was to examine whether primary health care and/or socio-economic factors account for delays in Ontario.

Method: Two hundred and forty-seven (247) chart reviews were undertaken of patients referred to the University Health Network Asthma Centre for evaluation of OA, with clinic visits from 1997-2002. Forty-two (42) patients fulfilling objective OA criteria were administered a structured telephone interview to examine the chronology and nature of health care consultation and reasons for possible delay in diagnosis.

Results: The mean time to diagnosis was 4.9 years (3.4 years excluding 4 outliers). On average, patients waited 7.4 months before discussing the work-relation of symptoms with a physician. Main self-reported reasons for delay were lack of enquiry about work relatedness by the primary care physician (41%) and fear of losing work time (37%). Reported increases in time during secondary care were related to difficulties associated with completion of investigations (35%). Lower education level ($p=0.04$) and household income ($p=0.03$) were significantly associated with an increased time to diagnosis.

Interpretation: Physicians who assess working adults with asthma need to ask pertinent work-related questions when taking a history in order to initiate timely investigations and referral. Socio-economic factors are also associated barriers to early diagnosis of occupational asthma.

MeSH terms: Asthma; occupational diseases; early diagnosis; health services accessibility; socioeconomic factors

Occupational asthma (OA), caused by exposure to workplace-specific substances,¹ is estimated to account for 3-7% of new onset adult asthma.² In Quebec and Ontario,³ OA is the most frequently compensated chronic occupational chest disease.⁴ Over 90% of cases in Ontario are due to sensitization to a specific workplace agent.³ The outcome of OA improves with early diagnosis and removal from further exposure to the sensitizer.^{5,6} Continued exposure results in persisting or worsening symptoms and impaired lung function.⁷

Despite the benefits of early diagnosis, previous studies have reported that the mean time from onset of symptoms to diagnosis has been at least 2 years.^{5,8-10} Among compensation claims, the lapse was a mean of 2 years for diisocyanates and 3 years for other causes of OA,⁵ 2.6 years among symptomatic workers exposed to red cedar⁸ and 16.9 months for diisocyanate-induced OA.⁹ An American clinic series reported 4.5 years,¹⁰ and a specialized referral center 3.8 years¹¹ before diagnosis.

Diagnosis of OA can be complex and time-consuming.^{12,13} Investigations are more easily performed and interpreted early after the onset of symptoms, and while the patient still works. Possible preventable delays in diagnosis of OA include lack of knowledge, inaccessibility to health care, delayed investigations or referral, or lack of workplace health and safety training. We hypothesize that socio-economic factors may also delay workers from seeking medical attention, such as fear of job loss, and difficulty taking time off work for physician assessments, similar to factors reported in non-occupational asthma.¹⁴⁻¹⁶ We assessed patient-reported factors that may have an impact on the time to diagnosis of occupational asthma.

METHODS

Subjects

Approval was received from the University Health Network Ethics Review Board for this study. Potential participants were identified from chart review of patients referred to the University Health Network (UHN) Occupational Lung Disease Clinic in Toronto for the diagnosis of OA. The referral base includes other respiratory and occupational medicine physicians, aller-

La traduction du résumé se trouve à la fin de l'article.

University Health Network, University of Toronto, ON

Correspondence: Dr. Susan M. Tarlo, Division of Respiratory Medicine, Toronto Western Hospital, Suite 7-449, new East Wing, 399 Bathurst Street, Toronto, ON M5T 2S8, Tel: 416-603-5177, Fax: 416-603-6763, E-mail: susan.tarlo@utoronto.ca

gists, workers' compensation systems, and primary care physicians. Criteria were used to classify individuals as having a *definite*, *probable*, or *possible* diagnosis of OA, or no OA.¹⁷ Patients with definite and probable OA were included in this study. Irritant-induced OA was excluded since its emergent presentation might favour more rapid investigation and diagnosis.

Appointment records were sequentially reviewed to identify patients assessed at the clinic for evaluation of work-related asthma between 1997 and 2002. Among a total of 247 patients, 34 fulfilled criteria for definite OA, 31 probable OA, 51 possible OA, while 131 had no OA criteria. Of the 65 with definite or probable OA, 42 agreed to participate and fulfilled criteria for sensitizer-induced-OA: 24 from 34 definite OA patients and 18 from 31 probable OA patients.

Data collection

Data was extracted from chart reviews for: age, gender, smoking status; chronology of symptom onset and diagnosis; category of OA diagnosis (definite, probable, possible); putative sensitizing agent; and time to diagnosis. A telephone questionnaire administered by one of the investigators obtained patient-reported information on possible reasons for a delay in diagnosis, the specialty of the initial assessing physicians, and socio-economic factors (available upon request from corresponding author).

