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Sudden cardiac arrest in the region of Lausanne: a 5 years consecutive observational study

Summary

During a 5-years consecutive observational study, we collected all out-of-hospital sudden cardiac arrests for which an emergency team was required on site in the Lausanne area. Data were collected and registered according to the recommendations of the Utstein committee.

There were 493 patients age: 68.5 ± 12 years, predominantly male (76%); the calculated mean annual incidence of out-of-hospital sudden cardiac arrest is 0.4‰. The majority of events occurred at home, in the presence of a witness, usually a family member, who rarely initiated resuscitation attempt. The interval from the collapse to the arrival of ambulance on site was 13 ± 8 minutes. Despite cardiopulmonary resuscitation attempts, 63% of the patients died on site, and only 9% were discharged alive after a hospital stay of 36 ± 30 days. Survival rate was better when the event occurred outside home, when a witness was present, when the witness was a healthcare professional, when cardiopulmonary resuscitation was initiated, and when ventricular tachycardia or ventricular fibrillation was documented as the first rhythm on site.

The 9% survival rate is globally similar to previously published data in Switzerland; this result confirms the absolute necessity for better information and general education on “how to resuscitate” to expect a significant improvement in the clinical outcome of patients victims of out-of-hospital sudden cardiac arrest.

Key words: out-of-hospital cardiopulmonary resuscitation; outcome

Résumé

Nous avons collecté de façon prospective pour une étude observationnelle et ce durant 5 années consécutives tous les arrêts cardiaques extra-hospitaliers dans la région lausannoise pour lesquels une équipe de réanimation a été sollicitée. La majorité des événements a eu lieu

à domicile, en présence d'un témoin – généralement un membre de la famille – qui a rarement initié les manœuvres de réanimation. L'intervalle entre le collapsus et l'arrivée de l'ambulance sur le site a été de 13 ± 8 minutes. Malgré la réanimation cardio-pulmonaire, 63% des patients décédaient sur place, et seuls 9% quittaient l'hôpital vivants après un séjour de 36 ± 30 jours. Le taux de survie était meilleur quand l'événement se déroulait à l'extérieur du domicile, quand le témoin était un professionnel de santé, quand la réanimation avait été débutée par les témoins, et lorsqu'une tachycardie ventriculaire ou une fibrillation ventriculaire avait été le premier rythme documenté sur place.

Les 9% de survie sont similaires aux données publiées précédemment en Suisse; ce résultat confirme la nécessité absolue d'une meilleure information et d'un enseignement généralisé sur les premiers gestes de la réanimation pour espérer une amélioration significative du taux de survie des victimes d'un arrêt cardiaque extra-hospitalier.

Mot-clefs: réanimation cardio-pulmonaire extra-hospitalière; taux de survie

Introduction

Sudden cardiac arrest (SCA) is the most common lethal manifestation of heart disease [1, 2]. The estimated annual incidence range varies from less than 200 000 to more than 450 000 death in the United States [3]; the annual number of SCA in Switzerland is close to 10 000, or one per hour [4]. Despite “call to act”, progress in our knowledge and effort in cardiopulmonary resuscitation (CPR), the sur-

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vival rate of out-of-hospital SCA remains poor [4]. Statistical and epidemiological data related to out-of-hospital SCA are scanty in our country [5, 6]: a retrospective analysis of pre-hospital resuscitation under urban conditions, performed during a consecutive period of nine years and published in 1995 showed that 12% of the studied population survived to hospital discharge. Bystander resuscitation before the arrival of the ambulance and ven-

tricular fibrillation (VF) on arrival in the emergency room were significant predictors of survival.

To evaluate the current situation in our city, we performed an observational study which collected all out-of-hospital SCA for which an emergency team or a physician was called on site in the Lausanne area, between 1997 and 2001.

Method

During a period of five consecutive years (1st January 1997 to 31st December 2001) all patients, victims of unexpected SCA, for whom an emergency team was required on scene in the Lausanne area (250 000 inhabitants), were collected and registered according to the recommendations of the Utstein committee [7, 8]. The Lausanne area encompasses urban, suburban and rural areas with a surface estimated to be 350 km². All patients were taken in charge by the ambulance system supervised by and under the responsibility of the emergency-unit medical staff of the University hospital of Lausanne (CHUV).

All witnessed and unwitnessed patients victims of out-of-hospital SCA more than 20 years old, and for whom an ambulance was called were included. Unwitnessed cases were included when circumstances suggested an unexpected event; SCA after a traumatic event, intoxication (medications, drugs), or in a terminal phase of a known chronic disease (*eg* cancer, heart failure) were excluded.

For all included SCA patients, information on age, gender, circumstances and time of the event were obtained from ambulance personnel, rescuer physician, family member or witnesses. Information related to time of events was collected whenever possible and included: call for the ambulance, start of reanimation, first registered rhythm, elapsed time to defibrillation shock. Furthermore, whenever possible, information on the medical history of the patient or on symptoms preceding the event was obtained from the physician, family members, or hospital charts. Clinical evolution of the patient during hospitalisation was followed using intra-hospital charts.

