Simple, easily memorised "rules of thumb" for the rapid assessment of physiological compensation for respiratory acid-base disorders

Respiratory acidosis and alkalosis are associated with compensatory physiological changes, including extracellular and intracellular buffering, and altered renal ion handling. In clinical practice, mixed acid-base disturbances may be misdiagnosed if the expected magnitude of compensation for a primary respiratory disorder is not known.

The ability to assess physiological compensation rapidly for acid-base disorders can be achieved either through intuition gained after many years of clinical experience, by use of a graph or nomogram,[1] or through the application of one of the published formulae for predicting compensation.[2 3] However, nomograms are often not readily available in clinical environments, and the most accurate formulae are complex and difficult to memorise reliably.

A comprehensive summary of previously published measurements of metabolic compensation for respiratory disorders was recently published.[3] Using these data, simple but accurate "rules of thumb" for the assessment of physiological compensation for respiratory disorders are developed here.

METHODS

In SI units, carbon dioxide tension (P_{CO_2}) and bicarbonate (HCO_3^-) are linked by the equation $[H^+] = 182.36\ P_{CO_2}/[HCO_3^-]$.
For clinical purposes, this can be simplified to $[H^+] = 180\ P_{CO_2}/[HCO_3^-]$. Manually extracted graphical data from the study by Schilchtig *et al*[3] are used here to generate new rules which more accurately estimate metabolic compensation for respiratory disorders. For the purpose of calculations, normal HCO_3^- concentration was taken as 24.4 mM and normal Pa_{CO_2} is taken as 5.3 kPa.

RESULTS

Of several methods tried, the most easily memorised approach was to calculate the number of mM change in HCO_3^- (ΔHCO_3^-) for a 1 kPa change in P_{CO_2}. This method enables the quick estimation of the appropriate HCO_3^- from a given value of P_{CO_2} for metabolic compensation for respiratory disorders.

The following rules are proposed:

Acute respiratory acidosis: $\Delta HCO_3^- =$ 1 mM for each 1 kPa change in P_{CO_2}

Acute respiratory alkalosis: $\Delta HCO_3^- =$ 2 mM for each 1 kPa change in P_{CO_2}

Chronic respiratory acidosis: $\Delta HCO_3^- =$ 4 mM for each 1 kPa change in P_{CO_2}

Chronic respiratory alkalosis: $\Delta HCO_3^- =$ 3 mM for each 1 kPa change in P_{CO_2}

The spread of clinical data (fig 1) shows that these rules predict compensation accurately within the approximate range ±5 mM.

DISCUSSION

The proposed rules fit the published data more closely than those proposed previously (fig 1).[2] There appears to be a maximum metabolic compensation for chronic respiratory acidosis and neither the rules of thumb presented here nor the published formulae accommodate this. Even in extreme circumstances, the maximum range for metabolic compensation appears to lie between 12 mM[4] and 50 mM.[5] Incorporating this additional information, the rule for chronic respiratory acidosis adopts a better fit with the published data (fig 1).

The data plotted in fig 1 also give evidence for the widely accepted tenet that overcompensation for primary acid-base disorders does not occur. This means that any change in $[H^+]$ opposite to that produced by the primary disorder must be pathological. In these conditions it is therefore not necessary to use the methods described here.

Finally, acute compensation for respiratory disorders is usually small. Thus, for normal clinical practice, only two rules must be learnt: chronic respiratory alkalosis (3 mM for each kPa of CO_2), and chronic respiratory acidosis (4 mM for each kPa).

