



Manifestation of Coronary Atherosclerosis in Klang Valley, Malaysia: An Autopsy Study

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Aims: The present study aimed to determine the epidemiological aspects of medico-legal autopsies and manifestation of coronary atherosclerosis.

Methods: This was a cross sectional study involving 222 cases recruited from National Institute of Forensic Medicine (NIFM) Hospital Kuala Lumpur (HKL) and Department of Forensic Medicine Hospital Sungai Buloh (HSgB) for a period of 15 months, from December 2012 to April 2014. Socio-demographic and autopsy findings, including the cause and manner of death were documented.

Results: Male and female subjects aged 18–70 years were recruited. Males contributed to 86% of the total subjects and comprised 61% of young adults. Road traffic accidents were the primary cause of death, contributing almost 50% of the subjects. One third of the cases comprised of death due to natural causes, wherein almost 75% of the subjects within this category succumbed to sudden cardiac death. Coronary artery disease (CAD) contributed to 60% of the sudden cardiac death (SCD). Single and double-vessel diseases were the most common pattern of atherosclerosis. In almost 80% of CAD cases, atherosclerosis affected the left anterior descending artery (LAD).

Conclusion: Cardiovascular diseases were the most significant natural cause of sudden death with a staggering figure of 75%. CAD was the single most commonly encountered pathology within the SCD. Most cases presented with single and double-vessel diseases, observed in all subjects, as well as the young adult population.

Key words: Sudden death, Coronary atherosclerosis, Cardiovascular disease

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Introduction

The frequency of coronary atherosclerosis is rapidly increasing and gravely affecting the population of productive people in Malaysia. Data from the Ministry of Health (MOH), Malaysia showed that cardiovascular disease (CVD) accounted for 23%–26% of all deaths from 1994 to 2001, thus making it the principle cause of death. Ischaemic heart disease (IHD)

accounted for 27%–35% of CVD for recorded death from 1985 to 2000¹. A five-year study conducted at University Malaya Medical Centre, Kuala Lumpur for all sudden natural deaths from 2000 to 2004 revealed an alarmingly high increase in CVD prevalence as the figure rose to 64.9%².

In order to assess the magnitude and progression of this health problem in the urban population, the present study examined the prevalence of those who succumbed to this disease based on the medico-legal autopsy cases brought to two major Forensic departments in Klang Valley, Malaysia. We also aimed to investigate the prevalence and pattern of atherosclerotic lesions and the cause and manner of death among young adults from the medico-legal autopsy cases.

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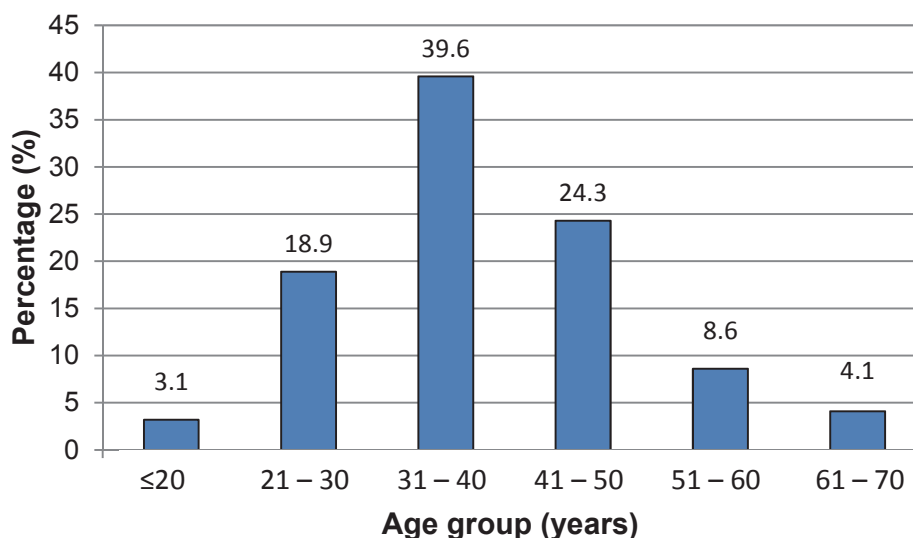


Fig. 1. Distribution of subjects according to age group.

