 Prague Medical Report / Vol. 107 (2006) No. 3, p. 290–296

Medical Factors of Falling Asleep behind the Wheel

Volná J., Šonka K.
Department of Neurology of the First Faculty of Medicine, Charles University in Prague, and General Teaching Hospital, Czech Republic

Received May 9, 2006, Accepted September 4, 2006

Key words: Traffic accidents – Excessive daytime sleepiness – Sleep disturbances – Sleep apnoea syndrome – Independent risk factors

This work was supported by grant MSMT ČR ME 701.

Mailing Address: Jana Volná, MD, Department of Neurology of the First Faculty of Medicine, Charles University, Kateřinská 30, 120 00 Prague 2, Czech Republic, Phone: +420 224 965 550

Abstract: Drivers' sleepiness and falling asleep while driving account for a considerable proportion of vehicle accidents (studies show different results from 1% to 30%). Sleepiness is rarely well recognised as a causing factor of traffic accidents. 2.5% up to 20% people suffer from excessive daytime sleepiness (EDS) with sleep deprivation as its most frequent cause. There is a strong association between sleep deprivation and medical problems – especially sleep disturbances. The sleep apnoea syndrome (SAS) has been identified as the most common cause of habitual drowsy driving. Patients with SAS (apart from other health problems) are 6 times more likely to have accidents. After adequate treatment of severe SAS with continuous positive airway pressure the risk of accident lowered 5×. Other important sleep disturbances include chronic insomnia, narcolepsy, restless legs syndrome and periodic limb movement in sleep. Sleepiness was described in Parkinson's disease, dementia, epilepsy, in chronic cardiacs and in people with complex internal health problems. Regular or single intake of drugs (benzodiazepines, antidepressants, antihistaminics, antipsychotics and others) can itself induce sleep problems. Sleepiness in persons without sleep disorder may occur due to preventable causes such as poor sleep habits which lead to sleep deprivation.

Introduction

Traffic accidents are the fourth principal cause of deaths in general [1]. The most frequent causes of such accidents include also excessive speeding and drunken driving. However, the drivers' sleepiness or sudden lapse into sleep behind the wheel have been found to take a large share in the rate of traffic accidents, too [2]. According to literary data, drivers' sleepiness or sleep may account for up to 30% of road accidents [3]. This is an alarming figure especially considering that somnolence is one of the best detectable and reversible condition [4].

And yet, sleep continues being very much underrated as a major cause of the high traffic accident rate [3]. The introduction of adequate effective countermeasures can prevent considerable loss of lifes as well as socio-economic loss.

Excessive daytime sleepiness

Excessive daytime sleepiness (EDS) is a medical term used for pathological proneness to dropping off during the day. To verify and quantify EDS subjective rating scales and objective measurement in sleep laboratory are used. The most frequent subjective standardised questionnaire in medical practice (in addition to medical history data) is the Epworth Sleepiness Scale (ESS). In ESS, the patient is asked to respond to a total of eight questions designed to indicate on a scale of 0–3 the likelihood of dozing off in a particular situation (reading, watching TV, as a passenger in a car, after meals ...). The Multiple Sleep Latency Test (MSLT) is widely used for objective verification of EDS. This test follows a precisely defined

protocol in the sleep laboratory [5]. An MSLT consists of five measurements starting at least 2 hours after definitive early-morning awakening, each time after a lapse of 2 hours. The patients are asked to lie down in a silent darkened room and invited to refrain from resisting sleep. If they do doze off or fall asleep they are allowed to sleep for 15 minutes to be woken up by the nurse. If they do not, the test is terminated after 20 minutes. Under scrutiny is the number of sleep onsets during the five testing periods, the sleep latency in each of the five tests, the average sleep latency and also the sleep stage reached. An average sleep latency of less than 5 minutes is pathological, values above 10 minutes are within norm; a range of 5–10 minutes is non-specific, i.e., other history data and clinical findings have to be taken into account. It's important to count also the sleep stage reached during the test – mainly REM sleep, which is typical for narcolepsy. Other objective measurements are also used [6].

Though the prevalence of EDS has yet to be precisely established, literary sources put it at about 5% (2.5–20%) [7, 8]. Sleep is usually preceded by drowsiness, which is why the driver ought to be alerted well before dozing off. However, this is not the case. Drowsiness affects man's judgement, qualitatively altering our perception of reality; a drowsy driver often fails to realise the risk of dozing. Drowsiness causes attention worsening, watchfulness reduction, reaction time prolongation, memory worsening, psychomotor co-ordination as well as decision-making impairment [9]. In other words, drowsiness is dangerous not only because of the risk of falling asleep but also, generally, as a state of slightly altered perception. It is not true, that closing the eyelids coincides with the moment of sleep onset [10].

