A case control study on autopsy findings in sudden unexplained nocturnal death syndrome

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ABSTRACT

Aim Sudden unexplained nocturnal death syndrome (SUNDS) has been linked to the Brugada syndrome. In some places, acute haemorrhagic pancreatitis is widely held to cause it. We conducted a systematic, controlled autopsy study on Filipino SUNDS victims to rule out structural heart findings as well as acute haemorrhagic pancreatitis as causes.

Methods and results A case control autopsy study was conducted comparing SUNDS victims between 18 and 50 years of age who died within 1 h of symptom onset with age- and gender-matched controls. There were 24 SUNDS (mean age 34.5 years) and 24 controls (mean 32.7 years). The autopsy incidence of structural heart disease was 8.3% (95% CI (1% to 27%)) and focal pancreatic haemorrhage was 4.17% (95% CI (0.1% to 20%)) but zero for true acute haemorrhagic pancreatitis among SUNDS victims. Autopsy findings in SUNDS versus controls were not significantly different from each other, showing no diagnostic abnormality in any of the organs. There was no significant difference in the incidence of acute haemorrhagic pancreatitis in both the SUNDS and control groups. We did not find fetal dispersion of the atrioventricular (AV) node, sclerosis or fibrosis of the AV conduction system, in a substudy of SUNDS cases.

Conclusions We have shown that there is no significant difference in the overall autopsy findings between SUNDS and controls. Autopsy findings were normal in 70% of SUNDS; no cardiac structural pathology was found in 87% of cases. Haemorrhagic pancreatitis is the cause of death in a minority of SUNDS. The cardiac conduction system is normal in a subgroup of SUNDS studied.

INTRODUCTION

Sudden unexplained nocturnal death syndrome (SUNDS) was first described in 1917. It is prevalent in Southeast Asia, colloquially called *Bangungut* (Philippines), *Pokkuri* (Japan) and *Lai-tai* (Thailand).¹⁻⁴

The victims are healthy and die during sleep, following agonal respiration. Most are young men (35.9 ± 7.8 years). Overall, 40% runs in families, 18% having a similarly affected sibling. The incidence peaks between March to May and September to October. The death rate is 26 per 100 000 persons per year.^{1 2} In the USA (1977–1982), the incidence of SUNDS was 92, 82 and 59 per 100 000 person years among Hmong, Laoatian and Kampuchean refugees, respectively.⁵ In the Philippines, it was 43 per 100 000 person years;⁶ in the West, the incidence is 0.16 per 100 000 person years.⁷ Several aetiologies have been proposed to explain SUNDS including hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia (ARVD), long QT syndrome and, prominently, Brugada syndrome.^{2 8 9} Others have suggested, however, that SUNDS and Brugada Syndrome are phenotypically, genetically and functionally the same.²

We have found the Brugada type 1 ECG pattern in 0.2% of the Philippine general population.⁹ We have found that asymptomatic individuals with this ECG pattern have a 6%–84% chance of developing syncope, presyncope or sudden death in 4 years.¹⁰ What remains unclear is whether SUNDS is a homogenous group, with no structural heart findings and with probable primary electrical disease of the heart, or whether a subset may be from rarer forms of primary myocardial disease such as hypertrophic cardiomyopathy or ARVD.

SUNDS is widely held in the Philippines to be due to haemorrhagic pancreatitis. This belief stemmed from autopsy studies done on Filipino migrants in Hawaii in the 1940s,¹¹ where autopsy diagnoses heavily relied on gross pathological findings.

The objective of this study was to compare autopsy findings among Filipino SUNDS victims versus age- and sex-matched controls. In particular, the following were compared: (1) overall autopsy findings; (2) cardiac structural abnormality; and (3) acute haemorrhagic pancreatitis. The autopsy incidence of structural heart disease and acute haemorrhagic pancreatitis among the SUNDS group was also measured. A subgroup of the first five patients underwent a detailed study of the conduction system.

SUBJECTS AND METHODS

This was a case control autopsy study of SUNDS among Filipinos. Subjects 18–50 years of age who died suddenly during sleep (within an hour after onset of symptoms) or after a traumatic event referred to the Pathology Department of the University of the Philippines College of Medicine or the Philippine National Police (PNP) for an autopsy from 1 January 2009 to 31 December 2011 were screened using a questionnaire. We excluded cases with history of cardiac, pulmonary or seizure disorder.

