Insomnia in the elderly patient

Insomnia is recognised as a cause of significant morbidity in the elderly, impacting considerably on quality of life. This article discusses the causes of insomnia in the elderly, and how it can be assessed and managed.

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The size of the problem

Insomnia is a symptom that describes difficulty in falling asleep (initial insomnia) or staying asleep (maintenance insomnia), or the perception that one is not getting enough sleep. Dissatisfaction with sleep is very common in the elderly, with reported prevalence rates ranging between 20 and 50% across different countries.[1]

In Australia, persistent insomnia is reported to occur in 16% of community dwelling elders and 12% of institutional dwelling elders.[2] Twenty per cent of elderly Australians attending general practitioners report sleep difficulties.[3] Insomnia is now recognised as a cause of significant morbidity in the elderly, impacting considerably on quality of life. Elderly patients with insomnia are at increased risk of nursing home placement and death because of its association with heart disease, depression, dementia and other chronic medical conditions.[4]

When one considers the ageing of our population (with estimates that by the year 2020 the number of people aged 60 and over will increase by 75%[5]), it is more important than ever for primary care physicians to develop a strategy for assessing and managing insomnia in the elderly. The aim of this review is to discuss the causes and mechanisms of insomnia in the elderly, and to provide a framework for its assessment and management.

Changes in sleep physiology with ageing

A number of reasonably well documented changes in sleep physiology are observed as we age. They are summarised in Table 1. The

IN SUMMARY

- Chronic illness plays an important role in much of what is thought of as 'age-related' changes in sleep. Numerous medical and psychiatric disorders can cause insomnia.
- A wide range of prescription drugs can cause insomnia in the elderly. Alcohol, caffeine and nicotine are also important causes.
- History-taking is crucial in establishing the cause of the sleep complaint. A sleep log or diary can clarify the patient's sleep pattern. The general medical history should focus on relevant diseases and their control, any cause of pain, and a thorough review of all medications.
- A specific search for the symptoms of depression and anxiety should be made in all cases.
- Regardless of the underlying cause, it is often wise to address sleep hygiene when managing patients with chronic sleep complaints.
- Underlying medical causes should be treated.
- If pharmacotherapy is being considered, the combination of cognitive behavioural therapy with the drug is recommended. The drug would be used in the short term and the behavioural therapy would achieve longer term improvements.

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Table 1. Changes in sleep physiology with ageing*

Stage 1 sleep proportion
Increased

Stage 2 sleep proportion
No change

Stage 2 sleep spindle amplitude and frequency
Decreased

Stage 3 + 4 sleep (slow wave sleep) proportions
Decreased†

Stage 3 + 4 delta wave amplitude
Decreased†

REM sleep duration
Variable

REM sleep latency‡
Decreased†

Sleep efficiency§
Decreased

Focal slow wave activity
Increased

Alpha frequency
Decreased

Beta (fast) activity
Increased

* Sleep characteristics measured on sleep studies.
† Most consistent observations.
‡ REM sleep latency is the time taken to reach the first REM stage.
§ Sleep efficiency is the ratio of total sleep time to time spent in bed.

significance of these changes is not certain. One interpretation is that the changes are related to declining cortical metabolic rate and dendritic pruning. Another hypothesis is that the changes represent an extremely early biomarker of ageing within the central nervous system.[6] Alterations in the circadian sleep–wake rhythm in the elderly result in a shift from the normal adult biphasic sleep–wake cycle to a polyphasic rhythm similar to that seen in neonates.

It has been postulated that the observed changes in circadian physiology represent the fundamental characterisation of the ageing process itself.[7] But, chronological age alone is not uniformly associated with a higher prevalence of sleep disturbance, implicating other medical or psychological factors in the sleep disturbance seen in the elderly. Evidence now points to the important role of chronic illness in much of what was previously defined as 'age-related' changes in sleep.

Causes of age-related changes in sleep

Ageing is associated with decreased physiological reserve in most organ systems. These changes, while asymptomatic, bring the aged individual closer to the threshold of clinical symptoms. With reduced physiological reserves, elderly people often cannot withstand even previously tolerated minor stressors without precipitating clinical symptoms or illness. These changes also occur in the systems that maintain sleep.