Statistical methods

Data were analyzed using the SAS statistical program, version 8. Descriptive statistics were used for demographic and categorical variables. Pearson correlations were used to investigate the relation of continuous data parameters to the time to diagnosis of OA. Pooled t-tests were used to compare duration of time to diagnosis for a given categorical variable. A general linear model was used to investigate associations between the duration of time to diagnosis and categorical variables. A significance level of 5% was chosen.

RESULTS

A total of 42 eligible patients participated (24 with definite and 18 probable OA), 26 males, 16 females; 8 participants were

TABLE I

Chronology of Diagnosis and Frequency of Self-reported Reasons for Delay in Discussing Symptoms with a Primary Care Physician

Chronology of Diagnosis	Years (s.d.)	n
Mean age at onset of symptoms	38.9 (10.1)	42
Mean duration of time to diagnosis (definite and probable OA)	4.9 (5.1)	42
	(range: 0-21)	
Mean duration of time to diagnosis (definite OA)	4.3 (4.1)	24
Mean duration of time to diagnosis (probable OA)	6.1 (6.2)	18
Length of time between symptom onset and reporting of symptoms	0.61 (0.82)	36
Reasons for Delay in Discussing Symptoms with a Primary Care Physician	%	N
Difficulty finding a physician	0	0
Physician did not schedule an appointment at a suitable time	11.9	5
Patient did not find the time to make the scheduled appointment	11.9	5
Underestimation of symptoms by patient	26.8	11
Afraid of forced job loss	33.3	14
Afraid of forced job change	26.2	11
Afraid of lost work time	37.5	15
Physician did not ask about a workplace association with symptoms	41.0	16
Patient did not reveal that symptoms were worse at work	18.0	7
Another healthcare-related delay not mentioned*	19.5	8
Another employer-related delay not mentioned†	9.8	4

* Includes: symptoms underestimated by MD or presumed to be of a different etiology than asthma (misdiagnosis); OA not suspected based on a perceived lack of symptoms

† Includes: non-provision of material safety datasheets (MSDS) and/or other supporting documents in a timely fashion

TABLE II

Frequency of Self-reported Reasons Influencing Disclosure of Symptoms

Reason	n	%
Symptoms became unbearable	39	92.9
Took advice of a friend or family member	11	26.2
Presence of a workplace screening program	7	16.7
If yes, referred to a physician through the screening program	3	42.9
Presence of a workplace health and safety program	18	43.9
If yes, influenced by workplace health and safety program	5	27.8
Aware that there was exposure to an agent at work that caused asthma	20	47.6
If yes, influenced by awareness	10	50.0
Co-workers experienced similar symptoms	25	69.4
If yes, influenced by co-workers' symptoms	6	24.0
Prior knowledge about OA before diagnosis	3	7.3
If yes, influenced by prior knowledge	1	33.3

current smokers. Almost half (48.6%) resided outside major centres containing tertiary care facilities (Toronto, Ottawa, Hamilton, London, Kingston, and Sault Ste. Marie). For these, the average driving distance to a major centre was 191.8 ± 312.8 km (range: 120-1133 km). Diisocyanates were the most frequently reported sensitizing agent (28.6%).

Mean duration of symptoms before the final clinical diagnosis (i.e., duration of delay in diagnosis) was 4.9 ± 5.1 years (4.3 ± 4.1 years for definite OA; 6.1 ± 6.2 years for probable OA, Table I). After excluding four outliers with a time to diagnosis of at least 14 years, the mean time to diagnosis was 3.4 ± 1.9 years. There were no significant associations between gender, current smoking status, or the distance from a major centre and time to symptom reporting or time to diagnosis of OA. Time to diagnosis was not significantly associated with age at onset of symptoms, age at diagnosis, time from symptom onset to the

reporting of symptoms to a physician, or suspected causative agent.

The most common cited reasons for delay in discussing symptoms with a primary care physician were: the physician did not inquire about a workplace association with symptoms, fear of losing work time, and fear of job loss (Table I). No single reason was significantly associated with increased time to symptom reporting or diagnosis. Most frequently cited reasons influencing disclosure of symptoms to a primary care physician (Table II) were that co-workers experienced similar symptoms and that symptoms became unbearable. Time to diagnosis was not significantly associated with the type of physician to whom the patient first presented (59.5% presented first to a family physician, 11.9% to a company physician, and 26.2% to an emergency department).

