OPINION

Multidimensional assessment and tailored interventions for COPD: respiratory utopia or common sense?

Vanessa M McDonald,1,2,3 Isabel Higgins,1 Lisa G Wood,3,4 Peter G Gibson2,4,5

ABSTRACT

Introduction The rising disease burden from chronic obstructive pulmonary disease (COPD) requires new approaches.

Method We suggest an approach based around three elements: inflammation and multidimensional assessment to identify therapeutic targets and case management to design and implement an individualised treatment programme based on these assessments.

Discussion This tailored approach to treatment would maximise efficacy, limit cost and permit a better risk–benefit ratio of treatment. The advantages include the ability to add up the benefits of individual therapies leading to a cumulative therapeutic benefit that is greater than each individual therapy alone. We can now design a multifaceted inflammation intervention for airway diseases based on targeting eosinophilic inflammation, non-eosinophilic pathways and systemic inflammation. COPD is a complex and challenging disease. The use of inflammation and multidimensional assessment is necessary to identify relevant treatment targets and maximise the scope of therapy while limiting unnecessary use of drugs. An individualised programme of management can be designed and coordinated by using a case manager. This new approach may provide tangible benefits to people with COPD.

Chronic obstructive pulmonary disease (COPD) is a high impact disease,1 with a global trajectory that predicts an alarming increase in illness burden.2 Current approaches are unlikely to be sufficient to address this problem since they are largely based around disease management concepts that have been available for several years, at a time when the global COPD burden is escalating. New approaches are required and we suggest an approach that is based around three elements: the use of inflammation and multidimensional assessment to identify therapeutic targets, and case management to design and implement an individualised treatment programme based on these assessments.3 Some see this as self-evident (common sense), whereas others see it as idealistic (respiratory utopia). We maintain it is pragmatic and achievable approach to a complex disease and results in a therapeutic paradox, when therapeutic benefits (statins) for systemic inflammation,12 may worsen neutrophilic airway inflammation13 and when applied generally in COPD has a worrying pneumonia risk.14 Recent and ongoing studies (http://www.clinicaltrials.gov) of anti-inflammatory medications in COPD apply single agents generally to all patients with COPD. This approach fails to recognise the heterogeneity of inflammation in this disease and results in a therapeutic paradox, when key pathophysiological processes can escape therapeutic intervention.

This raises the question of whether a tailored approach to treatment would maximise efficacy, limit cost and permit a better risk–benefit ratio. With this approach the benefits of individual therapies are each added together to bring a cumulative therapeutic benefit. Such multifactorial intervention is common with non-pharmacological therapies, such as pulmonary rehabilitation and asthma self-management education. Together with multidimensional assessment, it is also used successfully in other chronic diseases. The core elements of this approach are inflammation (table 1), multidimensional assessment1 and case management. This
Chest clinic

REAL WORLD EXAMPLE OF AIRWAY INFLAMMOMETRY CASE MANAGEMENT

Older adults (>55 years) with stable COPD (defined in online supplement) were recruited and allocated to usual care (n=19) or multidimensional assessment and management (n=17). The intervention consisted of individualised management based on the baseline multidimensional assessment. A personalised care plan was developed by the study physician and case manager. The clinicians and participants agreed on the tailored interventions for each of the identified problems. An inflammation algorithm (table 1) was used to inform treatment decisions for airway inflammation, systemic inflammation and mucus hypersecretion. Other tailored interventions were standardised according to the best available evidence. The case manager coordinated the plan. The interventions were delivered over 3 months during individualised visits (see online supplement table 1). Pulmonary rehabilitation participation occurred concurrently.

The participant characteristics are presented in table 2. The baseline multidimensional assessment identified a mean (95% CI) of 10.5 (9.7 to 11.2) clinical management problems per participant. These problems clustered into four domains: airway related problems, comorbidity, risk factors and behavioural issues.

The primary outcome of health status improved significantly from baseline to 3-month follow-up in the intervention group. The mean (95% CI) difference in St George’s Respiratory Questionnaire (SGRQ) for multidimensional assessment, airway inflammation and individualised management (MDAIM) was 14 (20.7 to 8.5) versus 3.5 (−3.8 to 10.8); p=0.0003 for control (figure 1A). The mean (95% CI) SGRQ score post intervention for MDAIM was 42.8 (35.3 to 50.4) versus 52 (45.1 to 58.9); p=0.06 for control.

Clinically significant quality of life improvement (decreased SGRQ score > 4 units at 3 months) was achieved in 14 (82.3%) participants in the MDAIM group and 5 (31.2%) in the control group (p=0.003). The number needed to treat in order for one person to achieve a clinically significant change in SGRQ was 2.