The study complied with the Declaration of Helsinki, was locally approved by the University ethics committee and informed consent was obtained from the relatives of the subjects.

We targeted enrolment of 30 healthy subjects who died during sleep and within an hour of the onset of symptoms into the SUNDS group and 30



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healthy age- and gender-matched trauma cases into the controls. Sample size was determined by the estimated volume of autopsies performed at the PNP Crime Laboratory.

A urine screen for methamphetamine/amphetamine, cannabinoids, opiates, cocaine, barbiturates, phencyclidines and benzodiazepines was conducted.

Autopsy findings

Complete autopsies were performed at both morgue facilities, where sections of the brain, lungs, liver, spleen, kidneys and the whole heart and pancreas were retained. Myocardial hypertrophy was defined as the gross finding of right ventricular or left ventricular thickness of more than 0.5 or 1.5 cm, respectively. Enlargement of the myocardial nuclei with squaring off of its edges was listed as 'hypertrophic changes'. Cases which showed no diagnostic gross or microscopic findings or nonspecific changes such as visceral congestion or mild portal triaditis of the liver were categorised as non-significant findings. Haemorrhages in the pancreas were described as such. A diagnosis of acute haemorrhagic pancreatitis was made only when the haemorrhage was accompanied by necrosis of pancreatic tissue, enzymatic fat necrosis and/or acute inflammation. All samples including that of the cardiac conduction system were examined grossly and microscopically by two independent blinded pathologists.

Study of the cardiac conduction system

The cardiac conduction system was studied in the first five SUNDS and control cases based on the method described by Suarez-Mier and Gamallo.¹² A 1–1.5 sq.cm block of right atrial tissue at the region of the sulcus terminalis was procured and embedded in paraffin. A second block was taken between the coronary sinus and the medial papillary muscle of the right ventricle. Additional sections from areas contiguous areas were taken as needed. Random samples were taken from the His bundle and bundle branches from the remaining subjects. We checked for fetal dispersion of the atrioventricular (AV) node; septation of the His bundle; fibrosis, necrosis and arteriosclerosis of the sinus node, AV node, His bundle, and the proximal bundle branches. Persistent fetal dispersion was defined as islands of conduction tissue separated from the AV node and dispersed in the central fibrous body. Septation of the His bundle is characterised by fragmentation of the main His bundle which form loops in certain cases.¹²

Statistical analysis

 χ^2 Test for 2×2 table was used to compare whether the proportions in the two groups (control vs SUNDS) were equal where p1 is the proportion in the control group having characteristic of interest and p2 is the proportion in the SUNDS group having the characteristic of interest. α Is 0.05 with two tailed 95% CI.

Confounding was addressed through randomisation and matching. The model used did not involve any interaction between or among variables. There were no significant missing data. Each SUNDS case was matched with the same age and sex control. No sensitivity analysis was performed.

RESULTS

In all, 57 potential cases were identified at the PNP Crime Laboratory (27 SUNDS, 30 controls). Three were excluded from the SUNDS group because of poor tissue fixation of histopathological samples; six were excluded from the controls, (five due to lack of a reliable informant, one due to poor tissue

Table 1 Demographics and medical history

	SUNDS group	Control group	p Value
Total number	24	24	
Age, years (mean±SD)	32.71±11.01	34.54±9.3	0.952
% of males	91.7%	91.7%	1.00
Previous syncope	1 (4.2%)	0	0.312
Severe abdominal pain before death	0	0	
Symptoms of heart failure	0	0	
Anginal symptoms	0	0	
First-degree relative with sudden death	4 (16.7%)	0	0.036
Sudden death during sleep	24 (100%)	0	0.000

There are no significant difference in mean age and proportion of male respondents in the study, indicating matched group. All tests use significance level of 0.05. SUNDS, sudden unexplained nocturnal death syndrome.

fixation). Hence, 24 SUNDS and 24 controls were included in the study.

The mean ages were 32.7 and 34.5 years in the SUNDS and controls, respectively; 91.7% were men in both groups. Previous syncope was noted in 4.2% of SUNDS; 16.7% had a first-degree relative who died suddenly, significantly more than in controls (p=0.036). Severe abdominal pain before death, heart failure symptoms or angina was not reported for either group. The toxicological screens were negative for both groups (table 1). Blood chemistries including liver chemistries were not available for all cases since all patients were dead on arrival.

