SUDDEN UNEXPECTED DEATHS IN DIFFERENT AGE GROUPS AT RAMATHIBODI HOSPITAL, BANGKOK, THAILAND: A RETROSPECTIVE AUTOPSY STUDY DURING 2003-2007

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Abstract. A sudden unexpected death is considered one type of medico-legal death in Thailand. In some studies, it comprises up to 50-60% of all medico-legal deaths. In this retrospective study, data were collected from 1,460 cases of sudden unexpected deaths, 39.9% of all deaths in which a medico-legal autopsy had been carried out. The study was conducted over a 5-year period from January 2003 to December 2007. There were 1,009 males and 451 females (M:F ratio = 2.2:1). The mean age was 55.3±0.98 years. The peak age group was the 46-60 years accounting for 28.2% of cases. The most common cause of death in all age groups was coronary atherosclerosis. Understanding epidemiological autopsy data is vital for determining the characteristics of the population involved.

INTRODUCTION

In Thailand, sudden unexpected death is considered a type of medico-legal death for which it is necessary to find the cause of death. However, many cases do not have reliable medical documents regarding underlying diseases that can help to explain the cause of death. There are also limitations in performing an autopsy, especially in rural areas. External examination for diseases often results in negative findings. The problem occurs when the cause of death cannot be determined but the record has to be completed. The common terms used to describe causes of death are "heart failure" or "cardiopulmonary arrest" which may not be the real cause. This inaccurate information is subsequently sent to the Ministry of Public Health for analysis and planning for the national public health policy.

A thorough review of the literature revealed no information regarding the causes of sudden unexpected death in Thailand. We reviewed death certificate data for 1967-2003. During the past 3 years, the most common causes of death were acquire immune deficiency syndrome, malignant neoplasms, accident, heart diseases and tuberculosis (Thai Ministry of Public Health, 2001-2004). However, in one previous study, by using verbal autopsy (by interviewing a close caregiver or witness to elicit signs and symptoms at the terminal time period and find out the probable cause of death by medical practitioners), they found that the correlation between verbal autopsy and the causes of death from the death certificate data was only 29.3% (Thai Ministry of Public Health, 2001-2004). Moreover, a verbal autopsy cannot compare with a medico-legal autopsy,

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known as the ultimate method to determine the cause of death.

Sudden unexpected death, especially when it occurs in an apparently healthy child or young adult can have a great impact on society in general and particularly on the medical community. Therefore, epidemiological autopsy-based data regarding the causes of sudden death is important to determine the characteristics of the population involved and to develop future national public health policies.

MATERIALS AND METHODS

The study material was comprised of all medico-legal cases sent to the Forensic Division, Department of Pathology, Ramathibodi Hospital during the 5-year period January 2003 to December 2007. All deaths were investigated and routine autopsy examinations were performed. Histological, alcoholimetric and toxicological investigations revealed were carried out to determine that deaths from natural causes were included. We excluded all non-live births (aborted fetuses, intra-uterine deaths and still births) and those whose age could not be determined (Fig 1). The data was collected and analyzed (SPSS program, version 14th). Information obtained included study year, gender, age at death and cause of death.

RESULTS

A total of 3,655 medico-legal cases were collected over the 5-year study period, 2,047 of these had an unknown cause of death. However, some cases had previous reliable medical documents about their underlying diseases to explain the cause of death. Some were Muslim, wherein an autopsy is prohibited by Islamic faith, so the autopsy was not performed in these groups. In some cases, there was an unnatural cause of death or a non-live birth. After excluding these cases, 1,460 cases remained, for which data was obtained and evaluated. There were 1,009 males and 451 females (M:F ratio 2.2:1). The age range was 1 day - 97 years (mean 55.3± 0.98 years).

