

ANALYSIS OF SUDDEN NATURAL DEATHS WHILE DRIVING WITH FORENSIC AUTOPSY FINDINGS

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ABSTRACT

Sudden natural death while driving has been insufficiently elucidated in Japan owing to the system of voluntary notification of relevant diseases when applying for driver's licenses and the low autopsy rates of traffic accident deaths. This report discusses the behaviors of the vehicles immediately after the drivers' death and the circumstances of the accidents with information obtained from police and the forensic autopsy findings. The results suggested that in a number of cases the cause of death of the driver might be misidentified as injuries resulting from an accident caused by human error such as delayed recognition, misjudgment or mishandling of the vehicle, if autopsy had not been performed. Furthermore, accidents caused by sudden natural death of the driver might be misclassified among fatal accidents in Japanese traffic statistics.

Our results demonstrate the importance of employing information gained from autopsy records in accident analysis to distinguish between fatal accidents and sudden natural death while driving, in order to clarify the degree to which human factors contribute to causing accidents.

INTRODUCTION

Dramatic improvements have been made in automotive collision safety performance in recent years as a result of continuous upgrades in global safety standards. In Japan, the results of assessments by the JNCAP, the country's first independent automotive safety evaluation body, have been made public since 1999, providing consumers with more detailed information on automotive collision safety. This has contributed to increased concern among Japanese consumers regarding safety performance, leading to a noticeable increase in the use of safety devices in automobiles. Although fatalities of vehicle occupants in automobile accidents have been decreased in Japan since 1995, they have still exceeded 3000 in 2003 [1].

Traditionally, the human factors accounting for road traffic accidents have mainly been classified as human error; i.e. delayed recognition, errors in judgment, mishandling of the vehicle. However, when we examined such accidents in detail, we found that some driver might have lost consciousness, or had already been dead before the accident, because the cause of death was diagnosed as sudden natural death with forensic autopsies. Given the likelihood that human error is not the cause of such accidents and those injuries sustained by the driver are not the direct cause of death, these accidents must clearly be distinguished from other fatal accidents. However, this fact has been underestimated in conventional studies. This paper will deal with sudden natural death of the while operating the vehicle. We analyze the subsequent behavior of the vehicle, the characteristics of the resulting accident, previous medical histories of the driver and autopsy findings. Furthermore, the paper will discuss Japan's legal regulations concerning competence in vehicle operation and the importance of forensic autopsy to distinguish between natural deaths while driving and traffic accident fatalities.

ACCIDENT STATUS

In Japanese traffic accident statistics, human factors accounting for traffic accidents are generally classified as human error, with a breakdown as follows (All percentages refer to single vehicle fatal accidents): Delayed recognition, due to forward inattention, etc. (27%), errors in judgment (27%), mishandling of the vehicle (40%) [2]. The majority of human error is ascribed to alcohol or fatigue; the statistical data does not refer to the effects of natural diseases in Japan. Although many studies of sudden natural death while driving have been reported to date [3]-[8], no comprehensive analysis concerning the circumstances of the accidents or avoidance maneuvers of the drivers of the vehicles involved have been shown. In addition, physical and mental

factors are not studied in Japanese national traffic accident surveys and have not been well recognized and appeared as a category in national statistics. Furthermore, most of surveys in specific regions have reported either the circumstances leading to accidents and the vehicles involved or medical findings concerning natural diseases suffered by the drivers. Therefore, it is urgently necessary to clarify the status of accidents due to sudden natural death and to obtain a comprehensive perspective on this issue for evaluating the risk of fatal accidents caused by natural diseases and for preventing them.

HEALTH PROBLEMS AND ROAD TRAFFIC LAW

Japan's Road Traffic Law was partially revised in 1999 with the formulation of new laws concerning conditions for the disqualification of disabled persons from holding drivers' licenses. These laws came into effect in June 2002. This revision of the Law did away with former provisions stating that individuals suffering from specific medical conditions were disqualified from holding a driver's license (or from taking a licensing test), and has provided, instead, for judgment in individual cases as to whether the driver's medical condition would affect their ability to drive safely.

