

ISCHAEMIC HEART DISEASE AS A NATURAL CAUSE OF DEATH IN MOTORISTS

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ABSTRACT

A study of 2,709 fatalities among road users, arising from a total of 59,164 accidents resulting in injury or death, between 1983-1992 in Singapore, showed that 1,134 and 904 deaths involved drivers of motor vehicles and motorcyclists (excluding pillion riders) respectively. In 13 cases of the former and 2 of the latter, death was deemed to have occurred naturally as a consequence of ischaemic heart disease. Two taxi drivers and both motorcyclists had apparently either collapsed "at the wheel" or whilst mounted on their motorcycles without their vehicles having been involved in actual accidents. In the remaining 11 cases, the vehicles had collided with other vehicles, fixed roadside structures or had veered off the road. However, none of these resulted in injury or death to passengers, occupants of other vehicles or to passing pedestrians.

Thus, the prevalence of fatal ischaemic heart disease, as a natural cause of death, among motorists during this time was 0.7% ($SD \pm 0.5$), corresponding to 0.25 per 1,000 ($SD \pm 0.18$) accidents resulting in injury or death; with less than 0.5% ($SD \pm 0.4$), corresponding to 0.19 per 1,000 accidents ($SD \pm 0.17$) resulting in injury or death, being associated with actual collisions.

Although significant and dramatic metabolic derangements may occur during driving, thereby predisposing motorists to ischaemic heart disease, or aggravating pre-existing disease, these results and those of earlier studies would appear to suggest that serious road accidents are rarely caused by, or contributed to, coronary atherosclerosis and its attendant complications.

Keywords: coronary atheroma, road accidents, motorists, metabolic derangement

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INTRODUCTION

Road accidents are common events in Singapore, which is a highly urbanised city state of some 2.8 million inhabitants. Statistics obtained from the Road Safety and Research Division of the Traffic Police Department (1993) indicate that 2,406 fatal road accidents involving motorists, passengers and pedestrians had occurred between 1983-1992, corresponding to an annual mean of approximately 240 ($SD \pm 19$) fatal road events during this time.

Within this period, well over 85,000 persons had been either slightly or seriously injured as a consequence of road accidents, accompanied by a total of 2,709 fatalities during the same period. In 1992 alone, the fatal and serious injury accident rates were 8.5 and 255.1 per 100,000 (population) respectively.

Since ischaemic heart disease is a leading cause of mortality and morbidity in Singapore, a retrospective study was undertaken to determine the prevalence of road accidents associated with this condition and to document the circumstances under which such deaths have occurred. This is particularly pertinent at a time when the importance of road safety is being strongly emphasised and the relationship of ischaemic heart disease and fatal motoring accidents has yet to be established nationally. Furthermore, such an undertaking is made feasible by the prevailing medico-legal system, in which every victim of an actual or an apparently fatal road accident becomes the subject of a Coroner's autopsy which is invariably conducted at the Department of Forensic Medicine, Institute of Science and Forensic Medicine.

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MATERIALS AND METHOD

The departmental autopsy records of actual, as well as apparent, fatal road accident cases in Singapore, which occurred during the period 1983-1992, were reviewed. Out of a total of 2,709 deaths involving pedestrians, motorists, motorcyclists and pedal cyclists, 15 cases in which the death of a driver or motorcyclist was attributable to ischaemic heart disease were identified. These were further analysed to determine the following: (i) their demographic characteristics, (ii) the nature and extent of the external injuries sustained by the subjects, (iii) the pathological findings, (iv) the extent of damage to the subjects' and other vehicles, (v) injuries to pedestrians, and (vi) the results of the toxicological analyses performed.

The circumstances in which these deaths occurred and the availability of relevant medical history at the time of death were also considered and verified by a corresponding review of the relevant Coroner's records.

RESULTS

Overall distribution and types of vehicles

There were between 226-349 ($SD \pm 19$) deaths presenting as actual or apparent road accidents per year during the period 1983-1992, making a total of 2,709 cases, representing a total of 2,406 accidents or approximately 240 accidents per year ($SD \pm 19$) during this time. Of these, 1,134 and 904 involved drivers of motor vehicles and motorcyclists respectively. Of the former, 143 were drivers of cars at the time of death, 6 were bus drivers, while 51 and 28 were driving light and heavy goods vehicles respectively.

On the whole, there were between 1-3 deaths per year related to ischaemic heart disease, involving motorists during this time. The total of 15 such cases consisted of 9 car drivers (including 4 taxi drivers), 2 motorcyclists, one bus driver, 2 drivers of light goods vehicles and one of a heavy goods vehicle.

Thus, coronary artery disease contributed to 1.3% and 0.2% of all fatal road events involving drivers of motor

vehicles and motorcyclists respectively. Together, they accounted for 0.7% (SD±0.5) of all fatalities among motorists as a whole, corresponding to a fatal accident rate of 0.25 per 1,000 accidents (SD±0.18) resulting in injury or death.