Sleep deprivation and its causes

EDS is most often caused by sleep deprivation, i.e., insufficient quality or quantity of the nocturnal sleep [11]. Sleep deprivation can be short-termed (less than six weeks) or chronic. Short-term sleep deprivation and subsequent potential EDS can be seen in individuals experiencing acute stress situations (occupational, familiar, partner-related, financial or other problems), in illnesses of short duration, very often in persons with poor sleep hygiene caused by external factors and regimen abnormities (especially in young people), these may be also the cause of chronic sleep deprivation. Straightforward connection with sleep deprivation has been found in circadian rhythmicity disorders, mainly in shift-work employess; the jet lag syndrome is another typical example. However, all sorts of sleep disorders, too, may account for sleep deprivation. Disorders of sleep are precisely classified but there is little space within this text for giving a complete list; hence, only the most frequent and typical of them will have to do [12].

Secondary EDS is EDS associated with other sleep disorders leading to sleep deprivation. The most common are insomnia, sleep apnoea syndrome, restless legs syndrome and periodic limb movement in sleep.

In our everyday practice, we come across the problem of chronic insomnia with excessive daytime sleepiness and proneness to fatigue as reactive symptoms. Acute insomnia is not a medical problem as it is usually related to a sudden change of regimen or to an overload of duties. Different studies put the rate of insomnia at 20–40% in the population [2, 13]. Accurate rate of insomnia on vehicle accidents is not described in the literature. Insomnia is more likely to affect women than men, it may be set off by prolonged exposure to stress, by poor sleep habits, chronic medication, or it may be connected with some other physical or psychic disorder. Primary insomnia is very rare.

The first step in the treatment of insomnia is to explore the patient sleep structure and optimalize the sleep regimen and sleep habits. This means mainly to keep regular time of sleep, prevent stress situations in the evening, sometimes it is useful to make ,"worry-time" in the evening to solve the problems the patient had during the day, alcohol and smoking is not desirable in the evening as well as coffee intake after 6 p.m. and evening exercising. Often the psychotherapy is needed, mainly cognitive-behavioral therapy is successful. The third generation hypnotics (zolpidem, zopiclon) can be prescribed for one month. In chronic insomnia antidepressants with influence on sleep are used (e.g. trazodon, mirtazapin).

The most thoroughly explored condition leading to excessive daytime sleepiness is the sleep apnoea syndrome (SAS) [14]. Its prevalence in the population is often estimated at 1–10% [15]. SAS is a disease marked by recurrent respiratory pauses in sleep described as apnoea (no breathing) or hypopnoea (reduced breathing). Such respiratory impairment mostly results in a blood oxygen drop, transient activation of the sympathetic-adrenal system and in a brief blood pressure and heart rate increase. The respiratory pauses also provoke brief arousal reactions or awakening from sleep. Though the patient is unaware of his/her arousal reactions, they do lead to sleep fragmentation, to lowered effectiveness of nocturnal sleep and, ultimately, to sleep deprivation. In the morning, the patients wake up unrelaxed (often more sleepy than before going to bed), sometimes with headaches, dryness in the mouth, and some of them remain excessively sleepy during the day. The typical SAS patient is a man aged about 50 years, obese, with a short and stout neck. There is also proof of correlation with anatomical abnormities in the oral cavity and facial bones (short or retracted mandible, short maxilla, prolonged or low-seated soft palate, large tongue, abnormities of dentition, and others). SAS patients often have other concomitant problems – hypertension, diabetes mellitus, chronic obstructive pulmonary disease or ischaemic heart disease. SAS intensity is potentiated by smoking and evening alcohol intake and also by the use of benzodiazepine hypnotics as these can affect the muscular tension and add to respiratory tract collapsibility.

Many studies have shown a causal connection between the SAS and increased traffic accident rate. Though numerical data may differ from one another, there is little doubt about the correlation between SAS and the increased risk of traffic

accidents. SAS is the most frequent health-related cause of driving in somnolence. The risk that an SAS-affected driver will run into a car accident is at least twice as high as in normal healthy drivers [9]. According to some authors, this likelihood is even much higher (up to 7 times) [16]. To go by another study, one in every six SAS patients has experienced sleepy driving and at least one third of them have already had a traffic accident [3]. Horstmann et al. found that in the SAS group 12.4% of all drivers had motor vehicle accidents as compared to 2.9% in the control group [17]. This study also shows that adequate treatment for SAS can reduce to at least one fifth the risk of traffic accident due to sleepiness. Continuous positive airway pressure (CPAP) has been found the most efficacious therapy for SAS [18]. CPAP makes use of breathing air of a higher atmospheric pressure through a nasal mask. Higher pressure in the upper airways works like an air splint preventing respiratory tract collapse, thus precluding breathing pauses as well as arousal reactions and awakenings. This makes for quality sleep and consequently, for lower EDS and tiredness. Patients can often feel this beneficial effect on EDS in a matter of a few nights using the apparatus. Another therapeutic possibility is surgical treatment (otorhinolaryngological operations or stomatosurgery). As a matter of course, all SAS patients ought to try and lose weight, abstain from smoking, avoid evening-time intake of alcohol and hypnotics, and deal with concomitant disorders.