A list of factors that may contribute to the development of insomnia in the elderly is presented in Table 2. Factors such as inactivity, less light exposure, decreased arousal threshold, altered autonomic (sympathetic) activity, and circadian rhythm changes diminish the functional reserves for quality sleep as we age.[8,9] This is further compounded by the increased frequency of diseases or problems such as dementia, cerebrovascular disease, heart failure, respiratory complaints, sleep-disordered breathing, nocturia, pain, polypharmacy, headache, depression and functional decline, which have all been shown to reduce subjective sleep quality.[3,10-13]

The combination of increasing disease burden with the reduced physiological reserve leads to the high prevalence of poor sleep quality with ageing.

Disease-related disturbances in sleep

Numerous medical and psychiatric disorders can cause insomnia. Common examples are listed in Table 3, and a selective discussion follows.

Table 2. Factors that may contribute to insomnia in the elderly

Biology of ageing
Reduced physiological reserve
Decreased arousal threshold
Alterations in autonomic activity
Circadian rhythm changes

Environmental factors
Insufficient light exposure
Impoverished time cues
Institutionalisation or house-bound

Behavioural factors
Decreased physical activity
Poor sleep hygiene

Psychological factors
Retirement and the loss of personal identity
Disruption of daily routines
Death of a spouse, family members or friends
Changes in social circumstances
Financial concerns
Perception of poor health and fear of dying
Psychological effects of chronic or terminal illness involving the patient or loved ones

Nutritional factors
Changes in body composition (decrease in lean mass, increase in fat mass)
Alcohol intake
Caffeine intake
Reversed pattern of fluid excretion (nocturnal polyuria)

Medical causes of secondary sleep disturbance

Pain is the best example of a symptom that affects sleep. The most common causes of pain in the elderly are the musculoskeletal disorders. Osteoarthritis, back pain, bursitis and fibromyalgia are particularly disruptive to sleep, and specific treatment of the cause and relief of pain will restore sleep quality. Ischaemic

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Figure. In elderly patients, exercise may simultaneously address a number of conditions contributing to sleep disturbance, including inactivity, obesity, depression, physical functioning and a range of comorbidities.

chest pain, dyspnoea, nocturia, and sensory impairment are also common precipitants of sleep disturbance in the elderly.

Primary sleep disorders

Ageing is associated with an increased prevalence of specific sleep-related disorders, the most common of which are sleep apnoea, restless legs syndrome and periodic limb movement disorder. These disorders can cause marked sleep disturbance in their own right, usually associated with daytime hypersomnolence.

The clinical aspects of sleep apnoea have been reviewed elsewhere.[14,15] However, it is worth noting that the reported prevalence of sleep apnoea, with or without symptoms, in community-dwelling elders is estimated to be 24%.[16] Furthermore, the mortality rate of elderly with severe sleep apnoea is 15 times higher than for those with no or mild sleep disordered breathing.[16] Hence diagnosis and treatment are worthwhile.

Restless legs syndrome and periodic limb movement disorder are also very common in the elderly, with reported prevalences of up to 15 and 45%, respectively. Restless legs syndrome is characterised by an irresistible urge to move the lower extremities, associated with unpleasant sensations.[17] Periodic limb movement disorder is characterised by repetitive, brief, jerking movements of the lower, and less commonly upper, extremities.[17] Reviews of these disorders in the elderly have been published elsewhere.[18,19]

Psychiatric disorders and cognitive impairment

In addition to medical disease, psychopathology is a very powerful risk factor for the development of insomnia. From both cross-sectional and longitudinal studies, depression appears to be the factor most strongly related to disturbed sleep with ageing, even more so than overall health status.[20,21] Depression affects both the subjective and objective measures of sleep. It is usually associated with difficulty falling asleep or early morning awakening, but may also cause daytime hypersomnolence.[22] Some depressed patients experience agitation as well, which can make falling asleep difficult (initial insomnia). The incidence of depressive symptoms in the elderly community has

Table 3. Common medical causes of insomnia in the elderly

Medical conditions

Cardiac (e.g. congestive cardiac failure, ischaemic heart disease)
Musculoskeletal (e.g. arthritis, myalgias, fibromyalgia, cramps)
Neurological (e.g. strokes, dysaesthesia)
Renal (e.g. prostatism, bladder dysfunction, nocturia)
Respiratory (e.g. asthma, chronic airflow limitation)
Gastric (e.g. gastro-oesophageal reflux or regurgitation, peptic ulcers)
Infections (e.g. tuberculosis)
Primary sleep disorders (e.g. sleep apnoea, periodic limb movement disorder)