In the MDAIM group health status continued to improve at 6-months follow-up (mean (95% CI) decrease of 17.1 (7.1 to 27.1) units, p=0.002) and was maintained at 12 months with a 13.5 (4.7 to 22.3) unit decrease from baseline (p=0.005). In the control group there was no statistically significant difference at either 6 months (4.5 (−1.2 to 10.3); p=0.1) or 12 months (3.1 (−3.5 to 9.7); p=0.3).

Targeted inflammation-based management reduced eosinophilic and neutrophilic airway inflammation and systemic inflammation (figure 1B–D).

DISCUSSION

Airway and systemic inflammation in COPD is heterogeneous and since any one person can exhibit more than one inflammatory process (figure 2), any individual may require more than one therapeutic approach. For example, targeting neutrophilic inflammation alone will treat 57% of people with COPD (figure 2). Targeting eosinophilic inflammation will treat a further 34% and

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### Table 1 Inflammation-based algorithm

<table>
<thead>
<tr>
<th>Component</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway inflammation</td>
<td></td>
</tr>
<tr>
<td>Eosinophilic (sputum eosinophil count %&gt;3)</td>
<td>ICS 500 μg twice daily (beclomethasome equivalent) and prednisolone according to Siva²³</td>
</tr>
<tr>
<td>Neutrophilic (sputum neutrophil count %&gt;61)</td>
<td>Azithromycin 250 mg daily for 3 months</td>
</tr>
<tr>
<td>Mucus hypersecretion</td>
<td>Positive expiratory pressure device (Acapella)</td>
</tr>
<tr>
<td>Systemic inflammation (CRP &gt;3 mg/litre)</td>
<td>Hypertonic saline 6% twice daily, nebulised</td>
</tr>
<tr>
<td></td>
<td>Simvastatin 20 mg daily for 3 months</td>
</tr>
</tbody>
</table>

If systemic inflammation and neutrophilic airway inflammation were present doxycycline was used in place of azithromycin to avoid coadministration of simvastatin and azithromycin. CRP, C-reactive protein; ICS, inhaled corticosteroid.

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### Table 2 Baseline participant characteristics

<table>
<thead>
<tr>
<th>Component</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Gender, M</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td>Age (years), mean (95% CI)</td>
<td>70.6 (65.8 to 75.4)</td>
<td>71.1 (67.1 to 75.2)</td>
</tr>
<tr>
<td>Post-bronchodilator FEV1% predicted, mean (95% CI)</td>
<td>55 (43.5 to 67.2)</td>
<td>48 (40.2 to 55.3)</td>
</tr>
<tr>
<td>Post-bronchodilator FVC % predicted, mean (95% CI)</td>
<td>71 (63.1 to 79.2)</td>
<td>67 (59.3 to 73.6)</td>
</tr>
<tr>
<td>FER, mean (95% CI)</td>
<td>0.59 (50.8 to 67.2)</td>
<td>0.51 (50.8 to 67.2)</td>
</tr>
<tr>
<td>SGRQ (units), mean (95% CI)</td>
<td>57 (51.5 to 63.4)</td>
<td>50 (44.0 to 55.5)</td>
</tr>
<tr>
<td>Smoking status, never/ex/current</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Charlson comorbidity index, mean (95% CI)</td>
<td>4 (3.3 to 4.7)</td>
<td>4.1 (3.7 to 4.5)</td>
</tr>
<tr>
<td>BMI (kg/m²), mean (95% CI)</td>
<td>27.8 (24.1 to 31.5)</td>
<td>28.4 (24.6 to 32.4)</td>
</tr>
<tr>
<td>CRP (mg/litre), median (IQR)</td>
<td>5.3 (2.5–9.5)</td>
<td>6 (2–9)</td>
</tr>
<tr>
<td>Sputum neutrophils (%), mean (95% CI)</td>
<td>59 (43.3 to 74.7)</td>
<td>59 (46.5 to 71.9)</td>
</tr>
<tr>
<td>Sputum eosinophils (%), median (IQR)</td>
<td>2.25 (1–7)</td>
<td>1.75 (0.5–2.65)</td>
</tr>
</tbody>
</table>

BMI, body mass index; CRP, C-reactive protein; FER, forced expiratory ratio; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; SGRQ, St George’s Respiratory Questionnaire.
targeting systemic inflammation will manage this problem in 59% of the COPD group. Drug therapy is increasingly pathway specific, and to target all of these different pathways in all people with COPD would require three drugs, that is, macrolide, statin and corticosteroid. A less costly and potentially safer approach is to use individual assessment and multicomponent therapy. We have developed a multifaceted approach that is likely to be highly effective and may be safer. The additive effects of targeted anti-inflammatory treatment to eosinophilic, neutrophilic and systemic inflammation should show at least cumulative benefits, and result in a greater proportion of the COPD population receiving effective anti-inflammatory therapy. We recognise that anti-inflammatory treatment in COPD needs to balance the nature of inflammation, treatment efficacy and the potential for adverse effects. For example, the broad application of macrolides is effective but there is a concern about side effects and microbial resistance. Consequently, an individually targeted approach may be a better way to maximise efficacy and minimise side effects.