Twenty patients were referred to a specialist at their first visit to their presenting physician. The presence or absence of an

TABLE III

Mean Time to Diagnosis According to Socio-economic Factors

	Number (%)	Mean Time to Diagnosis in Years (s.d.)	P
Highest level of education			
Primary	11 (26.2)	7.4 (6.7)	0.04
Secondary	22 (52.4)	3.6 (3.1)	
Post-secondary	8 (19.1)	3.1 (1.6)	
Personal income before diagnosis			
<\$30,000	14 (35.9)	6.4 (6.5)	0.12
\$30,000-\$50,000	21 (53.9)	3.3 (2.0)	
\$51,000-\$80,000	3 (7.7)	9.0 (9.8)	
>\$80,000	1 (2.6)	2.0	
Household income before diagnosis			
<\$30,000	8 (20.5)	9.1 (7.5)	0.03
\$30,000-\$50,000	14 (35.9)	3.4 (2.0)	
\$51,000-\$80,000	10 (25.6)	4.7 (5.7)	
>\$80,000	7 (18.4)	2.7 (1.8)	
Patient is sole income earner	16 (38.1)	6.4 (5.9)	0.15
Patient is not sole income earner	26 (61.9)	4.0 (4.3)	
Income loss post diagnosis			
Personal income loss	22 (55.0)	4.18 (4.2)	0.52
Household income loss	20 (51.3)	4.25 (4.3)	0.66
First language			
English or French	27 (64.3)	4.4 (4.1)	0.47
Other language	15 (35.7)	5.8 (6.5)	
Marital status			
Single	6 (14.3)	4.2 (2.4)	0.72
Married	33 (78.6)	5.2 (5.6)	
Widowed / Divorced	3 (7.1)	3.0 (2.6)	

Pearson correlations were used to investigate the relation of continuous data parameters to the time to diagnosis of OA. Pooled t-tests were used to compare duration of time to diagnosis for a given categorical variable. A general linear model was used to investigate associations between the duration of time to diagnosis and categorical variables.

immediate referral was not significantly associated with the duration of time to diagnosis, nor was the time between referral and specialist assessment (mean 3.2 ± 6.4 months). Patients reported an average of 2.2 ± 1.0 visits to the specialist before they were told that OA was suspected; the number of visits was significantly associated with an increased time to diagnosis ($r=0.49$, $p=0.02$).

Patients reported that OA was first suspected by themselves alone (31.7%), by the specialist alone (53.7%) or by themselves with their family physician (14.6%). Diagnosis was confirmed by a respiratory physician in 61.9%, allergist in 4.8% and occupational medicine physician in 7.1%. The category of specialist was not significantly associated with the time to diagnosis, nor was the source of referral (5 patients from a family physician, 16 from a specialist, 17 from a workers' compensation physician, 1 from a company physician, and 3 from unrecorded sources). Mean duration from the first UHN clinic visit to diagnosis was 2.3 ± 1.8 months and was not significantly associated with overall time to diagnosis.

Chart reviews identified 24 patients (61.5%) with delays in completing diagnostic investigations such as at-work/off-work asthma monitoring; 7 were unable to

undergo specific challenge tests due to inability to obtain/identify specific exposure agents. Patient-related factors (13 patients) included electing not to return to work for a trial of exposure, electing not to undergo further testing, difficulty performing methacholine challenges (e.g., patient use of bronchodilators before the test), and uninterpretable methacholine challenge test results (due to coughing during the test, smoking history, environmental allergy symptoms, and non-reproducible pulmonary function tests). Work-related factors (4 patients) included lack of workplace exposure information, work closure or employer refusal to allow a work trial. There was a trend to increased time to diagnosis related to difficulties completing specialist investigations in 7 patients (time to diagnosis of 11.3 years compared to 3.3 years for the other participants) ($p=0.056$).

Socio-economic factors

Patients completing post-secondary education experienced a significantly shorter time to diagnosis compared to others (3.1 ± 1.6 years versus 5.4 ± 5.5 years, $p=0.05$) (Table III). Time to diagnosis was longer in individuals with lower household incomes ($p=0.03$), which was not associated with level of education ($\chi^2=4.5$, $p=0.61$). The most common yearly person-

al income before evaluation for OA was \$30,000-\$50,000 (Table III), while after diagnosis, 72.5% ($n=29$) reported less than \$30,000. The largest proportion of patients reported a yearly household income of \$30,000-\$50,000 before evaluation for OA, while after diagnosis, 47.4% ($n=18$) reported a yearly household income of less than \$30,000.