The numbers of cases per year during the study period are shown in Fig 2. The age and sex distribution of the cases are shown in Fig 3. Deaths were the most prevalent in the 46-60 year old age group (28.2%) followed by the 31-45 year old age group (21.6%). Males out-numbered females in all age groups except for the >75 year old age group in which females predominated.

The causes of death are summarized by organ systems and major categories in Table 1. The specific causes related to organ systems are detailed in Table 2. Deaths arising from problems in the cardiovascular system (CVS) accounted for 44.7% of cases (*n*=652). The most common cause of death was coronary atherosclerosis, accounting for 61.8% of CVS deaths and 27.6% of all deaths. Hypertensive cardiovascular disease (HTCVD) ranked second in this category and caused

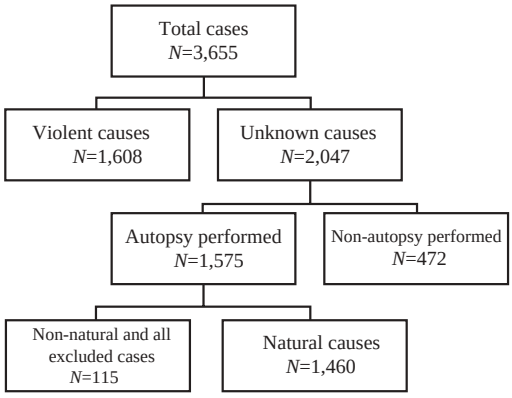

Fig 1–Distribution of medico-legal cases evaluated at the Forensic Division, Ramathibodi Hospital from 2003 to 2007.

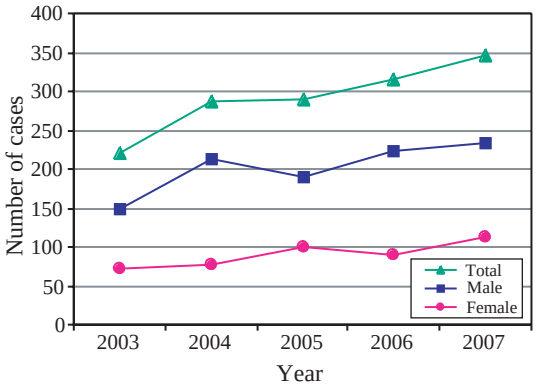

Fig 2–The number of autopsies in sudden natural death cases over the 5-year study period.

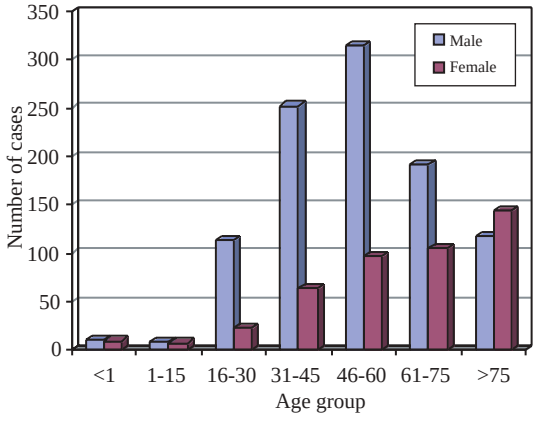

Fig 3–Age and sex distribution of autopsy cases performed for sudden natural death over the 5-year study period.

17.6% of CVS deaths. This was followed by respiratory system deaths in 16.4% of cases. Pneumonia was the second most common cause of death overall (49.2% of respiratory-related deaths and 8.1% of all deaths). Deaths due to gastro-intestinal system illness (GI) and central nevous system illness (CNS) accounted for 10.7% and 7.6% of all deaths, respectively. The most frequent causes of death in these two systems were cirrhosis and cerebrovascular accident (CVA), respectively.

Table 1
Cause of death by major categories and systems.

Cause of death	Number of deaths	% of all deaths
CVS	652	44.7
Respiratory system	240	16.4
Gastrointestinal system	156	10.7
CNS	111	7.6
Genitourinary system	51	3.5
Lymphoreticular system	5	0.3
Others	32	2.2
Undetermined cause	213	14.6
Total	1,460	100.0

CVS, cardiovascular system; CNS, central nervous system.