**Inflammetry**

Current evidence can now be used to design a multifaceted inflammetry intervention for airway diseases. High-quality evidence reports the superior effects of targeting airway eosinophilic inflammation in asthma and COPD, with a 50% reduction in exacerbations. Non-eosinophilic inflammatory pathways are addressed using macrolide antibiotics as immunomodulatory agents and studies demonstrate reductions in exacerbations, improved lung function and improved health status. Systemic inflammation represents a further pathway that could be identified by inflammetry and targeted by statins. In COPD an increasing number of observational studies report the positive effects of statins, including a reduced number of COPD exacerbations, reduced lung function decline, improved exercise capacity and reduced mortality. These

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**Figure 1** Biomarkers of inflammation in the group receiving treatment tailored to inflammation using the inflammation treatment algorithm. (A) Health status measured by St George’s Respiratory Questionnaire (SGRQ) improved significantly (lower score) in the intervention group and worsened in the control group, as measured at 3 months. (B) In the group within multidimensional assessment, airway inflammetry and individualised management (MDAIM) that received oral corticosteroids (OCS) sputum eosinophils (%) had normalised post intervention. The solid line represents the upper limit of normal for sputum eosinophils. (C) In the group within MDAIM that received antibiotics as anti-inflammatory agents sputum neutrophils (%) had normalised post intervention. The solid line represents the upper limit of normal for sputum neutrophils. (D) In the group within MDAIM that received statins for systemic inflammation there was a statically significant reduction in serum high-sensitivity C-reactive protein (hs-CRP). The solid line represents the upper limit of normal of hs-CRP.

**Figure 2** Venn diagram showing the prevalence of different inflammatory processes in chronic obstructive pulmonary disease.
published studies have targeted specific inflammatory processes in isolation, and while they show efficacy, to date there are no other published studies other than these pilot data that treat the overlapping features of the inflammatory processes present in individuals with COPD. Our composite inflammatory algorithm is described (table 1).

Case management

The needs of patients with COPD are complex and multidimensional, and as clinicians, our responses must also be multidimensional and integrated to meet these needs. Case management is an approach that offers a solution to these healthcare delivery issues in COPD. This approach can be used to complement individualised and phenotype-based treatments in this complex population.

This approach brings together multidimensional assessment, inflammometry and case management. It need not be restricted to COPD, but could usefully be applied to other chronic airway diseases, such as severe asthma and bronchiectasis. We have targeted problems that clustered into four domains: airway-related problems, comorbidity, risk factors and behavioural issues. There are additional issues that could be addressed and require further consideration, such as end of life care and whether disease severity using either GOLD stage or BODE (body mass index/airflow obstruction/dyspnea/exercise capacity) index has an impact on problem assessment and management.

When looking at the prospects and challenges of COPD management in the future, this form of respiratory utopia makes a certain amount of common sense!

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Contributors

VMMcD: project conception, study design, data collection, data analysis, data interpretation, writing and revisions of the manuscript, study design and revisions of the manuscript. IH: study design and review of manuscript. LGW: study design and review of manuscript. PGG: project conception, study design, data interpretation, and writing/revision of manuscript.

Competing interests

Dr Vanessa McDonald has been reimbursed for participation in educational meetings from AstraZeneca, Boehringer Ingelheim GlaxoSmithKline and Novartis. She has participated in studies funded by GlaxoSmithKline. Professor Isabel Higgins has no competing interests to declare. Dr Lisa G Wood has no competing interests to declare. Professor Peter Gibson holds an NHMRC Practitioner Fellowship. He has been reimbursed for participation in symposia funded by AstraZeneca, Boehringer Ingelheim, GlaxoSmithKline and Novartis. He has participated in studies funded by Pharmaxis and GlaxoSmithKline.

Ethics approval

Hunter New England Human Research and Ethics Committee and the John Hunter Hospital Charitable Trust Grants. VMMcD was the Practitioner Fellowship recipient. The authors would like to thank and acknowledge Amber Smith for the dietary intervention, Kelly Steel, Rebecca Oldham and Joanne Smart for statistical advice. Additionally we would like to thank and acknowledge Peter Gibson holds an NHMRC Practitioner Fellowship recipient. The authors would like to thank and acknowledge Heather Powell for her statistical advice. Additionally we would like to thank and acknowledge Amber Smith for the dietary intervention, Kelly Steel, Rebecca Oldham and Joanne Smart for data collection, the CARD laboratory team for sample processing and the participants for taking part.

Provenance and peer review

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REFERENCES

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