DISCUSSION

This study is limited by small subject numbers and data relying on participant recall. The diagnostic process for OA can be difficult and lengthy.^{12,13} Our patients (referred to a mainly tertiary referral centre) may be more complex than average patients with OA. Therefore results cannot be generalized and larger, prospective studies may better identify factors amenable to intervention. Complexity of these patients may account for the longer time to diagnosis in this study versus our previous reports,^{3,5} but the time is similar to other reports.^{10,11} A longer time to diagnosis among probable versus definite OA patients in this study (mean 6.1 years versus 4.3 years) supports their diagnostic difficulties.

Patients reported delayed disclosure of the work relationship of symptoms most commonly because their physician did not inquire about this association, attesting to the need for specific physician enquiry in order to initiate early diagnostic work up. Relatively few physicians are specifically trained to recognize or prevent occupationally induced illness.¹⁸

Workplace health and safety or screening programs were reported by less than half the patients. Only half knew before medical assessment that they were exposed to an agent potentially causing asthma. This may have had a negative impact on the importance they placed on seeking timely attention. Furthermore, one third reported they did not disclose symptoms for fear of losing their job, a factor possibly influenced by company size, presence of a union and the local economy; unfortunately this information was not assessed in our questionnaire.

Influence of education level on time to diagnosis of OA might reflect better health knowledge in more educated patients or greater confidence in ability to find alternative work. Similarly, although household

income was not significantly associated with education level, it was significantly associated with time to diagnosis. Despite access to universal health care, most medication payment is covered by workplace insurance. Economic factors including costs of medications have been associated with delays in seeking treatment for non-occupational asthma exacerbations.¹⁶ Our findings suggest that efforts to enhance early detection of occupational asthma should consider the need to assess socioeconomic barriers to diagnosis. These barriers may also be relevant for other work-related health problems, particularly those which can mimic non-occupational diseases and for which medical management may initially control symptoms and allow the patient to continue to work. Nevertheless, the failure to correctly identify and manage an occupational cause may permit progressive deterioration of the disease. Examples of other occupational lung diseases include chronic beryllium disease, mimicking sarcoidosis, or hypersensitivity pneumonitis mimicking idiopathic pulmonary fibrosis.

Other barriers to early diagnosis may need further investigation. In a few cases, delays were related to lack of information or assistance from the workplace. Diagnostic investigations are time-consuming. The use of specific challenge tests in diagnosis of occupational asthma requires specialized facilities, is of limited availability, and can result in false positive and false negative results. However, if readily available, this might provide a faster diagnosis than monitoring of serial peak flow monitoring and methacholine responses at work and off work which can require several months to complete, especially when patients have limited vacation time.^{12,13}

Not unexpectedly,^{7,19-21} personal or household income loss following a diagnosis of OA was common. Management of OA frequently necessitates removal of the patient from the exposure environment, often with a profound financial impact; long-term decrease in income has been reported in 95% of those leaving work with work-related asthma.¹⁹

Our findings highlight the need for physicians to be aware of pertinent questions to ask when taking a history of symptoms suggestive of asthma to initiate timely management.^{12,13} Additionally, employers

should educate workers on potential sensitizers in their work environment. For those with lower education and income, our findings suggest a need for improved social and economic systems to avoid these factors as barriers to diagnosis and to allow appropriate management.