Overall autopsy findings

The gross and microscopic findings in both the SUNDS and controls were not significantly different from each other showing no diagnostic abnormality in any of the organs in 70.8% and 54.2% of the SUNDS and control groups, respectively (table 2).

Cardiac findings

The autopsy, however, was diagnostic or suggestive of a structural cardiac pathology in 12.5% (95% CI 2.6% to 32.3%) and 25% of the SUNDS and controls, the difference of which was not statistically significant. In the SUNDS group, one had evidence of coronary arteriosclerosis, one had fibrofatty changes consistent with ARVD and one had chronic myocarditis. No findings of hypertrophy were found in the SUNDS group (table 2).

Study of the pancreas

Gross examination revealed significantly more haemorrhages in the SUNDS (37.2%) versus controls (4.2%) (p=0.0045). However, on histopathological examination only 4.2% (95% CI 0.1% to 20%) of the SUNDS group had haemorrhages versus 8.3% of the controls (p=NS). None of the SUNDS group had necrosis diagnostic of true acute haemorrhagic pancreatitis (table 3). The lone SUNDS case with focal pancreatic haemorrhage had pulmonary and splenic haemorrhages.

Extracardiac findings

Pulmonary haemorrhage was found in 3 (12.5%) of the SUNDS group compared with 6 (25%) of controls, while the majority showed non-specific congestion or oedema. There were significant liver (p=0.018) and kidney (p=0.004) histological findings

	Table 2	Frequency of	gross and	microscopic	autopsy	findings
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Autopsy findings (gross and microscopic)	SUNDS group (n=24)	Control group (n=24)	Total	p Value
No significant findings in all organs	17 (70.8%)	13 (54.2%)	30 (62.5%)	0.233
With diagnostic abnormality	7 (29.2%)	11 (45.8%)	18 (37.5%)	0.233
Cardiac	3/24 (12.5%)	6/24 (75%)		
Coronary arteriosclerosis	1 (4.2%)	1 (4.2%)	2 (4.2%)	1.0
Valvular defects	0	0	0	
Hypertrophy/dilatation	0	0	0	
RV dysplasia	1 (4.2%)	0	1 (2.1%)	0.312
Miscellaneous cardiac findings				
Large fibrosis	0	2 (8.3%)	2 (8.3%)	0.149
Chronic myocarditis	0	1 (4.2%)	1 (4.2%)	0.312
Myocardial haemorrhages	0	2 (8.3%)	2 (8.3%)	0.149
Old infarct	1 (4.2%)	0	1 (4.2%)	0.312
No significant cardiac findings	20 (87.5%)	18 (75%)	38 (79.2%)	
Gastrointestinal				
Haemorrhagic changes in the pancreas	1 (4.2%)	2 (8.3%)	3 (6.3%)	0.149
No significant gastrointestinal findings	23 (95.8%)	22 (91.7%)	45 (93.7%)	-0.551
Lung				
Haemorrhages*	3 (12.5%)	6 (25%)	9 (18.8%)	0.551
Miscellaneous lung findings				
Tuberculosis	0	1 (4.2%)	1 (4.2%)	0.312
Emphysematous changes	0	2 (8.3%)	2 (8.3%)	0.149
RDS	0	1 (4.2%)	1 (4.2%)	0.312
Pneumonitis	1 (4.2%)	0	1 (4.2%)	0.312
No significant lung findings	19 (79.2%)	14 (58.3%)	33 (68.75%)	0.119
Brain				
Subarachnoid haemorrhage*	1 (4.2%)	5 (20.8%)	6 (12.5%)	0.081
No significant brain findings	23 (95.8%)	19 (79.17%)	42 (87.5%)	
Liver				
Haemorrhages*	0	1 (4.2%)	1 (2.1%)	-0.018
Miscellaneous (schistosomiasis, hepatitis, cirrhosis, portal triaditis)	0	5 (20.8%)	5 (10.4%)	0.018
No significant liver findings	24 (100%)	18 (75%)	42 (87.5%)	0.009
Spleen				
Haemorrhages*	2 (8.3%)	2 (8.3%)	4 (8.3%)	-0.009
No significant splenic findings	22 (91.7%)	22 (91.7%)	44 (91.7%)	-1.0
Kidney				
Haemorrhages*	0	1 (4.2%)	1 (2.1%)	
Miscellaneous (CPN, ATN, lymphocytic aggregates)	1 (4.2%)	11 (45.8%)	12 (25%)	0.001
No significant kidney findings	23 (66.7%)	12 (45.8%)	35 (72.9%)	0.004

The alternative hypotheses are inequality of proportions. All tests use significance level of 0.05. There are four significant results.