In 213 cases (14.6% of all deaths), autopsy found no pathological abnormalities sufficient to cause death. The age groups with the most unexplained deaths were 31-45 and 16-30 years old (in 35.2% and 31.9% of all unexplained deaths, respectively). Males were more likely to have an unexplained death than females (M:F ratio 3.8:1). The mean age of unexplained death was 41.6±2.62 years (mean age in males 37.4 years, in females 57.8 years).

DISCUSSION

Sudden unexpected death was the most common indication for medico-legal autopsies in our study (56% of all cases), similar to findings in the USA, England and Nigeria, which comprised about 50-60% of all unnatural deaths (Hirsch, 1994; Knight, 1996; Amakiri *et al*, 1997; Escoffery and Shirley, 2002). This study represented the first review of causes of sudden death as evaluated by medico-legal autopsy performed at Ramathibodi Hospital. During the 5-year study, the number of cases gradually

Table 2
Cause of death by major categories and subcategories.

Major category and subcategories	Number of deaths			% of major category	% of all deaths (*N*=1,460)
	M	F	Total		
Cardiovascular system	459	193	652		44.7
Coronary atherosclerosis	285	118	403	61.8	27.6
HTCVS	81	34	115	17.6	7.9
Cardiomyopathies	40	9	49	7.5	3.4
Aortic aneurysm/dissection	21	16	37	5.7	2.5
Vulvular heart diseases	10	6	16	2.5	1.1
Carditis	7	8	15	2.3	1.0
Congenital heart diseases	8	1	9	1.4	0.6
Coronary abnormalities	7	1	8	1.2	0.5
Respiratory system	159	81	240		16.4
Pneumonia	75	43	118	49.2	8.1
Tuberculosis	42	13	55	22.9	3.8
COPD	23	4	27	11.3	1.8
Respiratory tract carcinoma	13	11	24	10.0	1.6
Pulmonary embolism	3	6	9	3.8	0.6
Asthma	3	3	6	2.5	0.4
Amniotic embolism	0	1	1	0.4	0.1
Gastrointestinal system	109	4 7	156		10.7
Cirrhosis	27	7	34	21.8	2.3
GI hemorrhage	17	8	25	16.0	1.7
GI carcinoma	13	7	20	12.8	1.4
Hepatobiliary carcinoma	13	7	20	12.8	1.4
Pancreatitis	14	4	18	11.5	1.2
Fatty liver[a]	11	5	16	10.3	1.1
Perforate ulcers	5	2	7	4.5	0.5
Hepatobiliary infection	4	2	6	3.8	0.4
Others	5	5	10	6.4	0.7
Central nervous system	81	30	111		7.6
Cerebrovascular accidents	69	23	92	82.9	6.3
Sudden death in Epilepsy	6	2	8	7.2	0.5
Meningitis	5	0	5	4.5	0.3
Brain abscess	1	2	3	4.5	0.3
Brain tumors	0	2	2	1.8	0.1
Congenital malformations	0	1	1	0.9	0.1
Genitourinary system	20	31	51		3.5
Acute pyelonephritis	13	11	24	47.1	1.6
Cervical carcinoma	0	7	7	13.7	0.5
Urinary tract carcinoma	3	3	6	11.8	0.4
ESRD	2	4	6	11.8	0.4
Ectopic pregnancy	0	2	2	3.9	0.1
Septic abortion	0	2	2	3.9	0.1
Prostatic carcinoma	2	0	2	3.9	0.1
Ovarian carcinoma	0	1	1	2.0	0.1
Infantile polycystic kidney disease	0	1	1	2.0	0.1

Table 2 (continued).

