

PERIOPERATIVE SLEEP AND BREATHING



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ABSTRACT

Sleep disruption has been implicated in morbidity after major surgery since 1974. Sleep-related upper airway obstruction has been associated with death after upper airway surgery and profound episodic hypoxaemia in the early postoperative period. There is also evidence for a rebound in rapid eye movement (REM) sleep that might be contributing to an increase in episodic sleep-related hypoxaemic events later in the first postoperative week. Speculation regarding the role of REM sleep rebound in the generation of late postoperative morbidity and mortality has evolved into dogma without any direct evidence to support it. The research presented in this thesis involved two main areas: a search for evidence of a clinically important contribution of REM sleep rebound to postoperative morbidity, and a re-examination of the role of sleep in the causation of postoperative episodic hypoxaemic events. To assess the latter, a relationship between airway obstruction under anaesthesia and the severity of sleep-disordered breathing was sought.

In 148 consecutive sleep clinic patients, 49% of those with sleep-disordered breathing (SDB) had a number of events in non-rapid eye movement sleep (NREM) that was greater than or equal to that in REM and 51% had saturation nadirs in NREM that were equal to or worse than their nadirs in REM. This suggests SDB is *not* a REM-predominant phenomenon for most patients. Of 1338 postoperative deaths occurring over 6.5 years in one hospital only 37 were unexpected, most of which were one or two days after surgery with no circadian variation in the time of death, casting further doubt on the potential role of REM rebound.

Five of nine subjects studied preoperatively had moderately severe SDB. Unrecognised and significant SDB is common in middle-aged and elderly patients presenting for surgery suggesting overall perioperative risk of important adverse events from SDB is probably small.

In 17 postoperative patients, sleep macro-architecture was variably altered with decreases in REM and slow wave sleep while stage 1 sleep and a state of pre-sleep onset drowsiness, both associated with marked ventilatory instability, were increased. Sleep micro-architecture was also changed with an increase in power in the alpha-beta electroencephalogram range. These micro-architectural changes result in ambiguity in the staging of postoperative sleep that may have affected the findings of this and other studies.

Twenty-four subjects with airway management difficulty under anaesthesia were all found to have some degree of SDB. Those with the most obstruction-prone airways while anaesthetised had a very high incidence of severe SDB. Such patients warrant referral to a sleep clinic.

PREFACE

The work in this thesis was carried out in the Department of Anaesthetics, University of Sydney and Royal Prince Alfred Hospital, under the supervision of Professor Barry Baker and Professor Colin Sullivan. No portion of this work has been submitted by the candidate for the award of any other degrees.

Approval to conduct this research was granted by the Ethics Review Committee of the Central Sydney Area Health Service (RPAH Zone). The relevant approval number is X98-0270.

With the exception of several figures adapted from a publication by Drs Aihua Wu and Gordon Drummond, used with permission to illustrate points made regarding that publication, this thesis is the work of the candidate and is completely original. Dr Kim Gray, as part of her Formal Project required for Fellowship of the Australian and New Zealand College of Anaesthetists, assisted with the collection and examination of the data concerning circadian variation in deaths (chapter 4). Dr Gray also assisted in the joint drafting of a paper, presented at the 2004 Annual Scientific Meeting of the College, that formed the basis for that chapter. The concept for the study was entirely my own and I was the supervisor for Dr Gray's Formal Project.

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Sr Sue Lawrence of the Sleep Laboratory at Royal Prince Alfred taught me, on her own time, to set up and stage sleep studies. Without that help, the research would not have been possible and I am most grateful for her teaching.

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Naturally I am very grateful to the patients who put up with a great deal of inconvenience to allow me to study them.

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Publications

Two chapters of this thesis, the literature review (chapter 2) and chapter 3 have been published in part as papers in peer-reviewed journals:

Loadsman JA, Hillman DR (2001). Anaesthesia and sleep apnoea. *British Journal of Anaesthesia* **86**(2): 254-66.

Loadsman JA, Wilcox I (2000). Is obstructive sleep apnoea a rapid eye movement-predominant phenomenon? *British Journal of Anaesthesia* **85**(3): 354-8.

Referencing System

Citations appearing in the text contain the surname of the first author and the year published with, if necessary, a letter if there is more than one publication from the same author or authors with the same surname in that year. Where a document was published under the auspices of a department or committee, the standard abbreviation for the name of the body concerned is used in place of a surname.

The reference list is sorted in alphabetical order of the first author's surname or the standard abbreviation for the publishing body. The form of the reference is that used for my own publication list above. In the case of references to sites on the World Wide Web, the citation contains the abbreviated name and the year the page was last updated, while the reference also contains the full name of the web page, the uniform resource locator (URL) and the year it was accessed for this thesis.

Abbreviations

AASM	American Academy of Sleep Medicine
ABOM	Australian Bureau Of Meteorology
AHI	Apnoea-Hypopnoea Index
AMI	Acute Myocardial Infarction
ASDA	American Sleep Disorders Association
BMI	Body Mass Index
CAGS	Coronary Artery Graft Surgery
CCF	Congestive Cardiac Failure
CO ₂	Carbon Dioxide
CPAP	Continuous Positive Airway Pressure
CSA	Central Sleep Apnoea
DSS	Diagnostic Sleep Study
ECG	Electrocardiogram
EEG	Electroencephalogram
EMG	Electromyogram
EOG	Electro-oculogram
FEV1	Forced Expiratory Volume (1 second)
FRC	Functional Residual Capacity
FVC	Forced Vital Capacity
IPPV	Intermittent Positive Airway Pressure
LMA	Laryngeal Mask Airway
nCPAP	Nasal Continuous Positive Airway Pressure
NREM	Non-Rapid Eye Movement (sleep)
OOS	Overnight Oximetry Study
OSA	Obstructive Sleep Apnoea
OSAS	Obstructive Sleep Apnoea Syndrome
PCA	Patient Controlled Analgesia
Pco ₂	Partial pressure of Carbon Dioxide
PSG	Polysomnogram
RDE	Respiratory Disturbance Event
RDI	Respiratory Disturbance Index
REM	Rapid Eye Movement (sleep)
SDB	Sleep-Disordered Breathing
SpO ₂ min	Minimum oxygen saturation (pulse oximetry)
SWS	Slow Wave Sleep
TST	Total Sleep Time

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