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TITLE PAGE

Title

Sudden natural death behind the wheel: Review of driver deaths and fitness to drive assessment history in Victoria, Australia 2012-2013

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ABSTRACT (144 words)

This study reviews the circumstances and medical causes of death of motor vehicle drivers who died in circumstances of sudden illness whilst behind the wheel in Victoria, Australia 2012-13. The driver's fitness to drive assessment history was also examined to identify prevention opportunities.

Deaths included in the study were those referred to a panel responsible for determining whether the driver fatality should be included in the official road toll, where prior doubt exists. A research team comprising of forensic physicians examined the case file of each death involving sudden illness.

Forty-five driver deaths during the two-year period were reviewed. Ischaemic heart disease was the most common cause of death. Over 80% of drivers were male with a median age of 64 years. While limited medical history was available, significantly impacting study analysis, findings identified minimal opportunity to improve the fitness to drive review process.

Keywords

driver, mortality, older people, fitness to drive

INTRODUCTION (256 words)

Approximately 10% of all deaths are sudden, within one hour of onset of symptoms.[1] Common causes are natural diseases of the cardiovascular or cerebrovascular systems. Fatal road collisions can occur from the sudden natural death of a person whilst driving a motor vehicle. In Victoria, Australia the sudden natural death of a driver is excluded from official road toll statistics. However, these unexpected medical events could pose a substantial risk to others. Opportunities to prevent such events are an important road safety consideration, consistent with the philosophy of 'Towards Zero' - a road safety strategy with a "vision for a future free of deaths and serious injuries on our roads".[2]

In Victoria and elsewhere, legislation exists to protect road users by ensuring that motor vehicle licence holders are capable of driving safely. In Victoria the driver licensing authority (DLA) operates a medical review system to assess a person's fitness to hold a licence. National guidelines also exist to guide health professionals in assessing their patient's fitness to drive.[3]

The incidence and causes of sudden death while driving are being elucidated.[4,5] However there is a paucity of research focused on prior determination of fitness to drive due to the complexities and limitations of assessing patients.

This study examined medical causes of death and, where available, the fitness to drive assessment history of drivers who died whilst behind the wheel in Victoria, Australia. The aim was to identify prior knowledge or warning signs associated with the death to identify prevention opportunities, including implications for fitness to drive assessments.

METHOD (274 words)

Study design

The research design was a retrospective cross-sectional observational descriptive study of all relevant deaths in Victoria, Australia from 1 January 2012 to 31 December 2013.

Case identification and inclusion criteria

In Victoria, a police collision database captures all deaths arising from vehicular incidents on the road network. Any sudden, unexpected death must also be notified to the coroner (*Coroners Act 2009* (Vic)). Given the importance of monitoring road fatality trends, certain road deaths are referred to a multidisciplinary fatal review panel (comprising a forensic pathologist, forensic physician, forensic psychiatrist and representatives of police, coronial and road authorities) to assist in determining whether the death satisfies national road toll reporting criteria.[6] These include deaths where it is considered that the most likely cause is due to: a new or underlying medical condition, intentional acts, or incidents outside the public road network. Driver deaths referred to the panel to assess eligibility on the basis of *medical cause of death* were identified for potential inclusion in the current study.

Data collection and analysis

A case file is created which contains relevant documents for consideration by the panel including: the official police collision report, any witness statements including medical statements, the autopsy and toxicology reports and any other material obtained during the police investigation. For the purposes of this study, these files were reviewed by a team of forensic physicians experienced in fitness to drive clinical assessment, to examine the collision circumstances, demographics and medical history. Once the team of forensic physicians assessed each file individually, the cases were collectively discussed to arrive at an opinion regarding the persons' fitness to drive prior to the collision.

RESULTS (552 words)

From 2012-13, 50 deaths were referred to the fatal review panel on the basis of a suspected medical condition causing death and 45 met the study inclusion criteria for further assessment by a team of forensic physicians. These deaths represented 10.3% (45) of the total 435 motorist deaths reported to police in the two-year period. Two of the 45 were counted in the official road toll. Three of the 45 deaths were not investigated by a coroner, as the deaths were deemed to be not sudden or unexpected, occurring in hospital days after the initial collision.

Incident particulars prior to death

All deceased drivers were driving a four-wheeled light vehicle (car). Driving was predominantly on dry sealed roads during daylight hours, with no trend evident in terms of day of the week. Five drivers were in a vehicle accompanied by one other passenger. The most common collision type was “off path on straight” where the driver veered to either the left or right of the road (60%, 27), typically into a fixed object or parked car. Twenty-seven collisions were single vehicle crashes and no other vehicle was implicated. Eighteen collisions involved one or more vehicles, with a maximum of five vehicles involved. Five of the 18 multi-vehicle collisions involved parked cars only.

In 38 of the 45 collisions, no other person was injured. Those causing injury to other persons were typically head-on crashes, where the deceased driver veered onto the incorrect side of the road. Almost 70% (31) of all collisions occurred in speed zones of 40-70km/h.

Driver profiles

The median driver age was 64 years (ranging from 26 to 86 years) and the vast majority were males (n=38, 84%). One was a commercial taxi driver working at the time, while the remaining were all driving private cars.

Ischaemic heart disease was the most common cause of death identified followed by cerebrovascular disease (Table 2).