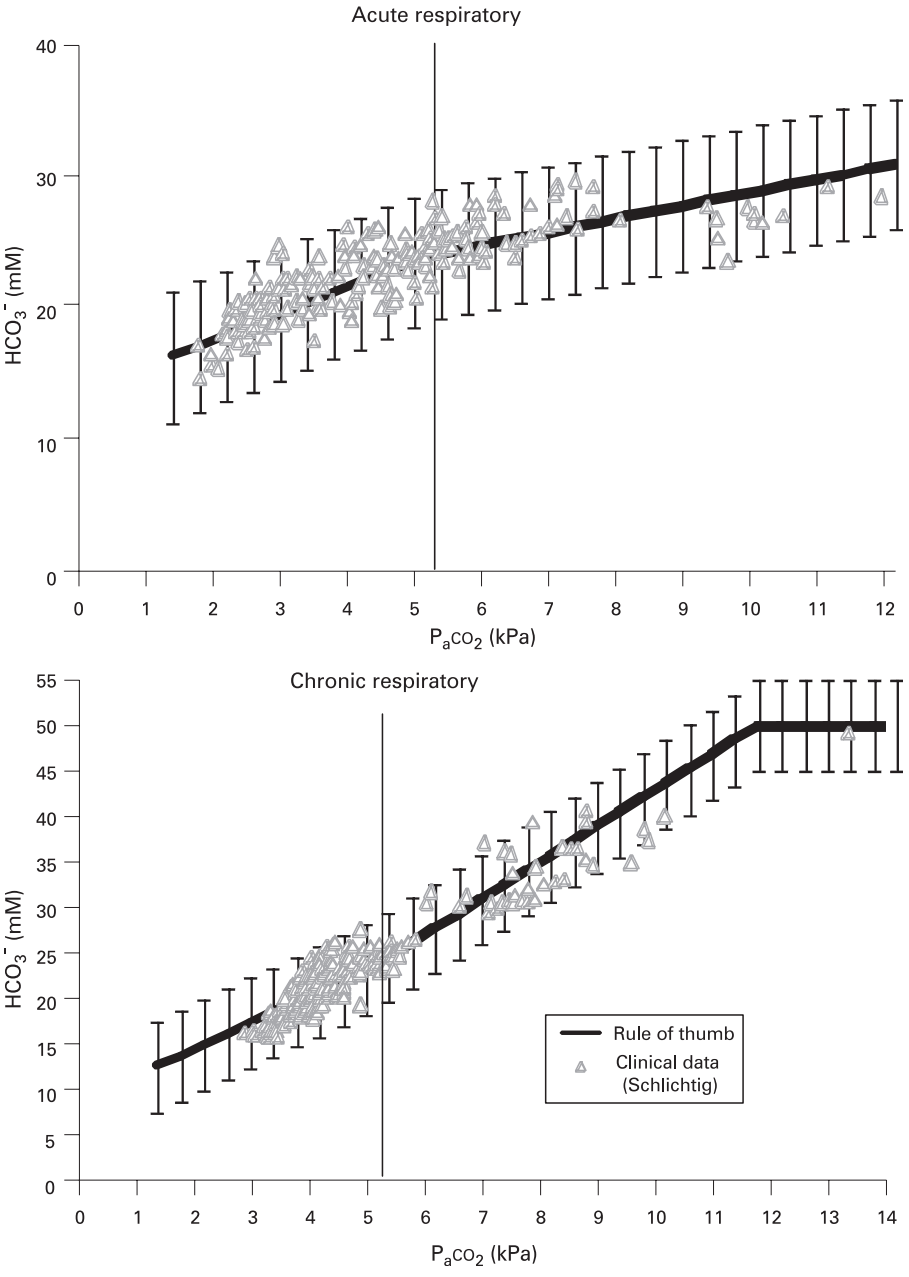

Figure 1 Rules of thumb (solid lines) compared against the clinical data collated by Schlichtig *et al*.[3] Error bars show the range ±5 mM.

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Lung Cancer Peer Review Survey

The National Cancer Peer Review Programme is undertaken by peer reviewers and user reviewers resulting in assessments on the quality of cancer services for NHS patients in England.[1 2] Throughout 2004–2007 the peer review process has been taking place across England. Responding to some disquiet at the benefits of peer review in its current format, the BTS Lung Cancer and Mesothelioma Specialist Advisory Group decided to carry out a survey of lead lung cancer clinicians in all trusts in England who were undergoing peer review. The methodology of the survey is detailed in the online Appendix.

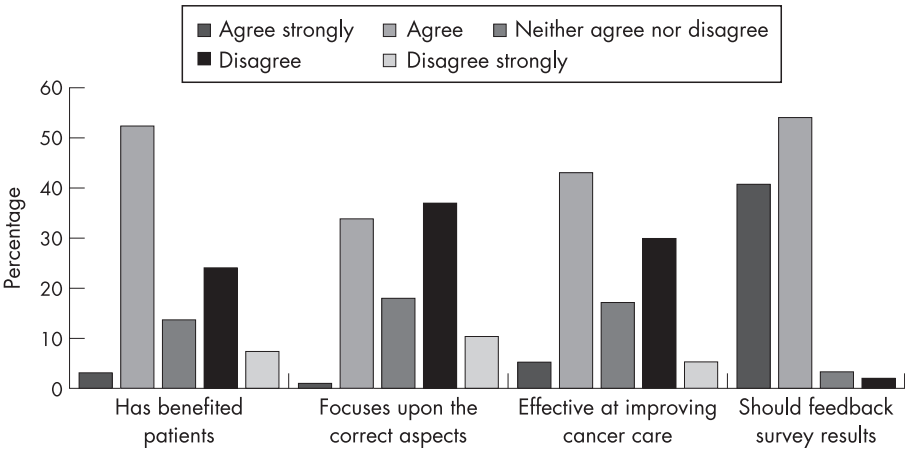

Figure 2 Opinions on peer review.