Lines in bold are the summary of all findings.

*Statistical analysis to compare the two groups not done due to the history of trauma for the control group. ATN, acute tubular necrosis; CPN, chronic pyelonephritis; RDS, respiratory distress syndrome; RV, right ventricular; SUNDS, sudden unexplained nocturnal death syndrome.

among controls (table 2). Further, subarachnoid haemorrhage was found in 1 (4.2%) while splenic haemorrhage in 2 (8.3%) of SUNDS victims.

Conduction system findings

A detailed study of the cardiac conduction system in five SUNDS versus five controls showed no fibrosis, necrosis or arterial sclerosis in the sinus node, AV node, His bundle, and proximal bundle branches. There was no fetal dispersion of the AV node or septation of the His bundle in all of the cases (table 4).

DISCUSSION

SUNDS is a condition that has caught the attention of many because it affects healthy young individuals. In the UK, its incidence is 0.16 per 100 000,7 among youngsters in the West it is 1-5 per 100 000¹³ ¹⁴ and in the Philippines it is 43 per $100\ 000.^{6}$

Autopsy studies on SUNDS reveal structural heart disease in 70% while the remaining 30% had normal findings.¹⁵ In another series, a third of cases, likewise, had grossly normal hearts; however, 79% of this group on microscopic examination were reclassified to have structural heart disease, while the remaining case had mild cardiac fatty infiltration, hypertrophy or focal inflammation.¹⁶ In our series, the proportion is reversed with 70% of SUNDS having structurally normal hearts.

Overall autopsy findings in SUNDS

Our data show that there was no significant gross or morphological finding across all organ systems to account for SUNDS. There was no difference in the rate of arteriosclerosis or valvulopathy or cardiomyopathy in both groups nor was there was any hypertrophy. This suggests that hypertrophic cardiomyopathy may not be a significant aetiology. We have a very high rate (70%) of sudden deaths with normal autopsy findings. This is in

Table 3 Fi	requency of	findings	related	to	the	pancreas
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	CONTROL (n=	24)	p Value	
Microscopic	Gross	Microscopic	Gross	Microscopic
1 (4.2%)	1 (4.2%)	2 (8.3%)	0.0045	0.551
	Microscopic 1 (4.2%) 0	Microscopic Gross 1 (4.2%) 1 (4.2%) 0 0	Microscopic Gross Microscopic 1 (4.2%) 1 (4.2%) 2 (8.3%) 0 0 1 (4.2%)	Microscopic Gross Microscopic Gross 1 (4.2%) 1 (4.2%) 2 (8.3%) 0.0045 0 0 1 (4.2%) 1 (4.2%)

The alternative hypothesis is inequality of proportions computed from Gross and Microscopic counts in both groups. All tests use significance level of 0.05. SUNDS, sudden unexplained nocturnal death syndrome.

SUNDS, sudden unexplained nocturnal death syndrome.

contrast with data from the West and Australia where only 5%–6% of sudden death cases were associated with structurally normal hearts. $^{16\ 17}$

Interestingly, one of the SUNDS victims showed ARVD, while one showed signs of coronary artery disease, three had pulmonary haemorrhage and one had subarachnoid haemorrhage. It is possible that a small proportion (12.5% (95% CI 2.6% to 32.3%)) of SUNDS may be attributed to ARVD or coronary artery disease. In our series, SUNDS may indeed be a clinically heterogenous group, with 70% having normal autopsy findings and 30% with the various pathologies. Corrado *et al* described 60 young victims with apparently normal heart on autopsy but on closer examination revealed focal myocarditis in 27, right ventricular (RV) dysplasia in nine and conduction system diseases in 24.¹⁶ However, in this series, none of the sudden deaths among the RV dysplasia victims occurred during sleep, although seven out of the nine occurred with sedentary activity, while 21 out of 27 myocarditis victims' deaths occurred at rest.¹⁶

Pulmonary haemorrhages were found in a considerable 12.5% of SUNDS cases. One case with pulmonary haemorrhage had focal pancreatic haemorrhage. Pulmonary haemorrhage is one of the factors associated with sudden infant death syndrome (SIDS). Several case reports can be found in the literature of pulmonary haemorrhages linked to SIDS.^{18 19} In a study by Krous