Psychiatric conditions

Anxiety disorders
Cognitive impairment
Depression

Medications/pharmacological agents

Nonprescription medications (e.g. decongestants, antihistamines, stimulants)
Prescription medications (e.g. diuretics, corticosteroids, some antidepressants)
Social drugs (e.g. alcohol, caffeine, nicotine, other)
Withdrawal syndromes (e.g. rebound from sedatives, other)

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been estimated to be as high as 30%,[23] and within institutions, up to 50%.[24] In a large US study, 14% of persons complaining of insomnia had major depression, compared with a 1% rate in those without sleep complaints.[25] Because of the strong association between depression and sleep difficulties, health care providers should consider underlying depression in every case of insomnia.

Other psychiatric problems associated with insomnia are largely related to anxiety. Anxiety and associated disorders often result in difficulty falling asleep and frequent nocturnal awakenings. Their onset in late life is frequently related to the onset of a depressive disorder.

Patients with dementia often have significant sleep–wake cycle disturbances,[26] including a disrupted and sometimes polycyclic sleep–wake cycle. Nocturnal awakening episodes may be quite common and are associated with wandering. The degree of disturbance parallels the severity of the dementia. The altered sleep pattern may not trouble patients themselves; however, it is a serious problem for carers and other residents.

Pharmacotherapy

The elderly are the greatest consumers of medications, and unfortunately the changes in both pharmacokinetics and pharmacodynamics with age combined with polypharmacy lead to high rates of adverse drug reactions. The principle of minimising drug use is a primary tenant in the care of the elderly because of the high rates of such adverse events.

The range of drugs that commonly cause insomnia in the elderly includes sympathomimetics drugs, corticosteroids, thyroxine, neuroleptics, certain antidepressant medications (particularly selective serotonin reuptake inhibitors), beta blockers and methyldopa. Other nonprescription pharmacological agents such as alcohol, caffeine and nicotine are also important causes of insomnia.

Unfortunately, the use of hypnotic medications as a treatment for poor sleep increases with age. Sedatives, particularly benzodiazepines, can cause daytime hangover effects, leading to an increase in daytime sleepiness and further disruption of the normal sleep pattern. They can cause neuromuscular impairment, falls and confusion.[27] The abrupt cessation of these drugs will cause a withdrawal state, characterised by rebound insomnia or florid acute confusion with hallucinations, which is commonly seen in hospital after an admission for unrelated disease.

Clinical assessment and investigation

History taking

The history is crucial in establishing the cause of the sleep complaint. Only after the history is taken should treatment be contemplated, and directed whenever possible to the underlying cause.

Initial questioning should focus on whether or not a sleep disorder is present:

- is the patient satisfied with his or her sleep?
- does sleepiness affect the patient's daily activities?
- does the bed partner report any unusual behaviour during sleep (e.g. snoring, breathing pauses, abnormal movements)?

If the patient's responses suggest a sleep disorder, it is important to take a more detailed history to define the patient's sleep pattern. For example, enquire about:

- bedtime routine
- length of time it takes to fall asleep
- number of awakenings during sleep period
- behaviour while awake in bed (e.g. watching the clock, television viewing, reading)
- perceived duration of sleep
- time of awakening
- daytime functioning.

Wherever possible, the history should be corroborated from the patient's bed partner or carer.

The general medical history should focus on other relevant diseases and their control, any cause of pain, and a thorough review of all medications. A specific search for symptoms of depression and anxiety should be made in all cases.

Examination

A thorough physical examination should be performed, as guided by the history. Of particular relevance may be examinations of cardiorespiratory and musculoskeletal systems, looking for evidence of heart failure, chronic airflow limitation and arthritis. Nasal and pharyngeal examination should be performed in patients with a history of snoring or features suggestive of sleep apnoea. Specific examination of the genitourinary system is indicated if nocturia or incontinence are thought to be causing sleep disturbance.