In our clinical practice, cases of the restless legs syndrome (RLS) and the periodic limb movements in sleep (PLMS) which are often coupled can be frequently seen. RLS is defined as an urge to move the legs or arms, this urge can be associated with unpleasant feeling in legs. These are mainly in the evening (sometimes also while resting during the day) and are diminished by the movement of the legs. PLMS are characterised by repetitive low extremity movements in sleep (mostly involving the big toe and ankle). RLS/PLMS prevents getting off to sleep or, in sleep, leads to arousals or awakenings and, as a result, to sleep fragmentation similarly as SAS. L-DOPA and some dopamine agonists are therapeutically used beside others.

The term primary EDS means that EDS is the main symptom of the disease, not the result of disturbed sleep for other case. Sleep disorders with primary EDS are narcolepsy, idiopathic hypersomnia a recurrent hypersomnia (these two are rare).

Narcolepsy prevalence is about 0.02–0.2%. Narcoleptic daytime sleepiness is both non-imperative and imperative with the patient falling asleep unexpectedly even while engaged in an ongoing activity. Apart from excessive daytime fatigue and sleepiness, there is often a paroxysmal loss of muscular tone triggered off by emotions – especially laughter or startle. These sudden losses of muscular tone lasting seconds or tens of seconds are known as cataplexy, and can adversely affect the ability to drive. Medical intervention for narcolepsy includes central stimulants (methylphenidat, modafinil), cataplexy is treated by antidepressants and newly by sodium oxybate.

Other diseases can be associated with secondary EDS but not due to sleep deprivation – e.g. Parkinson's disease, multiple sclerosis, infections, depression,

dementia, epilepsy, hormonal changes, states after brain injury, chronic heart disease, and the like.

Drug-induced sleepiness is another major problem. It may be caused by chronic medication, all patients are well advised to read the information leaflet attached to every new drug. EDS has been proved in benzodiazepines (these are used as hypnotics, anxiolytics, antiepileptics, muscular relaxants), antihistaminics (especially 1st-generation ones used as antiallergics), barbiturates, opioid analgesics, some antidepressants, antipsychotics, some antihypertensives and dopamine agonists (mainly pramipexol, ropinirol).

Alcohol is well known for its ability to potentiate sleepiness.

Independent traffic accident risk factors

Many studies have proved increased risk of traffic accidents as depending on some other factors [2, 19]. There is no doubt about this risk being increased in professional long-distance drivers (especially truck drivers), in motorway driving as distinct from urban driving, in driving between 02–06 a.m. (predominantly in drivers under 30 years of age), in driving between 02 to 04 p.m. (more often in older drivers over 50 years of age); drivers' age under 30 is a risk factor in itself. Also mentioned is the connection between the rate of traffic accidents and the weather (more accidents on dry road surface), insufficient driving experience, shift-work regimen and the already referred to jet lag syndrome.

Conclusion

Traffic accidents are the frequent cause of death in people in the productive age and, ultimately, the cause of growing morbidity and socioeconomic loss. Sleepiness or sudden lapse into sleep, too, appears to be an important circumstance of vehicle accidents. EDS may have a number of causes; what is important is its early identification and adequate treatment. Sleepiness may be induced by acute disruption of the sleep regimen or it may be caused by some other underlying disease. There appears to be a prominent correlation between the risk of road accidents and SAS. Needless to say, underlying disease control comes first in the prevention of EDS. Sleepiness can also be significantly influenced by a revision of the sleep regimen. As an instant help in sleepiness behind the wheel we recommend a break in driving at least 30 minutes long, possibly supplemented with a short nap and/or coffee or a brief physical exercise. Refreshment with cool air or intermittent loud music are also advisable while driving. Diverse technical devices in the car or on the road warning against dozing off may be a help, too [20]. As a preventive measure, drivers themselves should be increasingly informed of the potential risks of sleepy driving, and, last but not least, so should general medical practitioners because they are the first to meet patients, and because subsequent investigation and treatment often depend on their correct diagnosis [21].

