LETTERS TO THE EDITOR

Respiration in dystrophy myotonica

The interesting paper by Dr J E Clague et al (March 1994;49:240–4) contains some results and conclusions which are at variance with earlier studies.

Firstly, their results showed that the ventilatory response to carbon dioxide in these patients was lower than in the controls, but the difference was not significant. Several earlier studies showed clear evidence of a reduction in the slope of the ventilatory response. In addition, one study showed that the magnitude of this reduction was related to the severity of respiratory muscle weakness. I would therefore submit that the first conclusion in the abstract of the paper that “moderately severe global respiratory muscle weakness does not appear to influence the ventilatory response to rising carbon dioxide tension” is incorrect.

It should also be pointed out that the authors do not actually quote data confirming “global respiratory weakness” as they only report maximum inspiratory pressures (MIP). In this condition this may lead to underestimation of the severity of muscle weakness since previous studies in dystrophy myotonica have shown that maximum expiratory pressures tend to be relatively more impaired than inspiratory pressures. Weakness of expiratory muscles might also be relevant to the sensation of discomfort during carbon dioxide rebreathing. Clague et al assessed this by asking the question “how difficult is it to breathe?” They equate the answers with inspiratory effort sensation and go on to examine the relationship between this index and various factors including MIP. In the unnatural situation of ventilation stimulated by carbon dioxide both inspiratory and expiratory muscles are usually active, and therefore the sensation may not be determined solely by inspiratory effort. It might have been worth also exploring the relation between the effort sensation and expiratory muscle weakness.

A further point where the results appear to be at variance with earlier data relates to the variability of the timing of rebreathing.

The authors found no difference from normal in the variation of the duration of individual breaths. Previous work has, however, commented on patients with marked variation from breath to breath. The explanation for the discrepancy may lie in the technique used, since subjects in the study of Clague et al used a mouthpiece and noseclip, while studies showing marked variability of breathing used more surreptitious monitoring of chest wall movement which probably gives a fair reflection of undisturbed resting breathing.

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AUTHOR’S REPLY We were interested to read Professor Gibson’s letter which raises several important points. He is quite correct in stating that we did not include the maximum expiratory pressure data as we followed the normal convention of relating inspiratory effort sensation to maximum inspiratory pressures. This approach has been developed in Hamilton (Canada) and Cleveland (USA) but the subject table should certainly have contained the MIP data which was 56 (16) cm H2O for the myotonic group compared with 156 (23) cm H2O for our normal subjects. As can be seen the patient values are significantly below the age-matched controls and are very similar for both inspiration and expiration. This is the basis for the statement about global respiratory muscle weakness and we apologize for this point in the paper.

We were surprised to see no significant difference in the ventilatory responses to carbon dioxide between our patients and the control subjects. We suspect this reflects the selection of control subjects which we specified in the methods section. As can be seen, we did not study the most severely affected myotonic patients and, in particular, there were no subjects with diaphragm weakness—a difference between our study group and that of Professor Gibson which he cites in his reference 2.

We have conducted a subsidiary analysis adopting the same approach of pooling data that we used in our analysis of effort sensation. If this is done with the independent variable being ventilation, then a just significant effect of maximum inspiratory pressure can be seen (p=0.05) and this explains a very small amount of the variability in the ventilatory response to carbon dioxide. This analysis was removed for reasons of space during the revision of the paper.

Our point is that the ventilatory response to carbon dioxide in this group is continuous, with the most severely affected patients certainly having a reduced ventilatory response but many patients who are affected by dystrophia having preserved responses. Hence the problem is one of degree in the number of contributory factors, rather than an intrinsic defect always associated with the disease.

We have analysed the inspiratory effort sensation for both global and expiratory muscle weakness and found no difference in the conclusions from those listed in the paper. This is not surprising, given the similarity of the MIP and MEP results. We know of no data looking at the patterns of activation of the expiratory muscles during carbon dioxide rebreathing in patients with dystrophia myotonica. However, we doubt if this is substantially different from that seen in healthy humans.

Finally, we agree that the breathing pattern data we report are different from those obtained using non-invasive means of monitoring ventilation and we have suggested in paragraph 2 of the discussion that this may be so. Some of our patients showed substantial variability in their respiratory cycle duration when monitored awake as part of a sleep study described elsewhere. We were impressed by how easily these effects were abolished by a modest dead space. This effect may have an influence of a different set point for the apnoeic threshold in these patients that might be worth further systematic study.

However, these intriguing changes in ventilatory control may not reflect the total capacity of the individual to assess sensation unless that patient is confronted by an increased inspiratory load to breathing.