Further assessment

Most patients who present with sleep complaints will require only a thorough history and examination for a diagnosis and management plan to be instituted.

A sleep log or diary recorded over a two to three week period may help to

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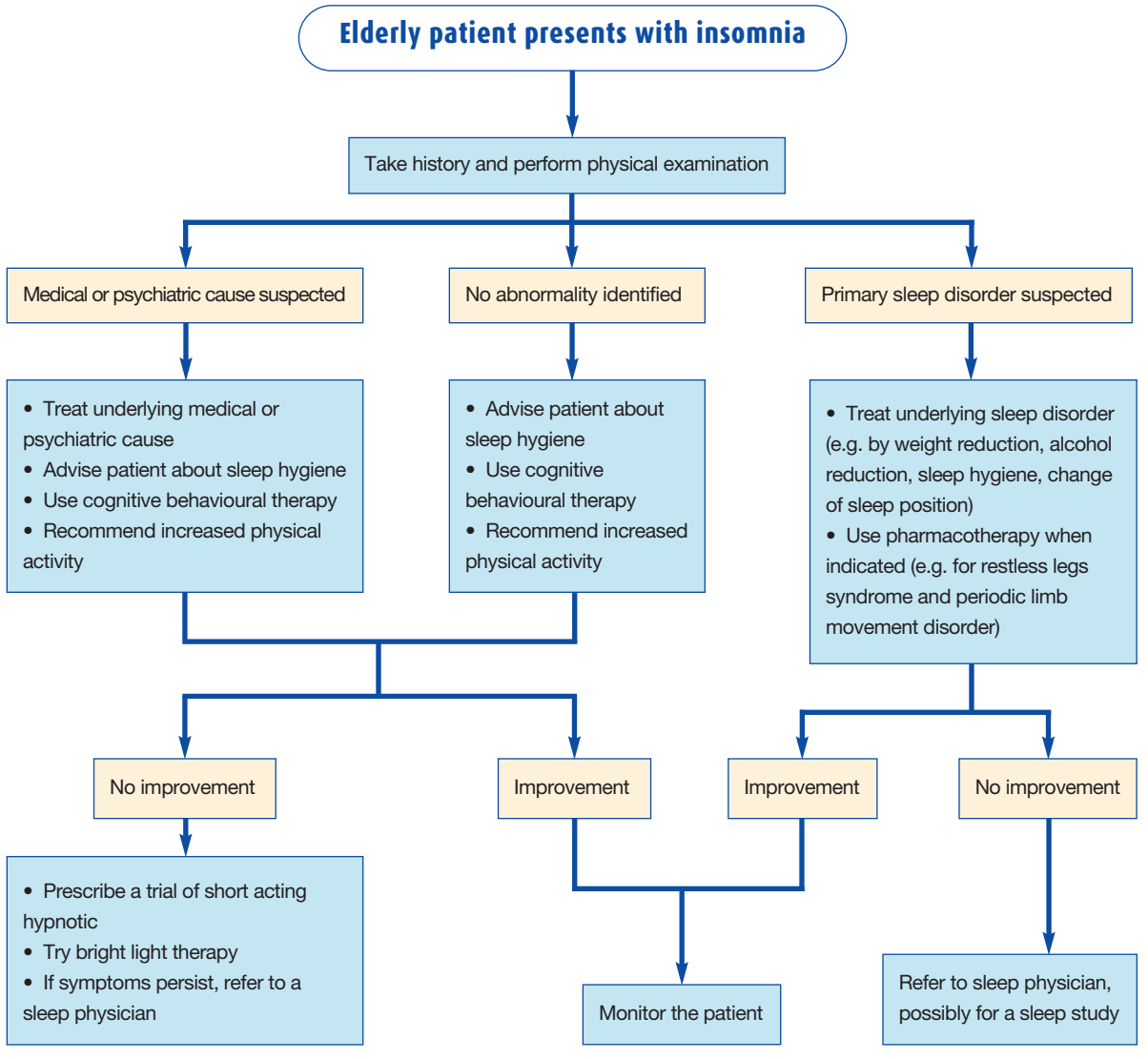
clarify inconsistencies or uncertainties in the history, and it can unmask previously unknown characteristics of the patient's sleep pattern. In general, the patient is asked to make a daily record of bedtime, approximate time of sleep onset, timing and duration of awakenings, final awakening time, nap times during the day, and the timing of meals, exercise and medications.