REFERENCES

- Bernstein IL, Chan-Yeung M, Bernstein DI, Malo J-L. Definition and classification of asthma. In: Bernstein IL, Chan-Yeung M, Malo J-L, Bernstein DI (Eds.), *Asthma in the Workplace*. New York: Marcel Dekker, 1993;1-4.
- Reijula K, Haahtela T, Klaukka T, Rantanen J. Incidence of occupational asthma and persistent asthma in young adults has increased in Finland. *Chest* 1996;110:58-61.
- Tarlo SM, Liss G, Corey P, Broder I. A workers' compensation claim population for occupational asthma: Comparison of subgroups. *Chest* 1995;107:634-41.
- Liss G, Ellison L. Recognition of occupational asthma. *Pract Allergy Immunol* 1994;9:252-60.
- Tarlo SM, Banks D, Liss G, Broder I. Outcome determinants for isocyanate induced occupational asthma among compensation claimants. *Occup Environ Med* 1997;54:756-61.
- Paggiaro PL, Bacci E, Dente FL, Talini D, Giuntini C. Prognosis of occupational asthma induced by isocyanates. *Bulletin Europeen de Physiopathologie Respiratoire* 1987;23:565-69.
- Gannon PF, Weir DC, Robertson AS, Burge PS. Health, employment, and financial outcomes in workers with occupational asthma. *Br J Ind Med* 1993;50:491-96.
- Chan-Yeung M, MacLean L, Paggiaro PL. Follow-up study of 232 patients with occupational asthma caused by western red cedar. *J Allergy Clin Immunol* 1987;79:792-96.
- Rosenberg N, Garnier R, Rousselin X, Mertz R, Gervais P. Clinical and socio-professional fate of isocyanate-induced asthma. *Clin Allergy* 1987;17:55-61.
- Wheeler S, Rosenstock L, Barnhart S. A case series of 71 patients referred to a hospital-based occupational and environmental medicine clinic for occupational asthma. *West Med J* 1998;168:98-104.
- Larbanois A, Jamart J, Delwiche JP, Vandenplas O. Socioeconomic outcome of subjects experiencing asthma symptoms at work. *Eur Resp J* 2002;19:1107-13.
- Tarlo SM, Boulet LP, Cartier A, Cockcroft D, Cote J, Hargreave F, et al. Canadian Thoracic Society Guidelines on Occupational Asthma. *Can Resp J* 1998;5:289-300.
- Tarlo SM, Liss GM. Occupational asthma: An approach to diagnosis and management. *CMAJ* 2003;168:867-71.
- Mansour ME, Lanphear BP, DeWitt TG. Barriers to asthma care in urban children: Parent perspectives. *Pediatrics* 2000;106:512-19.
- Jones AP, Bentham G, Horwell C. Health service accessibility and deaths from asthma. *Int J Epidemiol* 1999;28:101-5.
- Janson S, Becker G. Delay in seeking treatment for acute asthma. *J Asthma* 1998;35:427-33.
- Liss GM, Tarlo SM, Banks D, Yeung K-S, Schweigert M. Preliminary report of mortality among workers compensated for work-related asthma. *Am J Ind Med* 1999;35:465-71.
- Newman LS. Occupational illness. *N Engl J Med* 1995;333:1128-34.
- Yassi A. Health and socioeconomic consequences of occupational respiratory allergies: A pilot study using workers compensation data. *Am J Ind Med* 1988;14:291-98.
- Ameille J, Pairon JC, Bayeux MC, Brochard P, Choudat D, Conso F, et al. Consequences of occupational asthma on employment and financial status: A follow-up study. *Eur Respir J* 1997;10:55-58.
- Vandenplas O, Toren K, Blanc PD. Health and socioeconomic impact of work-related asthma. *Eur Respir J* 2003;22:689-97.

Received: March 17, 2004

Accepted: October 4, 2004

RÉSUMÉ

Contexte : L'asthme professionnel (AP) est l'asthme causé par l'inhalation de substances présentes dans le milieu de travail. Le pronostic est pire lorsque les symptômes se prolongent en raison d'une exposition continue. Des données permettent de croire qu'il existe une période de temps appréciable entre l'apparition des symptômes et l'établissement d'un diagnostic d'AP, pour des raisons qui n'ont pas encore été étudiées. Nous avons voulu examiner si des facteurs liés aux soins de santé primaires et/ou des facteurs socio-économiques pouvaient causer de tels retards en Ontario.

Méthode : Nous avons examiné les fiches de 247 patients aiguillés vers la clinique de l'asthme du Réseau médical universitaire (University Health Network Asthma Centre) entre 1997 et 2002 pour une évaluation d'AP. Nous avons mené des entretiens téléphoniques semi-structurés avec 42 patients respectant des critères objectifs de diagnostic de l'AP afin d'examiner le moment et la nature de leurs consultations médicales et les raisons d'éventuels retards dans leur diagnostic.

Résultats : Le délai moyen de diagnostic était de 4,9 ans (3,4 ans après exclusion de quatre valeurs aberrantes). En moyenne, les patients avaient attendu 7,4 mois avant de discuter avec un médecin des liens possibles entre leurs symptômes et leur milieu de travail. Les principales raisons déclarées par les intéressés pour avoir attendu étaient que leur médecin de premier recours ne les avait pas interrogés sur leur milieu de travail (41 %) et la crainte de devoir s'absenter du travail (37 %). L'allongement des délais dans les soins secondaires était lié aux difficultés de l'enquête médicale (35 %). La faiblesse relative du niveau de scolarité ($p=0,04$) et du revenu du ménage ($p=0,03$) présentait une corrélation significative avec un délai plus long avant le diagnostic.

Interprétation : Pour que l'enquête et l'aiguillage se fassent en temps opportun, les médecins qui évaluent les travailleurs adultes asthmatiques doivent poser des questions pertinentes sur le milieu de travail lorsqu'ils les interrogent sur leurs antécédents. Des facteurs socio-économiques font également obstacle au diagnostic précoce de l'asthme professionnel.