Major category and subcategories	Number of deaths			% of major category	% of all deaths (*N*=1,460)
	M	F	Total		
Lymphoreticular system	0	5	5		0.3
DIC	0	2	2	40.0	0.1
Lymphoma	0	1	1	20.0	0.1
β-thalassemia major	0	1	1	20.0	0.1
SLE	0	1	1	20.0	0.1
Other systems	12	20	32		2.2
Carcinoma	8	14	22	68.8	1.5
Skin/subcutaneous infection[b]	4	6	10	31.3	0.7
Undetermine cause of death	169	44	213		14.6
Total	1,009	451	1,460		100.0

HTCVS, hypertensive cardiovascular disease; COPD, chronic obstructive pulmonary disease; GI, gastrointestinal; ESRD, end stage renal disease; DIC, disseminated intravascular coagulation; SLE, systemic lupus erythematosus.

[a]The mechanism(s) of sudden fatty liver death is (are) unknown but it has been postulated to be due to metabolic/electrolyte imbalance.

[b]This group included many causes such as infected decubitus ulcers, cellulitis, necrotizing fasciitis, gangrene etc.

increase yearly. The mean age of the cases in this series was 55.3±0.98 years with about one half of the cases being between 31 and 60 years of age.

The most common categories of natural death were CVS, respiratory, GI and CNS diseases with the commonest causes being coronary atherosclerosis, pneumonia, HTCVD, CVA and tuberculosis. Other important causes of death were sequelae from alcohol consumption and smoking, such as cirrhosis, pancreatitis and chronic obstructive pulmonary disease (COPD). The number of coronary atherosclerosis cases increased in number every year. Coronary atherosclerosis was the most prevalent in the 46-60 year old age group (13.4% of all deaths) with a mean age of 63.3±1.48 years (mean age of males 60.0 years, females 71.5 years) but the trend tended toward involving younger cases. Pneumonia was common in all age groups but there was a higher prevalence in the elderly age group, while HTCVD, CVA and tuberculosis occurred more commonly in the older adult group (46-60 years old).

Our findings are similar to those in developed countries in which leading causes of sudden natural death were CVS-related disease followed by diseases of the respiratory systems (Di Maio, 1991; Amakiri *et al*, 1997; Thomus *et al*, 1998; WHO, 2003). Ischemic heart disease is the commonest cause of sudden death in developed countries (Di Maio, 1991; Thomus *et al*, 1998). Information regarding co-morbid conditions was not collected in this study, therefore, the contribution of some of these diseases, such as mild to moderate coronary atherosclerosis, HTCVD or tuberculosis, to the overall number of deaths was probably greater than that documented.

Information regarding the causes of death obtained from death certificate data for Thailand (not autopsy-based) in 2001-2003 revealed the most common causes of death were acquired immune deficiency syndrome (AIDS), malignant neoplasms, accidents, heart disease and tuberculosis (Thai Ministry of Public Health, 2001-2004). These are different than our findings. This may be explained by the fact that we excluded many cases which had previous reliable medical documents about the patient's underlying diseases and hence an autopsy was not performed in this study. Our results reflect diseases that attack rapidly without a previous diagnosis. Future national public health policies should consider these diseases and ways to prevent or recognize them early.

In some cases, the cause of death was unexplained on autopsy. This is similar to previous reports (Neuspiel and Kuller, 1985; Topaz and Edwards, 1985; Anderson *et al*, 1994; Shen *et al*, 1995). About 10-20% of sudden deaths have an unexplained cause (Neuspiel and Kuller, 1985; Burke *et al*, 1991; Anderson *et al*, 1994; Corrado *et al*, 1994; Shen *et al*, 1995; Cohle and Sampson, 2001). The most common age group with unexplained cause is adolescents. There were 213 cases with undetermined cause of death in our study. This comprised about 14.6% of all sudden deaths. The younger adult group was the most prevalent; 67.1% of all unexplained deaths occurred in the 16-45 year old age group; males were more commonly affected (M:F ratio 3.8:1). The cause of death in this group could be related to cardiac arrhythmias without previously diagnosed heart disease (Topaz and Edwards, 1985; Myerburg, 1997; Myerburg *et al*, 1997; Nademanee, 1997; Suárez-Mier and Gamallo, 1998).