A total of 94 responses were received from approximately 150 lung cancer leads (all consultant physicians). Responses were obtained from consultants in all cancer networks in England (fig 1). The majority (93%) had been personally involved in self-assessment; 59% felt that self-assessment had been a useful process, but there was significant impact upon clinical activities (in 36%) and management activities (in 49%). Respondents were asked to estimate the time spent on self-assessment; a wide range of answers was received, ranging from no time to 168 h with a mean of 19 h and a total of 1606 h (67 days). To attend the peer review interview, 62% of consultants had to cancel clinical sessions and 27% reported difficulties in getting colleagues to attend; 82% of respondents felt that the membership of the interview panel was appropriate. However, the format of the interview was overall felt to concentrate on the wrong aspects by 65%; 24% felt that the interview concentrated on outcomes whereas 91% felt that process and paper evidence were the main focus. Overall, 72% felt that the final report was a fair assessment of their lung cancer service.

The final questions asked for overall feelings about the peer review process (fig 2). There appeared to be mixed feelings about whether peer review had benefited patients, with only 55% giving a positive opinion. Approximately one-third agreed that peer review concentrated on the right aspects, but nearly 50% felt it did not. Similar responses were obtained to the question of whether peer review was an effective way of improving cancer care. Finally, 95% of respondents felt that the results of the survey should be fed back to those with responsibility for the peer review process.

We re-analysed the results according to seniority of the consultants, splitting them into those who were >10 years in post (n = 48) and those <10 years in post (n = 46). The results were similar in the two groups. However, the younger consultants were more likely to look upon self-assessment as a useful exercise (70% vs 56%) and were more likely to feel that peer review had benefited patients (61% vs 52%).

The survey questions allowed space for free text comments and many were made (see online Appendix).

One criticism of the results might be the rather low response rate of 61%. However, some 20% of the trusts that did not respond had valid reasons—for example, their lead clinician had since retired or moved to a different post. The survey has revealed strong feelings among lead clinicians regarding cancer peer review, and the overwhelming message of the survey is that clinicians feel that peer review is assessing the wrong things, concentrating on paper evidence of

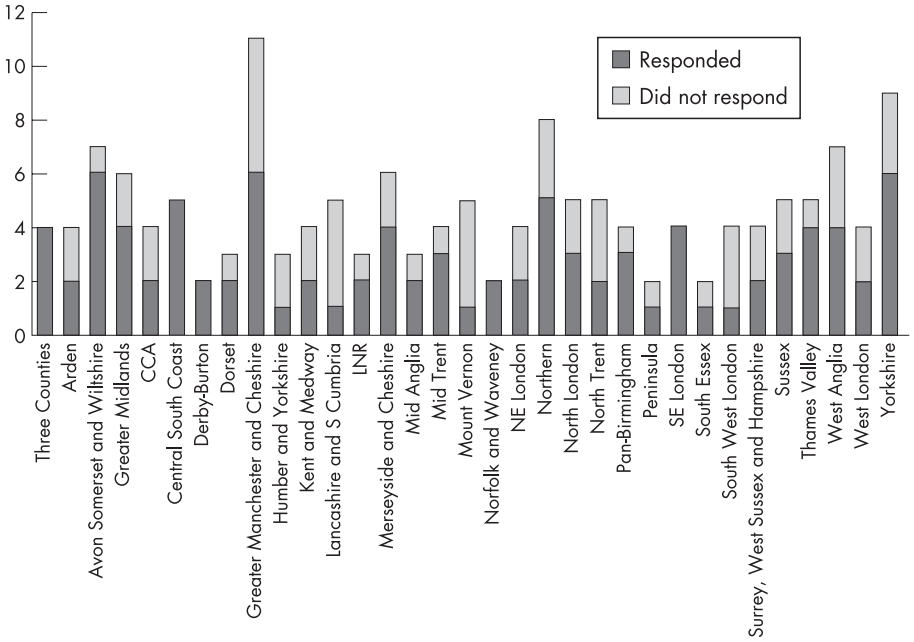

Figure 1 Responses by network.