Materials and Method

Study Population

The study sample comprised all natural and unnatural causes of sudden death cases which were brought to National Institute of Forensic Medicine (NIFM) Hospital Kuala Lumpur (HKL) and Department of Forensic Medicine Hospital Sungai Buloh (HSgB) for a period of 15 months, from December 2012 to April 2014. According to World Health Organization, sudden death is defined as natural, nonviolent, unexpected death occurring within 24 hours of the onset of symptoms³. Cases of sudden unnatural deaths such as road traffic accident fatalities, homicide or suicide victims that satisfied the inclusion criteria were also recruited. Exclusion criteria included known history of coronary artery disease (CAD), patients with chronic medical illness on anti-inflammatory medication and decomposed human remains. Male and female subjects aged 18–70 years were selected. Data pertaining to autopsy findings and the cause and manner of death were obtained.

Autopsy Examination

Autopsy was performed in all the cases. Examination of the heart included major epicardial arteries, left anterior descending (LAD), left circumflex artery (LCX), and right coronary artery (RCA). The arteries were cross-sectioned at 2–3-mm intervals. Any degree of narrowing by visual inspection was recorded and graded as below:

Grade I: Artery appeared grossly normal but had microscopic findings of atherosclerosis. Occlusion

is between 0%–25%.

Grade II: Thickening of vessel wall with 25%–50% luminal occlusion.

Grade III: Thickening of vessel wall with 50%–75% luminal occlusion.

Grade IV: Thickening and calcification with more than 75% narrowing of lumen.

Significant CAD was considered when $\geq 70\%$ luminal occlusion was observed³.

Results

A total of 222 autopsy cases were recruited; NIFM and HSgB contributed 150 and 72 cases, respectively. They were categorized into six groups according to the age range (Fig. 1). In terms of gender distribution, 191 (86.0%) subjects were males, and the remaining 31 (14.0%) were females. More than half of the subjects (61.7%) were young adults aged < 40 years, comprising 118 men and 19 women.

Malaysia is a multiracial country with major ethnic groups of Malays, Chinese, and Indians. The present study showed that Malays constituted almost 20% of the total subjects, with similar figures for the Chinese and Indians. However, the number of Chinese was remarkably smaller in the category of young adults, contributing only 9.5%, compared to 23.4% and 19% Indians and Malays, respectively. Furthermore, the increasing number of economic immigrants in Malaysia was also well reflected in this study. While Malaysians contributed to 60% of the cases, autopsies performed on deceased immigrants accounted for more than one third of the autopsy workload. The young adult population showed a high number as the immigrants con-

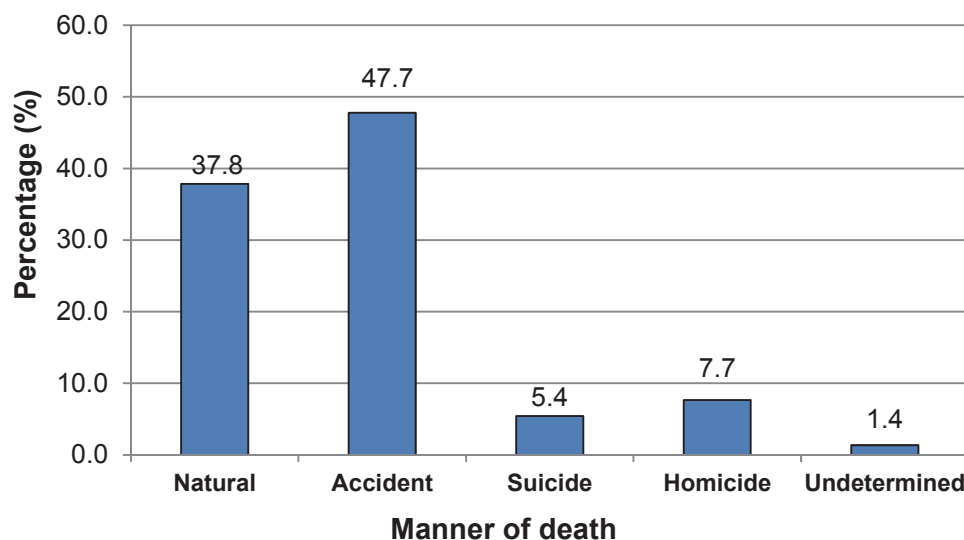


Fig. 2. Distribution of subjects according to manner of death.

tributed to 45.9% of the autopsy workload. Indonesia, Myanmar, Bangladesh, and Nepal nationals comprised the most frequently encountered cases during autopsies.