Circumstances of death

In 12 cases, death had occurred "on the spot", while 3 subjects were conveyed to hospital accident and emergency departments where they were subsequently pronounced dead.

Apparent collapse at the wheel, or whilst riding a motorcycle, without collision accounted for 4 cases. These comprised the 2 motorcyclists and 2 taxi drivers. Of the former, one rider was found lying on an expressway, next to his vehicle, while the other was found collapsed on his motorcycle and was conveyed to a hospital where he was subsequently certified dead. Similarly, both taxi drivers were found slumped in the driver seat of their vehicles on the roadside.

Two cases involved collisions with other vehicles, one with a parked vehicle and the other with a moving one. Collision with inanimate or fixed objects (such as lamp posts, trees, etc) accounted for 5 cases. Four vehicles veered off the road, 2 came to an abrupt halt in or astride a drain and one vehicle overturned.

This implies that the overall prevalence of actual road accidents associated with fatal ischaemic heart disease, excluding apparently sudden collapses without a collision or some other abrupt event, was 0.5% (SD±0.4) of fatal motor vehicular accidents involving both motorcyclists and other motorists (0.19 per 1,000 accidents (SD±0.17) resulting in injury or death).

Significantly, none of these cases resulted in injury or death to passing pedestrians or to the occupants of the same or of other motor vehicles.

Demographic characteristics

All 15 subjects were males. Their ages ranged between 39-69 years, with mean and median ages of 53.9 and 57 years respectively. There was a preponderance of Chinese (12 cases), with 2 Malays and one Indian. The other native ethnic groups and foreign nationals were not represented.

Medical history

In only one case was there a history of ischaemic heart disease, while 2 subjects were known to have been both hypertensive and diabetic.

External injuries

There were no external injuries in 9 cases, while the remaining 6 cases showed an overlapping distribution of the following injuries: Abrasions, bruises and lacerations on the forehead (3), bruises on the anterior chest wall (1), bruises on the anterior abdominal wall (2), abrasions and bruises on the upper limbs (3), and abrasions and bruises on the lower limbs (3).

None had sustained internal injuries.

Certified causes of death and pathological findings

In 5 subjects, death was deemed to have been due to acute myocardial infarction, including a case of a ruptured right ventricular infarct in a taxi driver whose vehicle had collided with a tree. In 4 cases, there was evidence of recurrent myocardial infarction, while coronary thrombosis was

present in 6 (including 2 with myocardial infarction) and severe atheromatous coronary occlusion was found in 2. All cases of myocardial infarction were confirmed by histological examination.

The heart was enlarged in 12 cases, of which 7 showed obvious concentric left ventricular hypertrophy, as indicated by left ventricular wall thicknesses exceeding 1.5 cm. The weights of these hearts ranged between 340-800 g, with a mean of 434 g (SD±116 g).

All 15 cases showed severe coronary atherosclerosis, with 6 showing one major artery with over 80% occlusion, and 9 showing an equivalent degree of occlusive atheroma in two or more major arteries. Four cases showed evidence of subintimal haemorrhage into the atheromatous plaques.

Toxicology

Toxicology analyses yielded almost uniformly negative results except in 2 cases, of which one showed a blood ethanol concentration of 40 mg/100 ml, while the other showed bile and urine morphine concentrations of 0.07 mg/100ml and 0.08 mg/100ml respectively. Both were found dead in their vehicles which were involved in collisions. It is unlikely that these low levels of ethanol and morphine would have had any significant contributory role in road accidents engendered by fatal ischaemic heart disease among the cases studied.

DISCUSSION

Ischaemic heart disease arising from severe coronary atherosclerosis is a very common, natural cause of sudden unexpected death⁽¹⁻³⁾. Other causes of sudden cardiac death include aortic valve stenosis, acute myocarditis (usually of a viral aetiology), the cardiomyopathies, in particular, hypertrophic obstructive cardiomyopathy (HOCM), as well as dilated and restrictive/obliterative cardiomyopathy, hereditary or acquired defects of the conduction system, mitral valve prolapse, hypertensive heart disease and electrolyte derangements⁽²⁾.

Sudden unexpected death where the circumstances strongly suggest a cardiac cause may pose problems for the pathologist. Ischaemic heart disease is undoubtedly the most frequent cause, but even when this is the case, the detailed pathology is controversial⁽⁴⁾.

The role of the forensic pathologist in the investigation of these deaths is not restricted merely to the determination of the actual cause of death, but also includes the elucidation of the contribution, if any, of ischaemic heart disease and its attendant complications to the causation of an accident and the relation between death and the accident.

This consideration may be of decisive importance in inquiries into major transport accidents, particularly those involving motor vehicles and aircraft disasters. On a lesser scale, the association of ischaemic heart disease with actual, or apparent, road traffic accidents involving only the deceased himself who was in control of the vehicle at the time of the accident, may have an important bearing on the compensation entitlement for the relatives of the deceased.