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Sympathomimetics and airway hyperreactivity

In commenting upon whether the use of sympathomimetics is associated with hyperreactivity of the airways to inhaled spasmogens, Drs Taylor and Sears and Drs van Schayck and van Herwaarden (February 1994;49:190–1) categorise the effect of sympathomimetics (at therapeutic dose levels) as small. Their opinions may be valid when histamine or methacholine are used for assessment of airway responsiveness, but it is possible that larger effects might have been observed if other test stimuli had been used. For instance, it is known that regular use of terbutaline resulted in an increased sensitivity to the spasmodenic actions of adenosine monophosphate that was greater than the corresponding change produced by histamine or methacholine. Recently, similar differential changes have been observed in allergic patients whose sensitivity to allergen, after regular use of salbutamol, was exaggerated to a greater extent than to methacholine.

Clinical observations of differential changes in sensitivity to intact airways to spasmogens were anticipated by an experimental analysis of the changed responsiveness of the airways in inhaled guinea pig antigen. In these animals, responsiveness of the airways to seven distinct spasmogens was measured before and after infusion of antigen. As humans, the magnitude of increased responsiveness was greater for some spasmogens than for others, with peptide-leukotrienes (LTC4 and LTE4) and bradykinin being particularly sensitive indicators of increased responsiveness during an acute allergic reaction in the guinea pig. Of possible interest to clinical investigators was the finding that, following prolonged exposure to salbutamol, the exaggerated responsiveness of the airways to LTC4 and LTE4 that accompanies a mild allergic reaction was further intensified. Thus, a substantial proportion of animals (78 of 235) became either too responsive for evaluation, or died during exposure to antigen or LTC4, even though concomitant responsiveness to histamine, acetylcholine, serotonin, and prostaglandin F2α was diminished significantly. A reduced response to certain spasmogens reflected a continued bronchodilator response to infused salbutamol, and these findings therefore explain the paradox of hyperreactivity to inhaled antigen without concomitant hyperreactivity to histamine as had been reported earlier but not understood. No mechanism has been established to account for this differential; however, it may be a manifestation of the properties of the (supposedly inert) enantiomer that comprises 50% of salbutamol, since induction of—

aggregated sensitivity to LTC4 has been ob-
erved to be a characteristic of s-salbutamol
in allergic animals.

There can be no doubt that allergic hyperre-
activity in the guinea pig is spasmogen se-
lective, with LTC4, LTD4, and histamine
being sensitizers in studies of this phe-
nomenon. However, following prolonged
(six days) exposure to salbutamol (1 mg/kg/
day) there is a divergence of changed re-
sponsiveness such that it might be concluded
from the use of LTC4, or LTD4, that airway
responsiveness had increased whereas, at the
same time and in the same animal, reduced
responsiveness to histamine would favour a
contrary conclusion. Hence, before cat-
tegorization of this airway responsiveness
due to sympathomimetics as being small in
asthmatic subjects, it would be prudent to
examine a wider range of test spasmogens.
When first investigated by use of sophisticated
receptor techniques, it was concluded that
allergic airway hyperreactivity did not occur
in the guinea pig.8 By giving consideration to
alternative test spasmogens it is now possible
to demonstrate substantial increased airway
responsiveness following a modest allergic
reaction in this species.9 Furthermore, it is
possible to define circumstances whereby sus-
tained exposure to sympathomimetics height-
es susceptibility to certain allergic mediators
so that even a low dose of antigen is
transformed from a source of mild dis-
comfort to sudden death. In the absence of
experimental data, it cannot be presumed that
this phenomenon cannot occur in asthma.

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2 Cockcroft DW, McParland CM, Britto SA, Sveys

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butamol and airway responsiveness to allergen.

3 Hoshiko K, Morley J. Allergic bronchospasm and
6 Chapman ID, Mazzoni L, Morley J. An
7 Morley J, Chapman ID, Foster A, Hoshiko K,
Mazzoni L. Effects of (+) and racemic sal-
butamol on airway responses in the guinea-
8 Popa V, Douglas JS, Boulou M. Airway responses to histamine, acetylcholine and preprobradykinin in the

AUTHORS' REPLY We thank Dr J Morley for his meaningful comment. We agree that our statement that the effect of sympatho-
mimetics on bronchial hyperresponsiveness is relatively small was based upon studies in which histamine or methacholine were used. Other test spasmogens may indeed have other effects. Moreover, we believe that the clinical significance of the effects of spasmogens which are inhaled in natural circumstances (such as allergens) is much greater than that of provocative effects such as histamine or methacholine. The recently published study of Cockcroft et al points to this difference.1

