Image Cover Sheet

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TITLE

ASTHMA IN AIRCREW: ASSESSMENT, TREATMENT AND DISPOSITION

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Asthma In Aircrew: Assessment, Treatment and Disposition

by

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SUMMARY

Asthma represents a spectrum of increased airway reactivity from mildly increased responsiveness through to severe life-threatening bronchospasm. Rational recommendations for treatment and aeromedical disposition require a careful assessment of bronchial reactivity through correlation of the clinical findings with results of pulmonary function testing including an objective measure of airway reactivity . Airway challenge testing with methacholine allows a safe, objective assessment of airway reactivity.

In the Canadian Forces, aircrew candidates with a history of wheezing, recurrent cough or bronchitis in childhood, or abnormal screening PFTs are further screened with an airway challenge test. Applicants with a PC20 less than 4 mg/ml are disqualified from pilot selection, and less than 2 mg/ml from other aircrew.

Trained aircrew who develop wheezing are assessed with full pulmonary function testing including a methacholine challenge test. Those with objectively confirmed mild bronchial hyper-reactivity requiring no treatment or controlled by inhaled anti-inflammatory agents (corticosteroids, sodium cromoglycate, nedocromial sodium) are returned to flying in other than fast jets where even minor small airway instability may worsen ventilation-perfusion mismatch caused by +Gz.

LIST OF ABBREVIATIONS

FEV1	Forced expiratory volume in one second
FVC	Forced vital capacity
FRC	Functional residual capacity
MMFR	Mid-maximal flow rate
MEF50	Maximal expiratory flow rate at 50% of the forced vital capacity
MEF75	Maximum expiratory flow rate at 75% of the forced vital capacity
MEF5	Change in MEF50 breathing heliox gas mixture
PC 20	The concentrationof methacholine in mg/ml which causesa 20% fall in the FEV1
TLC	Total lung capacity
URI	Upper respiratory infection

INTRODUCTION

The term asthma encompasses a spectrum of increased airway reactivity from mildly increased bronchial responsiveness induced only under unusual circumstances through to severe episodic bronchospasm requiring regular use of systemic medications. The latter situation is obviously incompatible with flying duties, while individuals with very mild bronchial hyper-reactivity may quite safely perform at least restricted flying duties.

The aeromedical concerns about asthma include acute incapacitation caused either by severe bronchospasm or at least theoretically, by gas trapping leading to pneumothorax or aeroembolism. Additional concerns include the various medications, many of which have aeromedically undesireable side-effects. Lastly, even mild bronchospasm may lead to ventilation-perfusion mismatching predisposing to hypoxia with a potential reduction in tolerance to +Gz, a concern in fast jet aircrew.

From an aeromedical standpoint, the problem lies in accurately identifying the degree of airway reactivity. The standard clinical tools of history and physical examination are often of little help since even severe asthmatics may be asymptomatic between episodes.

ASSESSING AIRWAY FUNCTION

Assessment of airway function and reactivity includes the following measures:

1. Careful clinical history
   - recurrent "bronchitis" or respiratory symptoms in childhood
   - history of other atopic disease; hay fever, eczema
   - family history of atopy or respiratory disease
   - wheezing with URIs, in unusual circumstances (eg around animals), or with exercise especially in cold air

2. Full pulmonary function assessment
   - maximum expiratory manoeuvers volume-time curves (FEV1, FVC, MMFR) flow-volume curves, air and heliox (V50, V75, V50)
   - lung volumes (TLC, FRC ? any gas trapping)
   - diffusing capacity
   - closing volume (single-breath nitrogen washout)

3. Repeat pulmonary function assessment after bronchodilator
   - improved flows
   - change in closing volume
   - change in lung volumes

4. Objective assessment of airway reactivity
   - standardized challenge tests with methacholine, histamine or cold air

5. Exercise testing +/- cold air

AIRWAY CHALLENGE TESTING

Assessment of airway reactivity through a standardized inhalation challenge test provides an objective measure of bronchial responsiveness. Such testing, when combined with other measures of pulmonary function and with clinical information may allow a rational recommendation about aeromedical disposition in a disease where the decision has historically been made more often on the inclination of the individual Flight Surgeon or Board than on any objective findings.

At DCIEM, we use the methacholine challenge test as developed and standardized by Hargreaves, Dolovich and Cockroft at McMaster University in Hamilton, Canada (1,2). After obtaining baseline expiratory flow parameters, subjects breathe nebulized solutions containing increasing concentrations of methacholine for a period of two minutes; repeat flow measurements are obtained after each concentration. The response is defined by the concentration of methacholine in mg/ml which produces a 20 percent fall in the FEV1, which is expressed as the PC20 (mg/ml). An example of a report is shown in Figure 1.