Investigations such as thyroid function tests, respiratory function tests and electrocardiography may be useful when indicated by the history and examination.

Even in patients in whom a primary sleep disorder is suspected, treatment can usually be commenced in the primary care setting. Referral to a physician specialising in sleep disorders should be considered when the diagnosis remains uncertain, when a sleep study is considered necessary, or if symptoms persist despite treatment. The use of polysomnography in this setting should be reserved for confirmation of diagnoses that are clinically suspected, or to assess the need for, and effectiveness of, treatment.

A schema for assessing and managing insomnia in the elderly is presented in the flowchart below.

Assessing and managing insomnia in the elderly



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MedicineToday PATIENT HANDOUT

Some suggestions to improve your sleep hygiene

- Create a quiet and relaxed environment for sleep, in terms of lighting, noise, temperature and comfort.
- Establish a regular sleep pattern, and bedtime ritual.
- Avoid staying in bed awake for long periods of time.
- Refrain from reading or watching television in bed.
- Do not look at the clock during the night.
- Avoid consumption of caffeine, alcohol and nicotine in the late afternoon or evening.
- Avoid foods, beverages and medications that may contain stimulants.
- Go to bed only when ready to sleep.
- Exercise regularly each day, but not after 6 p.m.
- Avoid daytime naps.
- Do not eat or drink excessively for three hours before bedtime.
- Try having a hot bath – it will raise your core body temperature and may help sleep initiation.
- Use the bedroom only for sleep, and sexual activity if it is relaxing.
- Avoid emotional or mental stimulation before bed.
- Set aside a 'worry time' in the evening to face your worries, rather than letting this happen as you go to bed.
- Do not worry if you cannot sleep.
- Learn behavioural and relaxation techniques that will assist with physical and mental relaxation.
- Avoid unfamiliar sleep environments.
- If you have sensory impairment, give yourself adequate light and stimulation during the daytime hours to establish proper sleep or night cycles.

Management

Behavioural therapy

Behavioural treatment, alone or in combination with pharmacological therapy, is the recommended treatment of choice for patients with chronic psychophysiological insomnia (that is, where a causative primary medical, sleep or psychiatric disorder is not identified). Broadly, this approach employs techniques aimed at ameliorating factors that perpetuate insomnia, ranging from sleep education and sleep hygiene advice to relaxation techniques and sleep restriction therapy.

Inadequate sleep hygiene refers to the performance of daily activities that are inconsistent with the maintenance of good quality sleep and full daytime alertness – in other words, bad sleep habits. Regardless of the underlying cause, it is often wise to address sleep hygiene in the management of patients with chronic sleep complaints (see the patient handout above). The patient needs to understand the importance of maintaining good sleep practices, and modifying behaviours that are considered to be hindering sleep quality or quantity.[28]

For patients in whom anxiety is a contributing factor, behavioural interventions such as relaxation training and stress management may have a role. Recently, the combination of these treatments with cognitive therapy (cognitive behavioural therapy) has been applied to the management of insomnia. The cognitive component is aimed at changing unrealistic and irrational beliefs and fears about sleep.

The importance of this form of nonpharmacological therapy cannot be overemphasised, particularly in the elderly in whom the use of medications is associated with potential problems. Even in situations where medications cannot be avoided, the use of behavioural therapies may reduce the dose required.

Cognitively impaired patients present particular management problems because they may not be able to comprehend or co-operate with behavioural therapies. It may be preferable to allow safe nocturnal wandering in a protected environment in such individuals, when possible, rather than using sedatives or antipsychotic agents in an attempt to extinguish poor sleep hygiene in the very demented. Environmental safety can be enhanced with night lights, easy access to spectacles, soft carpeting, locked doors and night-time carers.

In addition, increasing involvement in physical activities during the day, rather than sedentary pursuits, may increase the need for sleep at night and emphasise normal circadian rhythm.

Treatment of underlying medical causes

The general principle of optimising the management of all chronic medical conditions and minimising medication use is recommended for treating insomnia in the elderly. The intersection of many diagnoses and syndromes in the final common pathway to insomnia must be recognised. Depression must be aggressively looked for and treated when suspected, because it is so often present in conjunction with a high burden of chronic disease and functional decline. Prescription and nonprescription drug use is highest in the elderly, and therefore careful review of all medications, including over-the-counter and caffeine-containing compounds, is recommended.