Table 4 Cardiac conduction system analysis					
Variables	Control group	SUNDS group	Total		
Sinus node					
Fibrosis	0	0	0		
Necrosis	0	0	0		
Arterial sclerosis	0	0	0		
AV node					
Fetal dispersion	0	0	0		
Fibrosis	0	0	0		
Necrosis	0	0	0		
Arterial sclerosis	0	0	0		
His bundle					
Septation	0	0	0		
Fibrosis	0	0	0		
Necrosis	0	0	0		
Arterial sclerosis	0	0	0		
Proximal bundle branches	0	0	0		
Fibrosis	0	0	0		
Necrosis	0	0	0		
Arterial sclerosis					
Total	0	0	0		

All p values were computed using a two group comparison statistical procedure where a binomial distribution is assumed. Computations are carried out using Stata V.10.

SUNDS, sudden unexplained nocturnal death syndrome.

et al, intrathoracic petechiae was found in 291 out of 332 cases of SIDS.¹⁹ Whether it may play a role in SUNDS warrants further investigation.

Similarly, the significance of subarachnoid and splenic haemorrhages in a minority of cases needs to be further investigated.

Acute haemorrhagic pancreatitis and SUNDS

Acute haemorrhagic pancreatitis is widely believed to be the cause of SUNDS in the Philippines. This can be traced to studies by Majoska and Aponte on Filipino migrants in Hawaii¹¹ and Guam²⁰ in the 1940s where acute haemorrhagic pancreatitis was found in 21 of 28 and five of 11 cases, respectively.

Munger and Booton reviewed the death certificates of SUNDS cases in Manila (1948–1982).²¹ Most victims were males (96%) with a mean age of 33 years. Most deaths occurred between 01:00 and 04:00, in the months of December to January. Death certificate diagnosis of acute haemorrhagic pancreatitis increased from 22% in 1948 to 70% in 1982. These were apparently mostly issued without the benefit of a full autopsy (only gross pathology) and from the clinical history given by the deceased's next-of-kin.²¹

Tümer and Dener in a 10-year review found acute haemorrhagic pancreatitis in 0.36% of all medicolegal autopsies. Chronic alcoholic use was identified in a third of cases. The haemorrhage was confined to the head of the pancreas in three cases and involved the whole body in nine. While pulmonary congestion and haemorrhages were also found, no association between the two was established.²² Our series enrolled only sudden nocturnal death, hence dealing with a more specific population. We found focal pancreatic haemorrhage in one out of 24 cases or 4.2% (95% CI 0.1% to 20%) but no true acute haemorrhagic pancreatitis. Hence, even with a small population of 24, the 95% CI reveals that even at the extreme end of the spectrum, focal pancreatic haemorrhage appears to be a minor finding (at most 20%) of SUNDS. When the stricter criterion of necrosis was applied, none of the SUNDS were diagnosed with true acute haemorrhagic pancreatitis.

Shetty and colleagues found it in seven cases during a review of autopsies from 2004 to 2008 in Mangalore, India.²³ Sporadic case reports have linked acute haemorrhagic pancreatitis with sudden death although most of these did not occur during sleep and were associated with abdominal pain.^{24 25}

Gaw *et al* proposed that it was unclear whether pancreatitis is a result of normal postmortem changes in SUNDS.²⁶

Our data showed, for the first time, that there was no significant difference in the incidence of acute haemorrhagic pancreatitis in both the SUNDS and control groups using age- and gender-matched controls.

Interestingly, there seemed to be a discrepancy between the gross pathological reports of haemorrhages in the SUNDS group (37.2%) versus histopathological examination; true

haemorrhage was found in only one case (4.2%; 95% CI 0.1% to 20%). This discrepancy may be explained by a false positive gross pathological result. Postmortem lividity, congestion and autolysis may make the pancreas appear pink and lead to this misdiagnosis. Observer bias may have led to overdiagnosis. Our use of a control group and blinding controls observer bias. Histopathological examination, however, remains the gold standard for diagnosing haemorrhagic pancreatitis.

