Stable breathing through deeper sleeping

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Although there is evidence that patients with obstructive sleep apnoea (OSA) have anatomical susceptibility coupled with abnormalities in upper airway motor control and/or instability in ventilatory control, the data now suggest that the mechanisms underlying OSA vary considerably between patients. In some patients OSA is primarily the result of anatomical problems, while in others it may be due to dysfunctional motor control with only minimal anatomical abnormality. Similarly, abnormal ventilatory control (loop gain) may be important in only a subgroup of patients with OSA. As a result, the concept of individualised therapy has now emerged, such that treatment of the major underlying abnormality is likely to be beneficial in the appropriately targeted patient subgroups. In theory, patients with OSA who respond well to palatal surgery probably primarily have an abnormality in the velopharyngeal anatomy, whereas those who respond well to oxygen may have mainly an abnormality in ventilatory control instability.

The arousal threshold is one concept that has received some—but not sufficient—attention in the OSA arena. The trigger for arousal from sleep during respiratory events is believed to be increasing negative intrathoracic pressure (see figure 1). The realisation of the importance of the arousal threshold in the pathogenesis of OSA has recently been brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasis that most abnormalities in upper airway motor control (loop gain) are brought to light by the work of Younes, particularly the emphasize...
breathing may represent a substantial ecological strategy an individual may most susceptible and from what pharmacological stress a given individual may be arousals in certain patients. Ultimately, the benefit... an event termination of an apnoea or hypopnoea generally requires arousal from sleep. However, if upper airway dilator muscle activity increases sufficiently to re-establish pharyngeal patency, the event may be terminated without an arousal and thus less sleep fragmentation. Slow wave sleep increases the arousal threshold, thus potentially providing additional time for the upper airway muscles to respond sufficiently to overcome the collapsed pharynx. Non-myorelaxant hypnotics may directly increase the arousal threshold or slow wave sleep and promote stable breathing (proposed pathways indicated by dotted lines). In selected patients (with a low arousal threshold), this pharmacological approach may be beneficial. The plus sign indicates increased input to the selected pathway. Some arrows have been deleted for clarity.

Figure 1 Schematic representation of the chain of events that leads to arousal in obstructive sleep apnoea and possible modulating factors. The stimulus to respiratory load-induced arousal is believed to be increased respiratory effort (increased intrathoracic negative pressure). In the case of obstructive sleep apnoea, this is typically associated with hypoxia or hypercapnia. These stimuli provide additional neural output to the respiratory pump and upper airway dilator muscles. The termination of an apnoea or hypopnoea generally requires arousal from sleep. However, if upper airway dilator muscle activity increases sufficiently to re-establish pharyngeal patency, the event may be terminated without an arousal and thus less sleep fragmentation. Slow wave sleep increases the arousal threshold, thus potentially providing additional time for the upper airway muscles to respond sufficiently to overcome the collapsed pharynx. Non-myorelaxant hypnotics may directly increase the arousal threshold or slow wave sleep and promote stable breathing (proposed pathways indicated by dotted lines). In selected patients (with a low arousal threshold), this pharmacological approach may be beneficial. The plus sign indicates increased input to the selected pathway. Some arrows have been deleted for clarity.

of breathing. However, blinded randomised trials will clearly be required to determine whether these strategies actually improve clinical outcomes. In theory, the markedly negative intrathoracic pressure seen during stable flow limited breathing may represent a substantial afterload on the left ventricle. Such an afterload effect could potentially outweigh the benefits of reducing hypoxaemia and arousals in certain patients. Ultimately, genetic and other biomarkers may be required to determine to which physiological stress a given individual may be most susceptible and from what pharmacological strategy an individual may benefit.

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