Specific therapies

Pharmacological treatment of insomnia

Unfortunately medications are used far too frequently in the treatment of

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insomnia, often without due consideration of the underlying cause. Current teaching suggests that medications have a role in the management of acute insomnia, or as a temporary measure in patients with chronic insomnia. Recent work on the long term effect of pharmacotherapy in chronic insomnia suggests that it is more effective than placebo, but is not as effective as cognitive behavioural therapy.[29] Further research, with long term outcomes, is required before any drug therapy can be recommended for the long term management of insomnia in the elderly. The chronic and inappropriate use of sedatives is a large problem in our society and the use of sedatives and hypnotics is particularly fraught with hazards in the elderly.

The combination of a drug and cognitive behavioural therapy would seem a logical combination – with the benefits of a drug working more immediately and the behavioural therapy achieving longer term improvements in sleep. Patients, clinicians and 'significant others' rate combined therapy or cognitive behavioural therapy alone as more effective for chronic insomnia than drug therapy alone.[29]

There are several classes of drugs used to treat insomnia. The efficacy of several short-acting benzodiazepines, including temazepam, has been demonstrated in the elderly and they are the preferred short term treatment for insomnia.[29,30] Long acting benzodiazepines are associated with an increased risk of falls and hip fractures in the elderly, and they should be avoided.[27] Newer non-benzodiazepine hypnotic agents, such as zolpidem (Stilnox), have been shown to be effective in chronic insomnia, and they deserve particular attention in the elderly because of the lower side effect profile.[30]

Antihistamines such as diphenhydramine are often inappropriately used to promote sleep because their side effects include confusion, agitation, orthostatic hypotension, arrhythmias and urinary retention. As these drugs are available without prescription, a careful history must be taken to elicit their role in the clinical presentation.

Most tricyclic antidepressants have a sedative action and are often used in low doses as hypnotics. They have a clear role in patients with coexistent depression, although newer classes of antidepressant drugs offer some advantages in terms of side effect profile. Again, side effects (for example, constipation, orthostatic hypotension, urinary retention, falls, confusion and cardiac arrhythmias) limit the usefulness of tricyclic antidepressant drugs as hypnotics.

The use of barbiturates, chloral hydrate

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and chlormethiazole to treat insomnia is an inappropriate and outdated practice.

Treatment of specific sleep disorders

It is beyond the scope of this review to discuss details of treatment options for primary sleep disorders, but an overview pertinent to the elderly is presented in Table 4. The assessment and treatment of sleep apnoea has recently been reviewed elsewhere.[15] With respect to the treatment of restless legs syndrome and periodic limb movement disorder, levodopa is frequently used as first line therapy because of its low side effect profile.[17] This makes it an ideal choice in elderly patients. Clonazepam is also frequently used in adults, but because it has a prolonged half-life in the elderly, it is best restricted to more refractory cases.[18,19]

Novel and emerging therapies

Bright light therapy

Light is known to be an important modulator of circadian rhythms. It is known that properly timed exposures to bright light (7000 to 12,000 lux) for two to three days can shift the circadian phase. The direction of the shift depends on the timing of exposure: morning bright light results in phase advance (going to sleep and waking up earlier) and evening exposure leads to phase delay (going to sleep and waking up later).

Bright light therapy may be effective for a number of circadian sleep disorders, such as shift work, jet lag and advanced or delayed sleep phase syndrome. Indoor bright light administered during the day appears to improve the circadian rest–activity rhythm disturbance typically seen in demented patients,[31] and it has also been reported to improve sleep efficiency in elderly sleep maintenance insomniacs.[32] It would appear prudent to recommend exposure to bright light during the day to older adults with little or no sunlight exposure, both for prevention and treatment of sleep disturbances.