This study was approved by the local ethic committee. Data are presented as mean \pm SD. For continuous variable, the t-test (2-tailed) was applied to assess differences in means between groups; the χ^2 test was used for discrete variables.

Definitions

SCA was defined as the unexpected, non traumatic loss of vital sign in the absence of previous symptoms or within 24 hours of the onset of symptoms. This definition allows to include unwitnessed SCA for patients seen alive within 24 h of the event.

Witnessed SCA: occurred in presence of a bystander or of emergency medical personnel.

Unwitnessed SCA: the patient is alone at the moment of the event and is found unconscious or dead by a family member, a friend, or the emergency medical personnel.

This study was scheduled to be continued for several more years; it is published in 2008, a few years after the premature death of O. Moeschler, MD, co-initiator of this work.

Results

From January 1st, 1997, to December 31st, 2001, 493 patients having suffered an out-of-hospital SCA were recorded. There were 113 SCA in 1997, 93 in 1998, 93 in 1999, 89 in 2000 and 105 in 2001. Thus, the calculated mean annual incidence of out-of-hospital SCA in our study is 0.4 per 1000 inhabitants. The age of the studied population was 68.5 ± 12 years (28–87 y); there were 374 male (76%), aged 67.4 ± 12 years and 119 female (24%), aged 72.1 ± 11 years ($p < 0.002$).

Out-of-hospital SCA occurred mainly at home (64%), on street (15%), in a public place

(13%), in medical practice (3%) and at work (3%). Males were more frequently victims of SCA on street or at work and females more frequently at home ($p = ns$) (table 1).

Table 1

Site of sudden cardiac arrest.

	total (n)	male (n)	female (n)
At home	315 (64%)	230 (61%)	85 (71%)
On street	72 (15%)	61 (16%)	11 (9%)
Public place	65 (13%)	48 (13%)	17 (14%)
Practitioner	15 (3%)	11 (3%)	4 (3%)
At work	15 (3%)	14 (4%)	1 (1%)
p = ns			

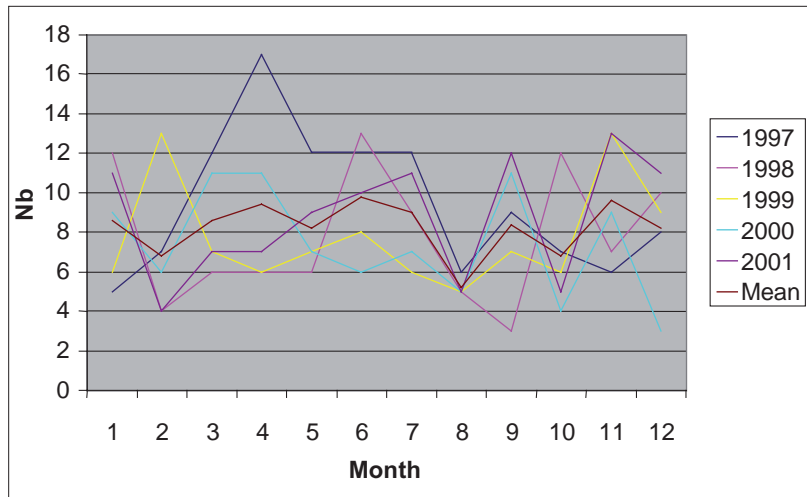


Figure 1
Monthly distribution of sudden cardiac arrest.