Cause and Manner of Death

Almost half of the cases in this study were fatalities of road traffic accidents. Natural causes of sudden death contributed slightly more than one third (37.8%) of the cases, whereas a smaller percentage of the subjects were victims of homicide and suicide (**Fig. 2**). In the population of young adults, similar patterns were observed. Sudden cardiac death (SCD) was accounted for almost 75% of the cases and the remaining causes were attributed to respiratory diseases, cerebrovascular accidents, and infection. Data from HSgB showed detailed natural causes of sudden death (**Table 1**).

Manifestation of Coronary Atherosclerosis

Because majority of the subjects were road traffic fatalities, it is not surprising that 73% percent of the total population presented with no atheroma or minimal atherosclerosis, causing less than 25% luminal occlusion in any of the major epicardial arteries. Only 5.4% of the fatal road traffic accident victims showed presence of significant atheroma. Almost 40% of the subjects died of natural causes. Within the SCD subgroup, 61.9% of the subjects died of CAD. CAD cases were further classified to demonstrate single, double, and triple-vessel disease, respectively. Single-vessel disease is defined as the narrowing of any one of the major coronary arteries. Double-vessel disease is defined as the narrowing of two major coronary arteries, and triple-vessel disease refers to the narrowing of all the

three major coronary arteries⁴. Double-vessel disease showed the highest incidence as it was observed in 24% of the cases, followed by single-vessel disease (22%), and triple-vessel disease (11%) (**Fig. 3**). Within the population of young adults, high percentage of none to minimal atheroma was noted, contributing to almost 82%, almost 10% more than the total study subjects. Within the natural causes of sudden death group of young adults, single and double-vessel diseases had similar frequencies, contributing to 20.5% and 22.7% respectively. Triple-vessel disease was observed in less than 10% of the cases.

In single-vessel disease, majority of significant atherosclerosis process was seen affecting the LAD (78.9%), followed by RCA (15.8%), and least involving the LCX (5.3%). Likewise, double-vessel disease affecting the LAD and RCA contributed to 60% of the cases within this sub-category. Combination of LAD and LCX and RCA and LCX contributed to 20% each.

Discussion

This study showed that majority of the study subjects died of unnatural causes. Approximately one third of the study subjects died of natural diseases. Nearly 75% of the subjects within the natural cause of sudden death category succumbed to SCD which included CAD, IHD, acute myocardial infarction (MI), hypertensive heart disease (HHD), and cardiomyopathies.

Studies have shown that the major cause of death in developing countries will shift from communicable diseases to non-communicable diseases such as CAD. It is projected that by 2020, CAD will be the leading

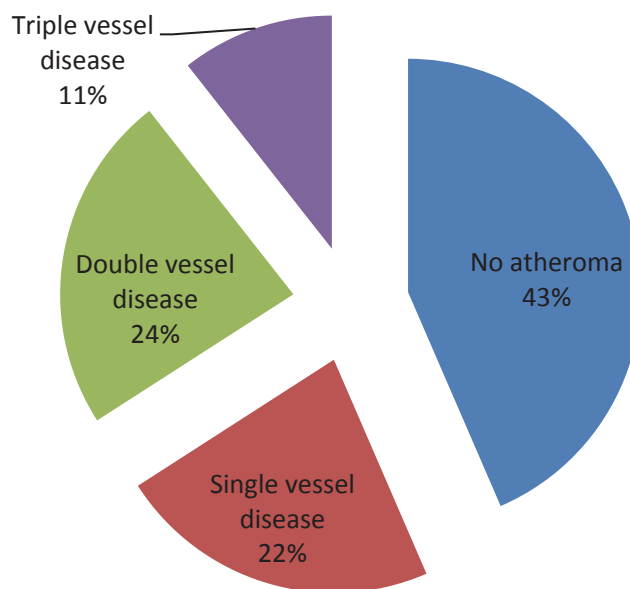
Table 1. Natural causes of sudden death

Causes of death	Frequency (n)	Percentage (%)
Cardiac causes e.g.; CAD, IHD, MI, HHD, Cardiomegaly	25	75.8
Thromboembolism	1	3.0
Hemorrhagic stroke	1	3.0
Pneumonia	1	3.0
Bronchial asthma	2	6.1
Undetermined	3	9.1
Total	33	100