From these, haemorrhagic pancreatitis does not appear to be the dominant cause of SUNDS. This is contrary to common belief in the Philippines where pancreatitis is held to be the major cause of SUNDS.^{11 20 21}

Other autopsy studies done elsewhere confirm that haemorrhagic pancreatitis is not the cause of SUNDS. Aponte performed autopsies on 11 *bangungut* cases; 10 were Filipinos and showed cardiac dilatation, no evidence of pericarditis or myocarditis. The lungs showed pulmonary oedema with areas of ecchymosis. The pancreas was normal in two cases; four cases had postmortem autolysis; and five cases had interstitial pancreatitis. Grossly, the pancreas appeared red and swollen. Histologically, there was interstitial oedema with scattered acute inflammatory cells and fat necrosis. There was no evidence of true necrotising pancreatitis.²⁰

In Ontario, Canada, from 1992 to 1995, among Southeast Asian victims autopsied, the consistent finding was acute nonspecific pulmonary oedema and congestion.²⁷ Similar autopsy findings were seen in Thai migrants to Singapore. In addition, moderate to severe intra-alveolar haemorrhages with myocarditis or pneumonitis were also noted.²⁸ None reported any findings of pancreatitis.

Conduction and electrical system studies

Park and Weinstein reported normal autopsy and toxicological findings among Filipino migrant workers in the Marianas and proposed ventricular fibrillation as the cause of death.²⁹ Ventricular fibrillation has been documented in survivors of sudden unexplained death syndrome (SUDS). Among the SUDS survivors, electrophysiological markers include the Brugada sign and inducible VF.³⁰ These arrhythmias likely result from primary electrical diseases of the heart.

Beyond this, anomalies in the cardiac conduction system have been implicated as culpable aetiologies of SUDS.²⁸ ²⁹ Developmentally abnormal conduction system pathways have been seen in victims of SUDS.³ Persistent fetal dispersion of the atrioventricular node and/or bundle of His, accessory conduction fibre connections, and congenital heart block were described.⁴

Okada and Kawai reported that there are two types of sudden cardiac deaths. The sinus node-related type includes patients with Pokkuri disease and hypertensive heart disease. The AV conduction system-related type includes myocardial disease and ischaemic heart disease. Using Lev's method, the histological changes found in these two types include fibromuscular dysplasia of the sinus node artery and fibrosis and hypertrophy of the AV conduction system which were found among SUDS cases but not in controls.³¹

Corrado and coworkers in their series found clinically silent accessory pathways in 18 out of 60 victims and degenerative conduction system abnormality (Lev's or Lenegre's) in six out of 60.¹⁶

Our data from our five SUNDS cases, where detailed study of the conduction system was performed, do not show such findings. We found did not find fetal dispersion of the AV node, hypertrophy sclerosis, fibrosis of the AV conduction system, or dysplasia of the sinus node or AV node artery. There were no accessory pathways found. Our data are consistent with Suarez-Meir and Gamallo where unexplained sudden death cases did not show persistent fetal AV node dispersion or His bundle fragmentation compared with controls.¹² This finding is expected as the more commonly encountered cause of sudden unexplained death is from an arrhythmic cause not related to a structural heart problem or problem with the conduction system.

Sudden death in the setting of normal autopsies suggests an arrhythmic cause of death. This is probably from ventricular fibrillation, although a small proportion may be from severe bradycardia, commonly from severe conduction system disease.³⁰ Even less common would be seizure disorders which may present initially with sudden death if the seizure causes respiratory compromise. However, such are likely to present early in life, such as in the setting of SIDS.

Inborn channelopathies such as the Brugada syndrome and congenital long QT syndrome account for a significant proportion of sudden unexplained death. Conventional autopsies yield normal results, as we have seen in our study. Molecular autopsies may be useful in identifying the genes for long QT syndrome, Brugada syndrome and Catecholamnergic polymorphic ventricular tachycardia. Identification of probands will allow for screening of first-degree relatives, who may be at risk for sudden death.³²

The Brugada type 1 ECG pattern is found in 0.2% of the general population in the Philippines; furthermore, even initially asymptomatic individuals with this ECG pattern have a considerable event rate of 43% (95% CI 6% to 80%).⁹ ¹⁰ Hence, it is not unlikely that the Brugada syndrome is a major aetiology of SUNDS in the Philippines although further study is required to directly and definitively establish this.

SUMMARY

In summary, we have shown that there is no significant autopsy finding in all organ systems in the SUNDS versus the control group. Overall, 70% of SUNDS have normal autopsy findings and 87.5% have structurally normal hearts. There are no findings of cardiac structural pathology such as hypertrophy or valvulopathy. A subgroup of SUNDS cases studied showed normal cardiac conduction system. Focal pancreatic haemorrhages but not true haemorrhagic pancreatitis was found in a minority of SUNDS cases.

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