In summary, natural causes of sudden death accounted for the majority of medico-legal autopsies conducted at the Forensic Division, Department of Pathology, Ramathibodi Hospital. This provides important data regarding the causes of death in the Thai population. While the spectrum of diseases encountered was similar to many developed countries, this may not represent the whole country since our study gathered data from Bangkok, the capital city. These findings may be significantly different for rural areas. Collation of medico-legal autopsy data from all part of the country would provide an invaluable epidemiological data for the planning of national public health policies.

REFERENCES

Amakiri CNT, Akang EEU, Aghadiuno PU, Odesanmi WO. A prospective study of coroner's autopsies in University College Hospital, Ibadan, Nigeria. *Med Sci Law* 1997; 37: 69-75.

Anderson RE, Hill RB, Broudy DW, Key CR, Pathak AD. A population-based autopsy study of sudden, unexpected deaths from natural causes among persons 5–39 years old during a 12-year period. *Hum Pathol* 1994; 25: 1332-40.

Burke AP, Farb A, Virmani R, Goodin J. Sports-related and non-sports-related sudden cardiac death in young adults. *Am Heart J* 1991; 121: 568-75.

Cohle SD, Sampson BA. The negative autopsy : sudden cardiac death or other? *Cardiovasc Pathol* 2001; 10: 219-22.

Corrado D, Basso C, Poletti A, Angelini A, Valente M, Thiene G. Sudden death in the young. Is it acute coronary thrombosis the major precipitating factor? *Circulation* 1994; 90: 2315-23.

Di Maio VJM. Natural death as viewed by the medical examiner : a review of 1000 consecutive autopsies of individuals dying of natural disease. *J Forensic Sci* 1991; 36: 17-24.

Escoffery CT, Shirley SE. Causes of sudden natural death in Jamaica. *Forensic Sci Int* 2002; 129: 116-21.

Hirsch CS. Forensic pathology and the autopsy. *Arch Pathol Lab Med* 1994; 108: 484-9.

Knight B. Forensic pathology. London: Arnold, 1996: 497.

Myerburg RJ. Sudden cardiac death in persons with normal (or near normal) hearts. *Am J Card* 1997; 79: 3-9.

Myerburg RJ, Interian A, Mitrani RM, Kessler KM, Castellanos A. Frequency of sudden cardiac death and profiles of risk. *Am J Cardiol* 1997; 80: 10-9.

Nademanee K. Sudden unexplained death syndrome in Southeast Asia. *Am J Cardiol* 1997; 79: 10-1.

Neuspiel DR, Kuller LH. Sudden and unexpected natural death in childhood and adolescence. *JAMA* 1985; 254: 1321-5.

Suárez-Mier MP, Gamallo C. Atrioventricular node fetal dispersion and His bundle fragmentation of the cardiac conduction system in sudden cardiac death. *J Am Cardiol* 1998; 32: 1885-90.

Shen W, Edwards WD, Hammill SC, Bailey KR, Ballard DJ, Gersh BJ. Sudden unexpected nontraumatic death in 54 young adults; a 30-year population-based Study. *Am J Cardiol* 1995; 76: 148-52.

Thai Ministry of Public Health, 2001-2004: 175-8.

Thomus AC, Knapman PA, Krikler DM, Davies MJ. Community study of the causes of ″natural″ death. *BMJ* 1998; 297: 1453-6.

World Health Organization. The World Health Report 2003. Chapter Six. Neglected global epidemics. Geneva: World Health Organization, 2003.

Topaz O, Edwards JE. Pathological features of sudden death in children, adolescents, and young adults. *Che*st 1985; 87: 476-82.