References

1. MOLA S.: Neurological diseases and driving. *Rev. Neurol*. 23: 334–350, 1995.
2. LYZNICKI J. M., DOEGE T. C., DAVIS R. M., WILLIAMS M. A.: Sleepiness, driving and motor vehicle crashes. *JAMA* 279: 1908–1913, 1998.
3. LAUBE I., SEEGER R., RUSSI E. W., BLOCH K. E.: Accidents related to sleepiness: review of medical causes and prevention with special reference to Switzerland. *Schweiz. Med. Wochenschr.* 128: 1487–1499, 1998.
4. RAJARATNAM S. M., JONES C. B.: Lessons about sleepiness and driving from Selby rail disaster case: R v Gary Neil Hart. *Chronobiol. Int.* 21: 1073–1077, 2004.
5. RICHARDSON G. S., CARSCADON M. A., FLAGG W., VA DEN HOED J., DEMENT W. C., MITLER M. M.: Excessive daytime sleepiness in man: multiple sleep latency measurement in narcoleptic and control subjects. *Electroencephalogr. Clin. Neurophysiol.* 45: 621–627, 1978.
6. VOLNÁ J., ŠONKA K.: Excessive daytime sleepiness – occurrence, causes, assessment, consequences. In: Neurodynamic and Neuroinformatics Studies (Second book on Micro-Sleeps); NOVÁK M. Neural Netwok World, edice monografií, Praha, 2005, 241–249.
7. KANEITA Y., OHIDA T., UCHIYAMA M., TAKEMURA S., KAWAHARA K., YOKOYAMA E., MIYAKE T., HARANO S., SUZUKI K., YAGI Y., KANEKO A., TSUTSUI T., AKASHIBA T.: Excessive daytime sleepiness among the Japanese general population. *J. Epidemiol.* 15: 1–8, 2005.
8. OHAYON M. M., CAULET M., PHILIP P., GUILLEMINAULT C., PRIEST R. G.: How sleep and mental disorders are related to complaints of daytime sleepiness. *Arch. Intern. Med.* 157: 2645–2652, 1997.
9. HARALDSSON P. O., AKERSTEDT T.: Drowsiness-greater traffic hazard than alcohol. Causes, risks and treatment. *Lakartidningen* 98: 3018–3023, 2001.
10. MILES W.: Sleeping with the eyes open. *Sci. Am.* 140: 489–492, 1929.
11. CARTER T., MAJOR H., WETHERALL G., NICHOLSON A.: Excessive daytime sleepiness and driving: regulations for road safety. *Clin. Med.* 4: 454–456, 2004.
12. AMERICAN ACADEMY OF SLEEP MEDICINE: International classification of sleep disorders, 2nd ed.: Diagnostic and coding manual. Westchester, Illinois: American Academy of Sleep Medicine, 2005.
13. PARTINEN M., HUBLIN C.: Epidemiology of sleep disorders. In: Principles and practice of sleep medicine; KRYGER M. H., ROTH T., DEMENT W. C. EDS. Elsevier Saunders, 4th ed., Philadelphia, 2005.
14. ŠONKA K., EDS.: Apnoe a další poruchy dýchání ve spánku. Praha, Grada Publishing, 2004.
15. PARTINEN M., TELEKAVI T.: Epidemiology of obstructive sleep apnea syndrome. *Sleep* 15: 1–4, 1992.
16. HARALDSSON P. O., CARENFELT C., DIDERICHSEN F., NYGREN A., TINGVALL C.: Clinical symptoms of sleep apnea syndrome and automobile accidents. ORL J. Otorhinolaryngol. *Relat. Spec.* 52: 57–62, 1990.
17. HORSTMANN S., HESS C. W., BASSETTI C., GUGGER M., MATHIS J.: Sleepiness-related accidents in sleep apnea patients. *Sleep* 23: 383–389, 2000.
18. SULLIVAN C. E., BERTHON-JONES M., ISSA F. G., EVES L.: Reversal of obstructive sleep apnea by continuous positive airway pressure applied through the nose. *Lancet* 1: 862–865, 1981.
19. SAGBERG F.: Road accidents caused by drivers falling asleep. *Accid. Anal. Prev.* 31: 639–649, 1999.
20. HORNE J., REYNER L.: Vehicle accidents related to sleep: a review. *Occup. Environ. Med.* 56: 289–294, 1999.
21. REUVENI H., TARASIUK A., WAINSTOCK T., ZIV A., ELHAYANY A., TAL A.: Awareness level of obstructive sleep apnea syndrome during routine unstructured interviews of a standardized patient by primary care physicians. *Sleep* 27: 1518–1525, 2004.