cause of death in developing countries, including Malaysia^{5,6}. Twenty years ago, CVD was already a principal cause of death in the country, accounting for 23%–26% of deaths from 1994 to 2001¹¹. A much recent study conducted by University Malaya Medical Centre showed that the figures have increased to a staggering 64.9% and continue to rise to 75% as observed in this study². Indeed, the projection has materialized and it is sooner than expected. A study in India and Pakistan also shared similar findings, where 76% individuals died of CAD⁷. In contrast, developed countries such as Canada showed that 40% of natural deaths were caused by SCD and 60% of the SCD deaths were attributable to CAD³. In the United States, SCD was also the most common cause of death in the country; however, the contribution was much lower, estimated to be 30%–50% of the cases^{8,9}.

In terms of the patterns of coronary atherosclerosis, single and double-vessel diseases had the same frequency, leaving triple-vessel disease as the least encountered pattern. In a local study conducted to determine the prevalence of premature CAD in patients using angiography, single-vessel disease was predominant in young patients. Multi vessel disease was frequently observed in the older age group. This may be because of rapid disease progression in a less extensive CAD in younger people while in older individual; gradually evolving process may result in multi vessel disease¹⁰. This is a stark contrast to a study by Dabit Arzamnedi *et al* which showed equal frequency of single, double, and triple-vessel disease in Canada. In fact, triple-vessel disease recorded the highest frequency, contributing almost 40% of the CAD cases¹¹. Studies in India and Pakistan also showed that triple-vessel disease was the predominant finding^{7,12}.

Our study showed that for anatomical distribution, the highest incidence of CAD involved the LAD, followed by equal incidence of RCA and LCX. These findings were consistent with the findings of a local study of living patients with CAD using angiogra-

**Fig. 3.** Manifestation of coronary artery atherosclerosis in natural death group of all subjects

phy¹³. Other studies also showed that LAD is the most commonly affected vessel^{3,9,14}. This phenomenon may be a result of the positive association between blood pressure and coronary atherosclerosis, as reported by many authors¹⁴. Generally, the left coronary artery (LCA) system has different hemodynamics compared to the RCA system. During diastole, blood flow in LCA is dominant, which is a major difference, suggesting that diastolic blood pressure is one of the risk factors for atherosclerosis¹⁴.

Klang Valley is the most populous and developed area in Malaysia, home to Malaysians as well as millions of immigrants. The study results may reflect the CAD patterns in the urban population of the country. Rapid socioeconomic growth in developing countries is strongly associated with increasing exposure to CAD risk factors, such as diabetes, hypercholesterolaemia, hypertension, and smoking^{8,11,15}. At the molecular level, 157 genomic loci have been identified to be associated with hypercholesterolaemia, and 46 loci are associated with CAD. In translation, mutations at the specific loci may increase 12–14% rate of heritability for hypercholesterolemia and 10% rate of heritability of CAD¹⁶.

Study Limitations

As the subjects in the present study were medico-legal post mortem cases, our findings may not reflect the actual patterns of coronary atherosclerosis in the country. In the local setting, most natural deaths would go by without autopsies. Large number of immi-

grants who were included in this study is also a limiting factor as it may not reflect the true pattern of atherosclerosis in the Malaysian population.

Conclusion

Cardiac diseases were the leading natural causes of sudden death in our population in individuals aged >20 years and in the category of young adults, contributing to almost 75% of cases. CAD was the single most commonly encountered pathology within the SCD. Single and double-vessel diseases had the same frequency, both in all the subjects as well as the young adult population. LAD by far, was the most commonly affected vessel.

Ethical Approval

The protocol was approved by the Research Ethics Committee, Universiti Teknologi MARA [600-RMI (5/1/6/01)] and Medical Research & Ethics Committee, MOH Malaysia [NMRR-11-1135-10262].

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Conflict of Interest

None.

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