The results of the study of Cockcroft et al and the other studies mentioned by Morley may be explained not only by the fact that other spasmogens were used, but also by the fact that the subjects involved were clearly sensitive to allergens. In other words, an in-
creased bronchial hyperresponsiveness during continuous use of a bronchodilator may occur especially in asthmatic patients. We have some information which supports this suggestion. In a secondary multivariate analysis of our study which showed an in-
creased decline in lung function during con-
tinuous bronchodilator use8 it was observed that only asthmatic patients who were both allergic and had a high reversibility of ob-
struction after a bronchodilator had an in-
creased decline in lung function during the use of the sympathomimetic drug salbutamol. As this effect was independ-
ent of all other important characteristics (for example, baseline bronchial hyper-
responsiveness, baseline lung function, peak flow variability, and smoking), it seems probable that reversibility and allergy were not merely measures of the severity of the disease but were real determinants of an increased de-
cline in lung function during bronchodilator use. The enhanced response to a
degrains may be caused by enhanced mediator release from mast cells, possibly due to mast cell β-receptor downregulation.1 This would mean that regular use of sympathomimetics in conjunction with exposure to allergenic grains would induce inflammation, which in turn is an im-
portant determinant for an increased decline in lung function.1 It would also explain why β agonists induce an increase in hyper-
responsiveness in some patients and not in oth-
ers in our study.

It seems paradoxical that particularly al-
lergic patients should be careful in using sym-
pathomimetics chronically, as these patients
will in general benefit most from the acute
bronchodilating effect of these drugs. This
allows for a second explanation for the pos-
sibly deleterious effects of bronchodilators, namely a masking effect of the drug.1 If a patient is sensitive to an antigen and wheezes or gets dyspnea, the mere presence, his natural
tendency will be to stay away from it. The bronchoconstrictive reaction to antigens will
warn him against repeated exposure. If, how-
ever, the patient is given effective broncho-
dilator medication and is therefore 'unaf-
cared on a normal life', he will quickly learn
to get rid of the wheezing when it starts or to prevent it altogether by taking the bronchodilator in advance. Since the sympathomimetic drug does not interfere with the late reaction to the
inhaled substance, patients may eventually
develop a progressive inflammatory airway
disease with increasing bronchial hyper-
responsiveness. We observed earlier that there was a correlation between decreased FVC at baseline and the increase in bronchial symp-
toms in patients who had been treated on demand, but that there was no correlation at all in patients who were treated with broncho-
dilators continuously.1 A poor perception of the severity of asthma seems to be a predictor of severe asthma, and it may be possible that
these drugs have an influence on afferent signalling and its processing in the brain.4

1 Cockcroft DW, McParland CM, Britto SA, Swye-
un, VA, Rutherford BC. Regular inhaled sal-
butamol and airway responsiveness to allergen.

2 Schayck CP van, Dompeeling E, Herwaarden
CLA van et al. Bronchodilator treatment in
moderate asthma or chronic bronchitis: con-
tinuous or on demand? A randomised con-
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CLA van et al. Wever AMJ, Weel C van. Interacting
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responsiveness on the annual decline in lung
function and the exacerbation rate in asthma. Am Rev Respir Dis 1991;144:1297-301.
4 Whitelaw WA. Asthma deaths. Chest 1991;99:

5 Schayck CP van, Folgering H, Otter JJ den,
Titimanna P, Weel C van. Does the continuous
use (from 1 05 to 1 1 1 1 ) of bronchodilators result in an allergy or bronchial hyper-
6 Barnes PJ. Blunted perception and death from

Bromchodilators in COPD

In their recent paper (April 1994;49:332-4)
Fink and coworkers found, in a group of
22 patients with severe COPD (FEV1 <50%
predicted), that theophylline therapy induced
a small but statistically significant increase in
maximal voluntary ventilation (from 43.0
l/min with placebo to 46.7 l/min) resulting in
an improvement in peak exercise capacity.
Since at the same time there was no change in
FEV1, it was concluded that theophylline was probably acting on the respiratory
cavities, either directly or via a central
stimulatory pathway. The finding of a statistically significant improvement in ar-
terial blood gases at rest favoured the second hypothesis.

However, we think that they have not paid
enough attention to another of their findings –
namely, the increase in FVC from 2.28l
to 2.38l. Although of small magnitude, this
change may well indicate beneficial broncho-
dilating effects of theophylline not reflected in
FEV1. Other workers have previously shown a
reduction in the work of breathing, a decrease
in trapped gas volume, and an increase in slow
vital capacity5 without concomitant change in
FEV1 in patients with COPD receiving theophylline. We have also recently found
such dichotomous responses to broncho-
dilators in COPD after betamimetic inhalations;6 significant decreases in specific airway resistance and sometimes increases in
maximal inspiratory flows can occur in the
absence of significant increases in FEV1. Such
a finding should not come as a surprise,
hence, since no change or only a small change in FEV1 after administration of broncho-
dilators is somehow included in the definition of COPD!7

We suggest that, for evaluating broncho-
dilators, we should stop concentrating only
on FEV1 measurements and should look at
other indices of airway function such as specific
airway resistance, maximal inspiratory
flows, and even the slow vital capacity.8

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2 Cockcroft DW, McParland CM, Britto SA, Swye-
un, VA, Rutherford BC. Regular inhaled sal-
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3 Schayck CP van, Dompeeling E, Herwaarden
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4 Whitelaw WA. Asthma deaths. Chest 1991;99:

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