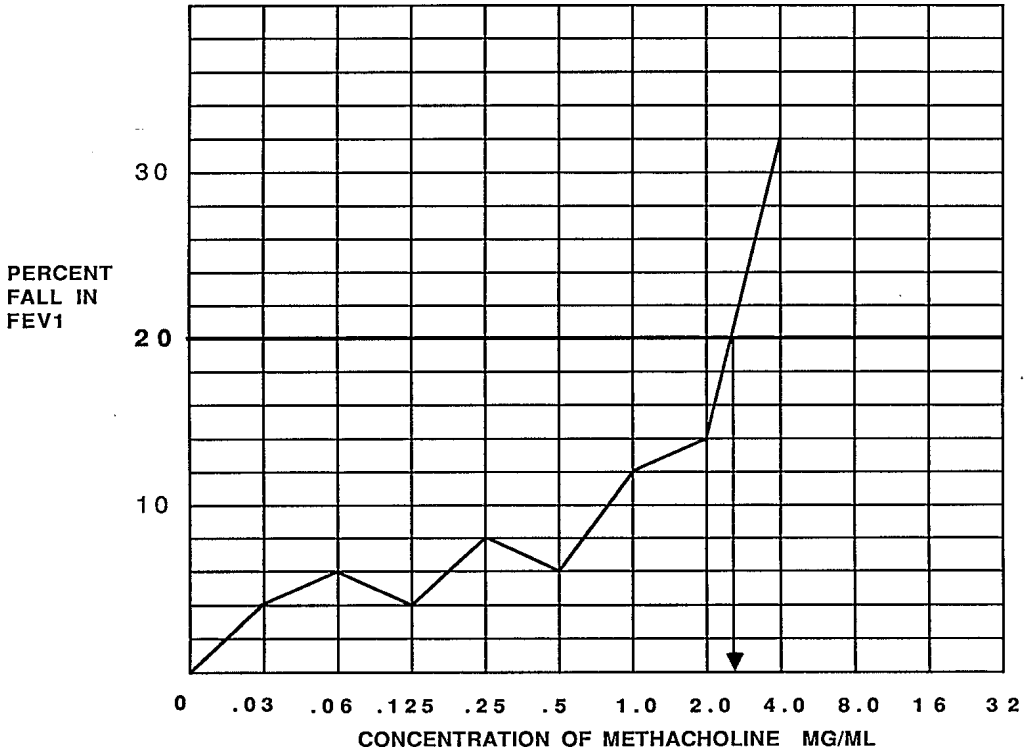
CENTRAL MEDICAL BOARD METHACHOLINE CHALLENGE TEST

SIN:_____ RANK_____ SURNAME, Initials: _____

PHYSICIAN: _____ TECHNICIAN: _____ DATE: _____

ASC/UNIT: _____ DOB/AGE: _____

DOSE RESPONSE CURVE



METHACHOLINE PC20: MG/ML

SEVERE	MODERATE	MILD/NORMAL

COMMENTS: Mildly increased bronchial reactivity. PC20 3 mg/ml

Figure 1

The test is relatively simple, inexpensive and easy to perform, with little risk to the subject. Particular attention must be paid to the calibration of the output of the nebulizer and the flow meter; errors in either can significantly affect the results. These should be recalibrated at regular intervals, especially in an aeromedical laboratory where decisions regarding an aviators career may hinge on the results.

AEROMEDICAL SCREENING/AIRCREW CANDIDATES

At the Central Medical Board at DCIEM, all candidates are screened with maximum expiratory flow-volume curves. Selected candidates are further screened with complete pulmonary function studies including methacholine challenge tests. The indications to proceed to complete pulmonary function testing are:

1. History of asthma or wheezing, or of recurrent cough or bronchitis in childhood.

2. Abnormal screening flow-volume curves (MEF50, MEF75, FEV1, or FEV1/FVC <80% predicted)

3. History of significant upper airway atopy.

The pass/fail criteria based on the methacholine PC20 are shown in Table 1.

TABLE 1

CMB METHACHOLINE STANDARDS

PC20 (mg/ml)	DISPOSITION
>4	Fit Pilot selection
2-4	Unfit pilot, fit other aircrew

Table 2 shows the CMB data for a two year period. Based on the above criteria, only a small percentage (3.5%) of the 1805 candidates required evaluation with methacholine challenge testing. Of the 63 candidates who underwent further evaluation, 57% were disqualified from pilot selection. The highest rejection rate was in the group with a past history of wheezing.