In cases where an applicant for a license suffers from one of the conditions listed below and there is concern that the condition will diminish their ability to drive safely, the license may be refused or held back, even if the driver has successfully passed the test. (In the case of individuals already possessing a license, the license may be revoked or suspended). The specific conditions are involved in:

1. Schizophrenia
2. Epilepsy
3. Recurrent syncope
4. Asymptomatic hypoglycemia
5. Manic-depressive psychosis
6. Severe dyssomnia
7. Other conditions involving symptoms which may diminish the ability to drive an automobile safely

Where a driver has declared that they have any of the conditions listed above or the symptoms listed below, the Public Safety Commission has the power to conduct individual interviews and, where necessary, to hold back or suspend licenses. At this time the driver may be requested to submit a medical certificate, and tests may be conducted. The symptoms are:

1. The driver has lost consciousness due to illness or an undetermined cause.
2. The driver has experienced paroxysmic general or local seizures or paralysis as a result of illness.
3. The driver falls asleep in the midst of their daily activities three or more times a week, despite getting sufficient sleep.
4. The driver has been advised by a physician not to obtain a driver's license or drive a vehicle due to illness.

Declaration of these conditions or symptoms which may disqualify the driver from holding a driver's license is made on a special form when receiving or renewing a license. This system basically relies on self-declaration. In addition, making an accurate judgment on whether the driver has a possibility to lose consciousness while driving or not, is difficult. However, the law was revised as mentioned above in order to take the right of the disabled to drive into account. Evaluating the risk of fatal accidents due to natural diseases is therefore important in enabling discussion on standards to be established with regard to medical conditions which may result in loss of consciousness while driving. To do so, we must first clarify the status of accidents involving sudden natural death.

ANALYSIS OF SUDDEN NATURAL DEATH WHILE DRIVING WITH FORENSIC AUTOPSIES

In the seven-year period between 1997 and 2003, 130 forensic autopsies (an average of 18.6 per year) on fatalities in traffic accidents occurring in Tochigi Prefecture (in the north of the Kanto Region in which Tokyo is also located) were performed at the Department of Legal Medicine at the Dokkyo University School of Medicine. This represents almost all of the traffic accident-related forensic autopsies conducted in the prefecture during this period. In the traffic accident death, the cause of death is confirmed with the findings of clinical diagnosis and examinations. However, for the cases in which the clinical diagnosis is not defined; the death from suspicious accident; unknown death whether due to internal or external cause, forensic autopsy is performed. Because there were 1446 traffic accident fatalities in Tochigi Prefecture in the same period (an average of 206.7 per year) According to the statistics of Transportation Bureau of National Police Agency, the 130 autopsies conducted in the prefecture represent 9% of this figure. Cause of death was given as sudden natural death in 22 of these 130 cases. Even taking into consideration the fact that forensic autopsies are

generally only conducted when the cause of death is not easily determinable, this indicates that we may infer that accidents involving sudden natural death occur more often than we normally think.

Looking at a breakdown of the deaths from disease, we found that the average age at death was 55.6 ± 12.0 years, with males comprising 86% (19 cases). The leading cause of death is ischemic heart disease (73%, 16 cases). (Figure 1)

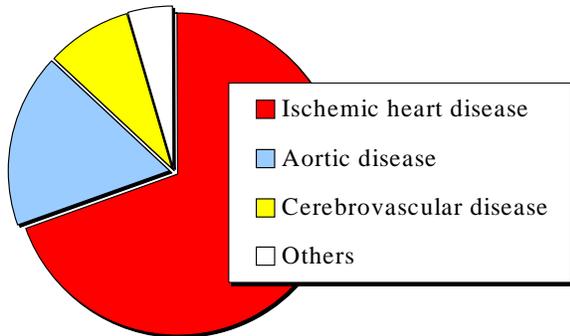


Figure 1. Distribution of Cause of Sudden Natural Death

In the following sections we discuss two autopsy cases with consideration of their implications.

Autopsy case 1

Accident circumstances

At approximately 8:00 in the morning, a 47-year-old woman wearing a seatbelt had been driving on a city street in a small passenger vehicle being equipped with no air bags. The vehicle made repeated contact with fences and walls on the left side of the street, coming to a stop after colliding with a utility pole on the right side of the street. Although the driver was transported to a hospital, she was pronounced dead at 1:30 in the afternoon.