In these situations, a medical history of ischaemic heart disease may or may not exist. Indeed, a large proportion of myocardial ischaemic episodes occur silently, with as much as 70% being unassociated with angina in patients with symptomatic coronary artery disease⁽⁵⁻⁸⁾. Also, approximately 10-15% of myocardial infarctions are silent⁽⁹⁾. Thus, it is not surprising that the current review yields only a positive medical history of ischaemic heart disease or of

known risk factors in only 3 out of the 15 cases studied.

In any event, where a fatal road traffic event has occurred, it is necessary to determine whether the underlying disease is:

- (i) co-incident: an incidental finding in an accidental traumatic death;
- (ii) contributory: the cause of the accident but not the cause of death; or
- (iii) causative: the cause of death and thereby the accident⁽¹⁾

In this respect, the results of the present study indicate that ischaemic heart disease was clearly the cause of death and, consequently, a road accident, in 11 out of 15 cases; whereas, in 4 cases, it caused death without actually having caused an accident. Indeed, while a co-incident finding of severe coronary artery disease may not be uncommon in accidental traumatic deaths, it would be considerably more difficult to assess the contributory role of underlying ischaemic heart disease in the causation of fatal or potentially fatal accidents.

The relationship between ischaemic heart disease and transportation accidents

It may be of interest to note that a large proportion of the research on the relationship between coronary artery disease and transportation accidents has been performed on aviation accidents⁽¹⁰⁻¹⁴⁾.

With respect to road accidents, a study done by Robinson in 1982, in Australia, showed that significant and dramatic metabolic changes occurred in the first quarter hour of driving⁽¹⁵⁾. These comprised a rapid rise in blood glucose, a rise in blood cholesterol and a reduction in coagulation time. At the same time, a fall in blood triglycerides was observed. He postulated that the latter occurred because triglycerides are apparently readily converted to glucose which, in turn, stimulates insulin release and that this, although happening naturally while driving, is an abnormal metabolic function that the body in its natural state is not required to perform and which could, therefore, have many deleterious effects on the metabolic system as a whole, thus predisposing to myocardial ischaemia. In a later study⁽¹⁶⁾, he presented mathematical data supporting a relationship between road accident deaths in both males and females and ischaemic heart disease, in which he suggested that road accident deaths are a function of vehicle usage which, in turn, creates stress on the bodily function resulting in ischaemic heart disease. He again emphasised the role of metabolic derangement, occasioned by the stress of driving, in the pathogenesis of ischaemic heart disease, stating that a "malfunction" in the control of cholesterol may lead to atherosclerosis, while an increase in the level of coagulants in the blood due to the abnormal stress of travelling in a motor vehicle may effect an increase in blood pressure and also predispose to strokes, ischaemic heart disease and coronary thrombosis which may be fatal. His second study also indicated that females tend to suffer far greater stress per kilometre travelled than their male counterparts.

However, to put matters in perspective, it should be noted that studies conducted by Grattan and Jeffcoate (1968), Baker and Spitz (1970) and, more recently, Christian (1988)⁽¹⁷⁻¹⁹⁾, showed that sudden natural death in motorists,

which mainly resulted from cardiovascular disease, does not actually pose a substantial threat to other road users, nor are they particularly common. Specifically, Christian's conclusions were drawn from a prospective study carried out over a period of 10 years from 1978-1987⁽¹⁹⁾. Out of the 30,000 accident victims studied, there were 267 fatalities, of whom 24% were found to have died from natural causes, mostly due to pre-existing cardiovascular disease. This corresponded to an incidence of 2.1 episodes of acute illness per 1,000 accidents resulting in injury or death, which was similar to Grattan and Jeffcoate's earlier reported incidence of 1.5 per 1,000 accidents derived from a study of 10,000 accident victims⁽¹⁷⁾.

The results of the present study, which indicate a very low prevalence of fatal ischaemic heart disease in the causation of road accidents involving motorists {0.7% of all accidents involving motorcyclists (0.2%) and other motorists (1.3%), with only 0.5% actually being associated with a collision}, are clearly compatible with the findings of the earlier studies quoted above. In addition, it is significant that none of these accidents resulted in injury or death to pedestrians or to the occupants of the same or other vehicles. This, and the observation that only minor external injuries were sustained by the subjects, indicate that these had been low velocity collisions, or equally likely, that these motorists were able to slow down considerably, from a normal or moderate driving speed, before losing control of the vehicle; or even to a stop before collapsing at the wheel.

These earlier studies certainly have a great bearing on the question as to whether persons with ischaemic heart disease, particularly the elderly, should be denied the right to drive and evidently suggest that there is essentially no justification for restricting or depriving this category of people of their driving licences on account of their pre-existing cardiac condition. Again, the findings of the present study would appear to be in agreement with that of its predecessors. Nevertheless, there can be little doubt that motorists who are at high risk for cardiovascular disease and those who are advancing in years, should be subject to stringent, periodic medical examination, to further reduce such accidents which, arguably, are preventable. This ought to apply, particularly, to drivers of heavy goods and public service vehicles.

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