AIRCREW STATUS	DISPOSITION	No.
Fast Jet Pilots (8)	Unrestricted flying	6
	Removed from fast jets	2
Rotary Wing Pilots (6)	Unrestricted flying	5
	Restricted from CF5/CF18	1
Transport Pilots (1)	Restricted from CF5/CF18	1
Flight Surgeons (3)	Unfit fast jets	2
	Decompression chamber	
	Unrestricted	1
Navigator Students (2)	Ceased Training	2
Flight Steward (1)	Continue Duties	1

TABLE3. DISPOSITIONOFAIRCREWREFERREDFOR EVALUATIONOFREACTIVEAIRWAYSDISEASE.

In many cases, demonstration of normal or very mildy increased airway reactivity on methacholine challenge testing allowed the aircrew to be returned to unrestricted flying duties. Two cases are given as examples:

Case 1. A 30 year old tactical helicopter pilot developed symptoms of wheezing and shortness of breath while renovating a house he had recently acquired. He had been cleaning and painting in the house, in which pets had previously lived. He went to the Base Medical Clinic and was found to be mildly dyspneic, with bilateral wheezes but good air entry on auscultation. He was given inhaled salbutamol via a nebulizer with rapid resolution of the symptoms. He was given a salbutamol inhaler but he did not require further treatment.

He gave a history of upper airway atopic symptoms as a child, and had been on a desensitization program. On occasion , he had developed mild wheezing on exertion in cold air and with lower respiratory tract infections. He had not had any such symptoms since the age of 8 until this particular episode.

Pulmonary function tests showed normal expiratory flow rates with a modest increase in flow rates at low lung volumes after bronchodilator. A methacholine challenge test showed normal airway reactivity, with a PC 20 of 4.0 mg/ml.

TABLE 2	No.	PERCENT OF TOTAL	NUMBER REJECTED	PERCENT OF CANDIDATES SCREENED
CANDIDATES SCREENED	1805			
AIRWAY CHALLENGE TESTS	63	3.5	36	57
Upper Airway Atopy	12	0.7	2	16
Wheezing or bronchitis	45	2.5	32	71
Abnormal PFTs	6	0.3	2	33

He was returned to flying duties as a tactical helicopter pilot.

Case 2. A 24 year old jet instructor pilot developed symptoms of mild intermittent dyspnea over a period of several weeks. He had awakened on several occasions in the night with this sensation. The problem was brought to the attention of the Flight Surgeon only after the instructor declared a physiological emergency during a local training flight after he became seriously dyspneic. Although the pilot was not wheezing after the incident, the question of mild asthma was raised.

Full pulmonary function tests were normal, with no change after bronchodilator. On methacholine challenge testing, the PC20 was found to be 16 mg/ml.

Having eliminated reactve airways disease as a likely cause for the problem, attention was directed to hyperventilation as a possible cause. His wife was expecting their first child within a few weeks, and the symptoms resolved following delivery.

TREATMENT OF REACTIVE AIRWAYS DISEASE IN AIRCREW

Current trends in the treatment of asthma reflect the recognition of the very significant contribution of inflammation in the pathogenesis of the disease . Chemical mediators of inflammation are released upon stimulation of mast cells triggering both a bronchoconstrictive and inflammatory response. (3). The drugs which act primarily as relaxants of tracheobronchial smooth muscle (bronchodilators) include the theophylline derivatives, beta-adrenergic agonists, and anticholinergics. Those that act primarily as inhibitors of inflammation include corticosteroids, sodium cromoglycate and nedocromil sodium.

In flight deck aircrew, because of the significant side-effects of the bronchodilators, only the inhaled anti-inflammatory agents are generally compatible with continuing flying duties. However, in individuals with mild to moderately increased airway reactivity, aggressive treatment with inhaled anti-inflammatory agents alone or in combination can result in a significant stabilization of airway hyper-reactivity. To achieve this the agents must be used meticulously on a regular daily basis. In Canadian Forces aircrew, these agents are used with no flying restriction required. Demonstration of improved or normalized airway reactivity on treatment may be carried out with challenge testing before and while on treatment.

Preventive measures are also important and worthwhile. Agents that precipitate symptoms should be removed from the environment whenever possible, including cigarette smoke, furry animals, feather pillows, down comforters, and rugs and other materials that collect dust or foster mould.

There is still considerable controversy about the role of immunotherapy and desensitization in the treatment of asthma. It remains of unproven benefit. Because of the complex logistics involved including a mandatory period of grounding required after desensitization it is not advised in Canadian Forces aircrew for the treatment of reactive airways disease.

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