Table 4. Treatment options for specific sleep disorders

Obstructive sleep apnoea

Weight loss
Reduction of alcohol intake
Continous positive airway pressure
Dental appliances
Surgery

Restless legs syndrome and periodic limb movement disorder

Levodopa and/or carbidopa (Kinson, Madopar, Sinemet)
Pergolide (Permax)
Clonazepam (Rivotril, Paxam)

Melatonin

Melatonin has hypnotic and hypothermic effects and has been proposed as a treatment for insomnia. Reduced melatonin production has been associated with sleep disorders in the elderly.[33,34] The therapeutic effects of exogenous melatonin for circadian sleep disorders associated with jet lag, delayed sleep phase syndrome and blindness are reasonably well established. Some studies suggest a role for melatonin in the treatment of insomnia in the elderly in cases where melatonin deficiency is esta lished.[33] Further work is required to clarify the efficacy and safety of melatonin in this setting.

Exercise

It is generally accepted that exercise will enhance sleep, although the evidence for such claims is only beginning to accumulate. In elderly patients, exercise may simultaneously address a number of conditions contributing to sleep disturbance, including inactivity, obesity, depression, physical functioning and a range of comorbidities such as arthritis, cardiac disease and diabetes.[35]

In the elderly there is evidence for the effectiveness of both aerobic and non-aerobic (weight lifting) exercise for sleep disturbance.[35,36] The choice of exercise is determined by location, preference and comorbidity. The effective amount of aerobic exercise is four 30- to 40-minute sessions a week at 60 to 75% of heart rate reserve (moderate intensity). For weight lifting exercise, it is three 60-minute sessions per week targeting the large muscle groups – three sets of eight repetitions using a load of 80% of the one repetition maximum (high intensity).

It has been consistently found that the time exercise is performed before bedtime is a significant factor in reducing sleep onset latency.[37,38] Exercise is optimal when it is performed four to eight hours before the desired sleep time.

Conclusion

Like most geriatric conditions, insomnia is a multifactorial syndrome that is best addressed with a thorough search for treatable and underlying causes, an understanding of the environmental and social factors contributing to its expression, and a holistic approach to therapy relying, when feasible, on nonpharmacological long term interventions. MT

A list of references is available on request to the editorial office.