Vehicle behavior during the accident

While traveling along an almost straight road of 5.4m in width, the vehicle struck a concrete block wall on the left side of the road. The vehicle proceeded approximately 20m and struck another wall on the left side of the road. Proceeding a further 13m, the vehicle again struck a stone wall on the left side of the road. The vehicle then proceeded approximately 120m and struck a utility pole on the left side of the road, after which it veered to the right, finally colliding almost head-on with a utility pole approximately 25m further on the right side of the road (Figure 2).

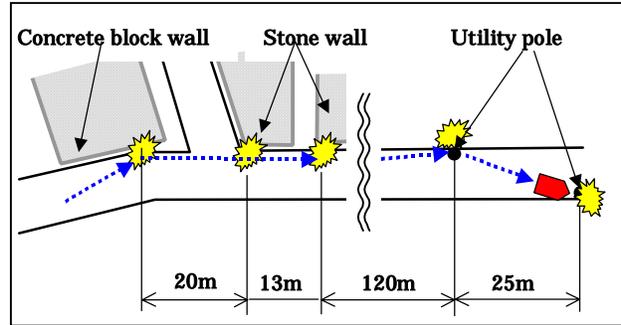


Figure 2. Vehicle Behavior of Case 1

Status of damage sustained by the vehicle

Frontal impact with the pole caused significant deformation of the front central section of the engine housing. (Figure 3) The steering wheel and column were deformed, but no significant deformation of the sides of the vehicle or of the cabin was observed.



Figure 3. Status of the Vehicle of Case 1

Autopsy findings

Height: 154.5cm; Weight: 46.5kg; Previous medical history: None.

Region of the head: Subarachnoid hemorrhage due to the rupture of aneurysm, a diameter of 1.5cm, at the top of the basilar artery was found, accompanied by a subarachnoid hemorrhage. No other traumatic changes were observed. (Figure 4)

Region of the neck: Hemorrhages in the soft tissue of the anterior surface of the cervical vertebrae and fractures of the 3rd intravertebral disk, and the 6th vertebral body of the neck, were observed. No abnormal findings in the dura of the cervical vertebrae and the spinal cord were found.

Region of the chest: Hemorrhage of the anterior surface of the pericardial cavity of the anterior mediastinum, and fractures of the right 8th rib (lateral part of the chest), right 9th-12th ribs (posterior part of the chest) and left 2nd rib (anterior part of the chest), and peripheral intramuscular hemorrhage were observed. No abnormal findings were found in the lungs, the heart and the thoracic aorta.

The cause of death was diagnosed as subarachnoid hemorrhage due to a ruptured aneurysm of the basilar artery.



Figure 4. Subarachnoid hemorrhage shown in autopsy case 1

Considerations

In this case, during the accident the vehicle made repeated contact with structures at the side of the road, from the initial contact with a concrete block wall to the impact with the utility pole. There was no sign that the driver had attempted avoidance maneuvers by braking, turning the steering wheel, etc. during the accident. In addition, the scratches left by the initial contact with the wall suggest that it was a minor one, and given that she was wearing a seatbelt, it is difficult to imagine that it would have caused sufficient trauma to the driver to render her incapable of operating the vehicle. We may therefore infer that the driver was already incapable of steering the vehicle at the time of initial contact with the wall.

Although the trauma was caused by the secondary impact with interior components of the vehicle, none of which could have been the direct cause of death. Because of the presence of a ruptured aneurysm, the subarachnoid hemorrhage was judged to be endogenous, and the driver was judged to have died of natural causes. However, no prior medical history for the driver existed and multiple fractures were observed in the regions of the neck and chest, if no eyewitness accounts of the accident had been available, without autopsy, this accident would have

been incorrectly classified as mishandling of the vehicle.

Autopsy case 2

Accident circumstances

At approximately 7:45 in the morning, a 59-year-old man was driving on the expressway in a passenger vehicle. After making repeated contact with the guardrails on the left and right sides of the road, the vehicle collided with a guardrail on the median divider and came to a stop. The police arrived at the scene at 7:57 and found the driver unconscious. He was wearing a seatbelt and the airbag was inflated. An ambulance arrived at 8:06, at which time the driver was judged to be in a state of cardiopulmonary arrest. Although he was transported to a hospital, where he was pronounced dead at 8:50.