Table 1: Age group of deceased drivers

Age group	**n**	**(%)**
25-34	1	(2)
35-44	-	(-)
45-54	7	(16)
55-64	15	(33)
65-74	10	(22)
75-84	9	(20)
85+	3	(7)
Total	*45*	*(100)*

Table 2: Primary cause of death among deceased drivers

Primary cause of death	**n**	**(%)**
Ischaemic heart disease	23	(51)
Injuries	6	(13)
Ischaemic heart disease with multiple injuries	3	(7)
Cerebrovascular disease	3	(7)
Pulmonary disease	1	(2)
Indeterminate	6	(13)
Unascertained (no cause identified at autopsy)	3	(7)
Total	*45*	*(100)*

Licensing information

All drivers held a full current licence; none were suspended or had their licence cancelled on the basis of a medical review. Seven drivers had a motorcycle endorsement and eleven had a heavy vehicle licence endorsement but were not driving these types of vehicles at the time. One driver was an interstate licence holder.

Medical review

At least 15% (n=7) of the 45 drivers had been previously notified to the DLA medical review section. The full DLA file was available in only two of the seven cases and both drivers were issued with conditional licences - one for corrective lenses and the

other, automatic transmission (usually imposed if a driver has some disability that prevents the use of their left side limbs) and restricted from driving more than 20km from home (usually imposed for frail drivers who might not be able to tolerate long distance driving but who need to maintain mobility near their home).

Some form of medical history to enable further clinical review was available for 33 of the 45 (73%) drivers. The medical histories identified that three drivers had indicated warning signs or symptoms in the 28 days preceding the incident. Two drivers complained of chest pain. In one case, the passenger advised rescuers the driver had complained of chest pain prior to rolling the vehicle. In another, the driver had consulted a general practitioner for chest pain (first and only presentation).

DISCUSSION (413 words)

The extent of sudden natural death among motorists (10%) was consistent with the incidence reported among the general population. The most common cause of driver death was ischaemic heart disease, also reflective of the leading underlying cause of death in Australia[7] and consistent with previous studies.[5]

Collisions were most often single-vehicle in lower speed zones and fortunately uncommonly injured other road users. This is also consistent with previous research describing sudden driver incapacitation as low speed events. Drivers often attempt to brake or steer, slowing the vehicle which assists in avoiding a collision and reduce injury severity.[4, 5, 8]

The fitness to drive assessment review was significantly impacted by the absence of full medical histories. Few drivers had been notified to the DLA prior to the fatal incident (n=7, 15%). Further, coroners may not require a full investigation into death if autopsy reveals natural causes. Nevertheless, there was not an indication of significant warning to facilitate early intervention.

The case identification method excluded deaths where the driver sustained traumatic injuries and an acute medical event was not suspected. Severe injuries may mask

the role of an initial disease attack.[4] Future studies should examine all drivers, not only those where sudden natural death is initially suspected.

As the incidence of ischaemic heart disease increases with age it is inevitable that the risk of sudden death behind the wheel will increase in older people. Some predisposing factors such as a family history of sudden death, a history of ischaemic heart disease, diabetes, ventricular arrhythmias, obesity, heart failure, and low socioeconomic status are known but are poor predictors of whether a fatal event will occur in any given patient.[9]

While these are medical realities, in practice the decision whether to restrict a person's driving on the basis of a statistical risk of death is difficult. The Austroads guidelines do not address this directly but allow a person to hold a private car licence if there is a "satisfactory response to treatment". What constitutes a satisfactory response is not specifically defined nor how to consider mild symptoms such as chest pain, breathlessness or palpitations. This makes the guidelines a relatively insensitive approach to determining risk of any future cardiac events including sudden death. While it is impractical to deny all patients with risk factors for sudden death a driver licence, it is reasonable to apply more stringent criteria for commercial drivers where the exposure to driving is greater and the implications of a collision are more severe.

CONCLUSION (111 words)

It is not currently possible to eliminate sudden death behind the wheel. Licensing restrictions based on the existence of risk factors need to be carefully applied. Restriction must balance risk reduction with the medical and social benefits of keeping patients mobile for as long as possible. With the advent of the Safe System approach in road safety,[2] the road system must be forgiving of error and ensure that in the event of a crash, serious or fatal injury does not occur. Measures such as

reduced speed limits, safer vehicles and roadside barriers will ultimately assist to help protect other road users in the event of sudden natural death behind the wheel.

REFERENCES

1. Forensic Pathology Online. Sudden Deaths. http://www.forensicpathology online.com/e-book/autopsy/sudden-deaths; Accessed December 2016.

2. Victorian Government. Towards Zero. https://www.towardszero.vic.gov.au; Accessed December 2016.

3. Austroads. Assessing Fitness to Drive for Commercial and Private Vehicle Drivers. http://www.austroads.com.au/drivers-vehicles/assessing-fitness-to-drive; Accessed August 2016.

4. Tervo T, Räty E, Sulander P et al. Sudden death at the wheel due to a disease attack. *Traffic Inj Prev*. 2013;14,138-44.

5. Motozawa Y, Hitosugi M, Kido M et al. Sudden death while driving a four-wheeled vehicle: an autopsy analysis. *Med Sci Law* 2008; 48, 64-8.

6. Australian Bureau of Statistics. Guidelines for Reporting and Classifying Road Vehicle Crashes. 1983.

7. Australian Bureau of Statistics 3303.0 Causes of Death Australia. http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/47E19CA15036B04BCA2577570014668B?opendocument; 2016 Accessed 21 August 2016.

8. Büttner A, Heimpel M, Eisenmenger W. Sudden natural death 'at the wheel': a retrospective study over a 15-year time period (1982-1996). *Forensic Sci. Int*. 1999; 103, 101-112.

9. Chugh SS et al (2008) Epidemiology of Sudden Cardiac Death: Clinical and Research Implications. *Prog Cardiovasc Dis*. 2008; 51, 213–228.

Highlights

- The sudden natural death of motor vehicle drivers is common
- Ischaemic heart disease is a leading cause of death
- Few drivers indicate warning signs or symptoms in the lead up to death; determining risk of future cardiac events including sudden death is difficult
- The sudden natural death of drivers likely poses a low risk to other road users