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Does the asthma visual analogue scale relate to the asthma control questionnaire?

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1 Control based asthma management, comprising a continuous cycle of assessment,
2 adjustment, and review of treatment response, is recommended by the Global Initiative for
3 Asthma (GINA) guidelines (1). Objective measurement and documentation of asthma control
4 in UK clinical practice is often poor. In the National Review of Asthma Deaths (UK), of the
5 69% of patients who had an asthma review before their death, only 27% had any formal
6 assessment of asthma control (2). Therefore, having a simple, but effective tool to detect
7 changing severity of asthma is important.

8 The Asthma Control Questionnaire (ACQ-6), is a widely used and well validated non-binary
9 metric which strongly predicts future exacerbations(3) . It demarcates between controlled (C),
10 partially controlled (P), and uncontrolled (U), based on cut point scores of <0.75 , $\geq 0.75 < 1.5$,
11 and ≥ 1.5 respectively (4). The asthma visual analogue scale (VAS) is a 10cm continuum
12 indicating the overall symptom burden (5), and can be patient or physician administered. It
13 has been demonstrated, in a large Japanese population to discriminate between GINA defined
14 categories of C, P and U as $<1.5\text{cm}$, $\geq 1.5 < 7.19\text{cm}$, and $\geq 7.19\text{cm}$ respectively (5). VAS has
15 also been shown to be effective in adolescents at detecting changes in asthma symptoms
16 reflecting more detailed multi-item asthma diaries (6). We have evaluated for the first time
17 whether VAS correlates to ACQ-6, and if the predefined GINA cut points relates to ACQ-6
18 defined levels of control.

19 We retrospectively analysed $n=84$ patients who volunteered for asthma screening into clinical
20 trials at the Scottish Centre for Respiratory Research. All patients gave written informed
21 consent for their anonymised screening data to be used. Patients had to have a physician
22 based asthma diagnosis for at least three months before attending screening, and be free from
23 an asthma exacerbation requiring steroids for 3 months prior to screening. Patients completed
24 basic spirometry (Micromedical, Chatham, U.K.), exhaled nitric oxide (FeNO, NIOX MINO,
25 Circassia Ltd, UK) had their medical history and concomitant medications recorded, and

26 completed both ACQ-6 (Qoltech Ltd), and VAS questionnaires. As per Ohta et al. patients
27 were asked to perform the VAS, and ~~As per Ohta et al. patients were asked to~~ “pPut a mark
28 on the line below to indicate how much your symptoms bother you?”, with a 0-10cm line
29 presented to the patient, 0cm= “not at all bothersome”, and 10cm= “extremely bothersome”
30 (5).

31 The average age of patients was 52 years, and 90% of patients were receiving inhaled
32 corticosteroids (ICS) with a mean beclometasone dipropionate (BDP) equivalent dose of
33 675µg/day. Of those on ICS 80% received a long acting beta-2 agonist (LABA) as a
34 combination inhaler (ICS/LABA), 42% of those receiving ICS also received concomitant
35 leukotriene receptor antagonist (LTRA), mean FeNO was 45ppb, mean forced expiratory
36 volume in 1 second (FEV1) was 89% predicted; 63% of patients had a positive skin prick
37 test, with the mean number of positive skin prick tests being 2.

38 VAS correlated with ACQ-6, overall Spearman’s correlation was 0.62, $P < 0.001$. Mean VAS
39 levels for ACQ were: C (< 0.75): 2.2cm (95% CI 1.35-3.06), P ($\geq 0.75 < 1.5$): 2.56cm (95% CI
40 2.61-4.50), U (≥ 1.5): 5.27cm (95% CI 4.46-6.08) (Figure 1). VAS did not correlate ($r_s = 0.08$,
41 $p = \text{NS}$) with FeNO, or FEV₁ % predicted ($r = -0.18$, $p = \text{NS}$).

42 Between group differences for mean values comparing GINA defined VAS categories of C
43 ($n = 22$) vs P/U ($n = 62$) showed a significant difference for ACQ: 0.57 vs 1.73 ($p < 0.0005$), but
44 not FEV1: 89% vs 89%, or FeNO: 32ppb vs 30ppb.

45 Between group differences for mean values comparing ACQ defined categories of C ($n = 27$)
46 vs P/U ($n = 57$) showed no significant difference for: FEV1: 91% vs 88% or FeNO 29ppb vs
47 36ppb. ACQ score also did not correlate to FeNO ($r = -0.06$, $p = \text{NS}$).

48 Receiver operator curve analysis, using ACQ to compare C vs U/P revealed an optimal cut
49 point for VAS of 1.95cm (AUC 0.8, sensitivity 88%, specificity 68%), comparing C vs U

50 revealed a VAS cut point of 3.5cm (AUC 0.7, sensitivity 66%, specificity 61%). Furthermore
51 the GINA defined cut point of ≥ 7.19 cm was associated with a sensitivity of 26% and
52 specificity of 91%.

53 Our data showed that VAS correlated with the overall ACQ-6 score, however the VAS cut
54 points used to determine GINA defined control were not tailored to ACQ. The mean VAS of
55 5.27 (95% CI 4.46-6.08) for patients with an $ACQ \geq 1.5$ was not only lower than the 7.19cm
56 GINA cut point, but also the ROC suggested that a much lower VAS value (≥ 3.5 cm) would
57 optimally identify such patients. The corollary is that patients with a $VAS \geq 3.5$ cm, should
58 warrant further enquiry into their asthma control (e.g. using ACQ), and that VAS may only
59 be considered a quick screening tool in a busy clinic. Furthermore VAS is sensitive to
60 bronchodilation (7) and can be repeated daily (6). The benefit of a daily symptom score such
61 as VAS is that it may obviate recollection errors from retrospective questionnaires (8),
62 furthermore, in adolescents, asthma VAS has been evidenced as predictive of future asthma
63 control at 6 months (6).

64 The failure of VAS to correlate with FEV_1 % predicted corresponds with data from primary
65 care, where VAS did not correlate to peak expiratory flow (9), suggesting that a proportion of
66 asthmatics do not reliably detect changes in their lung function. This has been evidenced
67 previously in the context of acute bronchoconstriction (10).

68 We acknowledge our study has limitations. Firstly, the sample size is small, and from a single
69 site, therefore it may not represent the general asthma population. Secondly this was a
70 retrospective analysis, which found that VAS cut points correlating to GINA defined asthma
71 control were not the most suitable for ACQ defined asthma control. The VAS cut points
72 assessed in our study, were from a large cross sectional Japanese population. However, it
73 cannot be assumed that these cut points are generalizable to other regions. A prospective

74 study with a larger sample size, using the lower cut points derived from our ROC analysis
75 would further clarify how sensitive VAS is at detecting levels of ACQ asthma control of C, P,
76 U. Finally, the VAS is a snapshot of current control, whereas the ACQ is reflective of the
77 previous week.

78 We conclude that the GINA defined VAS cut off (≥ 7.19 cm) is a poor predictor of control in
79 relation to an $ACQ \geq 1.5$. Hence, further evaluation is required to define the VAS threshold in
80 relation to control defined by ACQ rather than GINA, and also whether a decline in VAS
81 correlates to a decline in ACQ, as change in control is arguably more important as current
82 level.

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Figure 1.

Distribution of ACQ control categories relative to VAS levels. Vertical lines represent GINA defined cut points of control (1.5cm) and uncontrolled (7.19cm) asthma.

Figure 1
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