Vehicle behavior during the accident

At an estimated speed of 100km/h, the vehicle struck a guardrail on the median strip at a gentle right-hand curve, and continued in contact with the rail for several meters. The vehicle then veered to the left and proceeded for approximately 100m. It struck a guardrail on the left shoulder of the expressway and continued for approximately 30m in contact with it. The vehicle then veered to the right and proceeded for approximately 80m. It struck a guardrail on the median strip and continued in contact with the rail for approximately 70m, when it came to rest with its right side in contact with the rail. Slip marks were observed in the gutters at the points where the vehicle struck the guardrails, but there were no skid marks on the road surface, indicating that the driver had applied the brakes. (Figure 5)

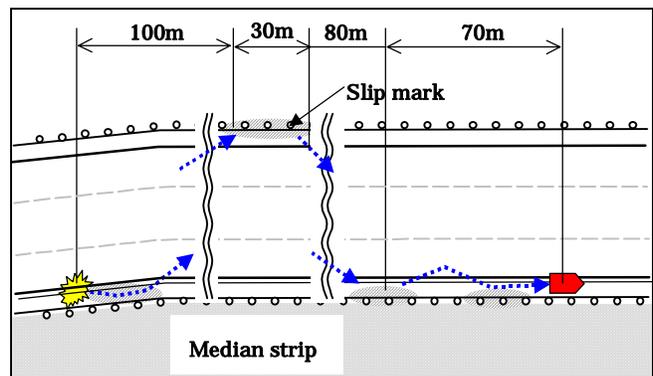


Figure 5. Vehicle Behavior of Case 2

Status of damage sustained by the front suspension and wheel were broken. No significant damage to the engine housing or deformation of the

cabin was observed. Both front airbags were inflated. (Figure 6)



Figure 6. Status of the Vehicle of Case 2 Just after the Crash

Autopsy findings

Height: 166cm; Weight: 64kg; Previous medical history: Angina pectoris. No traumatic changes were observed on the body surface.

Internally arterosclerosis and stenosis of the coronary arteries were observed. No other abnormal regions were found except the findings of acute death. Histologically massive ischemic changes of the cardiac muscle were found. The cause of death was diagnosed as ischemic heart failure (natural causes).

Considerations

Viewing this case from the perspective of vehicle behavior (the fact that there was no evidence of avoidance maneuvers, etc.), we may infer that the driver was already unconscious or dead when the vehicle first struck the guard rail on the center divider. Slip marks and the damage on the guard rails indicate that the airbag was probably triggered by the initial contact with the guard rail. However, because the vehicle remained virtually parallel to all the guardrails it scraped along, there was minimal impact to the vehicle or occupant. Furthermore, because the driver was wearing a seatbelt no trauma was observed. There was therefore little chance that this could be judged as a case of death due to accident trauma. However, if the vehicle had collided head-on with a man-made structure such as the pillar of a guardrail and the driver had consequently been injured, that the accident could be misjudged as a case of a driver having fallen asleep at the wheel.

CONCLUSION

Accidents occurring due to the sudden natural death of the driver are not caused by negligence in vehicle operation, and the injuries sustained by the driver in the accident are not the direct cause of death. Therefore, when accident surveys are conducted and when measures to prevent accidents are examined, this type of accident must be clearly distinguished from accidents due to human error such as mishandling of the vehicle. Therefore, we must first clarify status and attain a comprehensive understanding of these accidents.

In Japan, because forensic autopsies are conducted on only 4-5% of all traffic accident fatalities, in some cases the causes of deaths are not necessarily be accurately identified. In addition, there have traditionally been very few accident surveys and a lack of statistical data which deal with the sudden natural death of vehicle drivers. For this reason our knowledge of sudden death while driving is limited. Therefore, we must carefully determine whether the cause of death due to a natural disease or not, especially in a condition which might cause loss of consciousness or sudden death. With considering the past medical histories of the driver, we must actively carry out autopsies to determine the cause of death. At the same time, it is essential that we record the details of these accidents and thus accumulate knowledge. To enable this, in future it will be necessary, in addition to expanding the scope of accident surveys, to share knowledge with medical staff and relevant government agencies, and to create a system ensuring that these accidents are not overlooked. Autopsy results will play an important role in this process.

Moreover, we must also put into effect preventative safety measures, which take into consideration the physical condition of drivers, in order to reduce the incidence of these types of accidents, and also implement measures to prevent secondary accidents which may result from them.

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