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Insomnia in the elderly

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References

1. Foley DJ, Monjan AA, Brown SL, Simonsick EM, Wallace RB, Blazer DG. Sleep complaints among elderly persons: an epidemiologic study of three communities. Sleep 1995; 18: 425-432.
2. Henderson S, Jorm AF, Scott LR, Mackinnon J, Christensen H, Korten AE. Insomnia in the elderly: its prevalence and correlates in the general population. Med J Aust 1995; 162: 22-24.
3. Mant A, Eyland EA. Sleep patterns and problems in elderly general practice attenders: an Australian survey. Community Health Stud 1988; 12: 192-199.
4. Pollack CP, Perlick D, Linsner JP, Wenston J, Hsieh F. Sleep problems in the community elderly as predictors of death and nursing home placement. J Community Health 1990; 15: 123-135.
5. World Health Organization. Ageing: exploding the myths. Geneva: WHO, 1999.
6. Feinberg I, Thode HC, Chugani HT, March JD. Gamma distribution model describes maturational curves for delta wave amplitude, cortical metabolic rate and synaptic density. J Theor Biol 1990; 142: 149-161.
7. Samis HV. Aging: the loss of temporal organisation. Perspect Biol Med 1968; 12: 95-102.
8. Zepelin H, McDonald CS. Effects of age on auditory awakening thresholds. J Gerontol 1984; 39: 294-300.
9. Zepelin H, McDonald CS. Age differences in autonomic variables during sleep. J Gerontol 1987; 42: 142-146.
10. Gislason. T, Almqvist M. Somatic diseases and sleep complaints. Acta Med Scand 1987; 221: 475-481.
11. Ballinger CB. Subjective sleep disturbance at the menopause. J Psychosom Res 1976; 20: 509-513.
12. Yunus MB, Holt GS, Masi AT, Aldag JC. Fibromyalgia syndrome among the elderly: comparison with younger patients. J Am Geriatr Soc 1988; 36: 987-995.
13. Cook NR, Evans DA, Funkenstein H. Correlates of headache in a population based cohort of elderly. Arch Neurol 1989; 46: 1338-1344.
14. McNamara SG, Cistulli PA, Sullivan CE, Strohl K. Clinical aspects of sleep apnea. In: Saunders NA, Sullivan CE, eds. Sleep and breathing. 2nd ed. New York: Marcel Dekker, 1994: 493-528.
15. Worsnop C, Pierce R, McEvoy RD. Obstructive sleep apnoea. Aust N Z J Med 1998; 28: 421-427.
16. Ancoli-Israel S, Coy T. Are breathing disturbances in elderly equivalent to sleep apnea syndrome? Sleep 1994; 17: 77-83.
17. American Academy of Sleep Medicine. Practice parameters for the treatment of restless legs syndrome and periodic limb movement disorder. Sleep 1999; 22: 961-968.
18. Flamer HE. Sleep disorders in the elderly. Aust N Z J Med 1996; 26: 96-104.
19. Youngstedt SD, Kripke DF, Klauber MR, Sepulveda RS, Mason WJ. Periodic leg movements during sleep and sleep disturbances in elders. J Gerontol A Biol Sci Med Sci 1998; 53: M391-M394.
20. Newman AB, Enright PL, Manolio TA, Haponik EF, Wahl PW. Sleep disturbance, psychosocial correlates and cardiovascular disease in 5201 older adults: the cardiovascular health study research group. J Am Geriatr Soc 1997; 45: 1-7.
21. Rodin J, McAvay G, Timko C. A longitudinal study of depressed mood and sleep disturbances in elderly adults. J Gerontol 1988; 43: 45-53.
22. Knowles JB, MacLean AW. Age-related changes in sleep in depressed and healthy subjects: a meta-analysis. Neuropsychopharmacology 1990; 3: 251-259.
23. Blazer D, Hughes DC, George L. The epidemiology of depression in an elderly community population. Gerontologist 1987; 27: 281-287.
24. Parmelee PA, Katz IR, Lawton MP. Depression among institutionalised aged: assessment and prevalence estimation. J Gerontol 1989; 44: 22-29.
25. Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. JAMA 1989; 262: 1479-1484.
26. Bliwise DL. Sleep in normal aging and dementia. Sleep 1993; 16: 40-81.
27. Ray WA, Griffen MR, Scheffner W, Baugh NK, Melton LJ. Psychotropic drug use and the risk of hip fracture. N Engl J Med 1987; 316: 313-319.
28. Zarcone V, Kryger MH, Roth T, Dement WC, eds. Principles and practice of sleep medicine. 3rd ed. Philadelphia: WB Saunders, 2000: 657-661.
29. Morin CM, Colecchi C, Stone J, Sood R, Brink D. Behavioural and pharmacological therapies for late-life insomnia. JAMA 1999; 281: 991-999.
30. Nowell PD, Mazumdar S, Buysse DJ, Dew MA, Reynolds CF, Kupfer DJ. Benzodiazepines and zolpidem for chronic insomnia: a meta-analysis of treatment efficacy. JAMA 1997; 278: 2170-2177.
31. van Someren EJ, Mirmiran M, Swaab DF. Indirect bright light improves circadian rest–activity rhythm disturbances in demented patients. Biol Psychiatr 1997; 41: 955-963.
32. Murphy PJ, Campbell SS. Enhanced performance in elderly subjects following bright light treatment of sleep maintenance insomnia. J Sleep Res 1996; 5: 165-172.
33. Garfinkel D, Laudon M, Nof D, Zisapel N. Improvement of sleep quality in elderly people by controlled release melatonin. Lancet 1995; 346: 541-544.
34. Haimov I, Lavie P, Laudon M, Herer P, Vigder C, Zisapel N. Melatonin replacement therapy of elderly insomniacs. Sleep 1995; 18: 598-603.
35. Singh NA, Clements KM, Fiatarone MA. A randomized controlled trial of the effect of exercise on sleep. Sleep 1997; 20: 95-101.
36. King AC, Oman R, Brassington GS, Bliwise D, Haskell W. Moderate-intensity exercise and self-rated quality of sleep in older adults. JAMA 1997; 277: 32-37.
37. Youngstedt SD, O'Connor PJ, Dishman RK. The effects of acute exercise on sleep: a quantitative synthesis. Sleep 1997; 20: 203-214.
38. Taylor SR, Driver HS. Is sleep affected by physical exercise and fitness? Crit Rev Physical Rehab Med 1995; 7: 131-145.

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