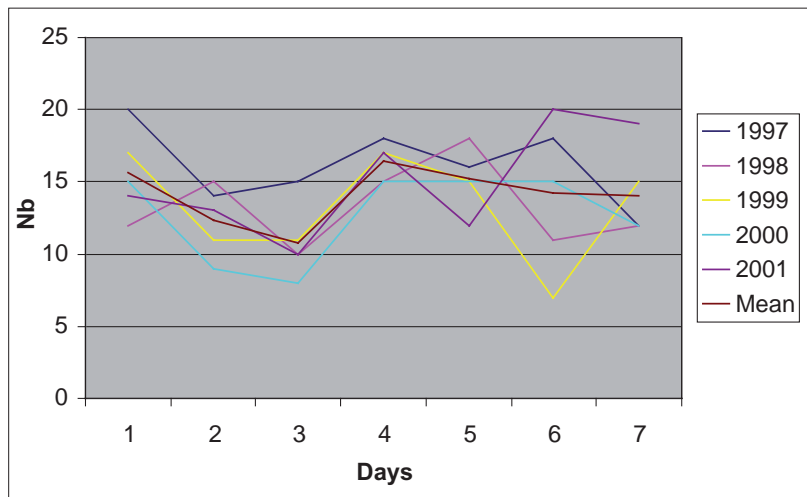


Figure 2
Daily distribution of sudden cardiac arrest. Day 1 = Monday

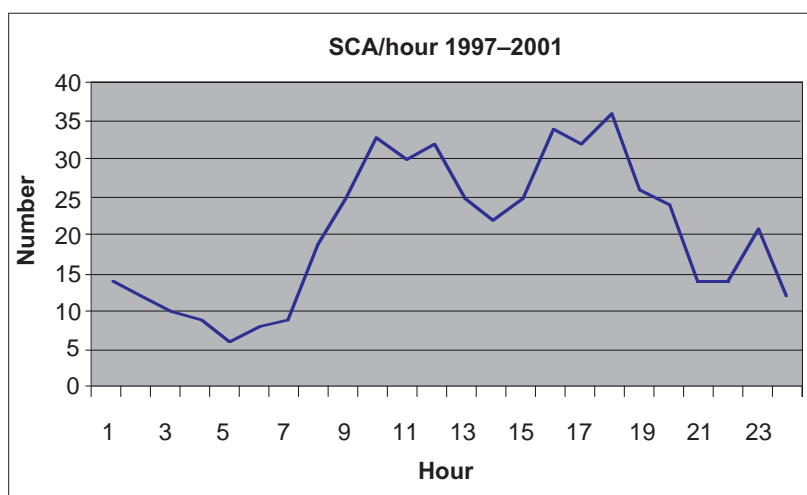


Figure 3
Circadian pattern of sudden cardiac arrest.

SCA occurred at rest in 53%, while walking (20%), during sleep (8%), during exercise in (5%) or in a car in (3%).

Out of 493 patients, 393 (79%) had a witnessed event (81% for male, 75% for female; $p = ns$); the witness was a family member in 53% of the cases, a healthcare professional in 18%, a friend in 14%. A witness was present in 78% of SCA occurring at home and in 82% when they occurred in a public place or on street ($p = ns$).

Symptoms immediately preceding a witnessed event were present in 59% of the cases; victims complained of angina pectoris in 39%, a sensation of "not feeling well" in 35%, dyspnoea in 21% and extreme fatigue in 4%; in 41% of witnessed SCA, the patients did not complain before the event.

Distribution of the events

The monthly distribution of events during the study period 1997–2001 shows great variability; however August and to a lesser degree February show a trend to a lower event rate compared with other months (fig. 1). The daily distribution suggests a higher peak of out-of-hospital SCA on Thursday and Monday and a nadir on Wednesday (fig. 2). The hourly distribution of events is characterised by a very low nocturnal event rate and a double diurnal peak, the first in the morning (10 to 12 am) and the second around 5 to 7 pm (fig. 3).

Cardiopulmonary resuscitation and related outcome

Cardiopulmonary resuscitation (CPR) was initiated in only 121 out of 393 witnessed events (31%) accordingly in only 25% of all SCA; thus, in 69% of the cases, the first active rescuer was the healthcare professional called on site. When present on site, a family member initiated CPR in only 16% of the cases compared with 28% when a friend was present ($p < 0.05$). Furthermore, CPR was more often initiated when the event occurred in a public place or on street (40%) compared with home (19%) ($p < 0.001$). Of note, in 38 of all SCA (8%), the witness at scene was a healthcare professional and CPR was initiated in 92% of these cases.

The estimated interval between the witnessed collapse (time data given by the witness) and the reception of a phone call at the emergency service was 7.5 ± 8.5 minutes; this interval was 4.7 ± 4.1 min for 180 patients transferred to the hospital after initial CPR *vs* 9.3 ± 9.9 min for the other 313 patients dead on site ($p < 0.0001$); patients transferred to the

Table 2

First documented rhythm on site.

Rhythm	number	delay to call (mean)	EMS on site (mean)	% discharged alive
Asystole	218	9.9 min ^{a, b}	16 min ^{c, d}	1%
Ventricular fibrillation	166	4.9 min ^a	10.7 min ^d	17%
Pulseless electrical activity	83	6.8 min ^b	11.6 min ^c	5%
Ventricular tachycardia	8	4.5 min	7.7 min	50%

EMS = Emergency Medical Service
^a p < 0.001; ^b p < 0.05; ^c p < 0.001; ^d p < 0.001

Table 3

Sudden cardiac arrest: survival rate.

On street or in public place	15%	at home	5%	p < 0.001
Witness				
– yes	10%	– no	2%	p < 0.02
– family member	4%	– friend	17%	p < 0.001
– HCP	24%	– no HCP	9%	p < 0.01
CPR	20%	no CPR	5%	p < 0.001
At work	0%			

CPR = cardio pulmonary resuscitation initiated; SCA = sudden cardiac arrest;
HCP = health care professional

hospital after initial CPR were also younger (65.6 ± 1.2 vs 70.2 ± 0.7 ; $p < 0.0007$). The interval between the collapse and the arrival of ambulance on site was 13 ± 8 minutes. The first documented cardiac rhythm on site was asystole in 44%, VF in 34%, pulseless electrical activity (PEA) in 17% and ventricular tachycardia (VT) in 2% (table 2). According to this first documented cardiac rhythm, the interval between collapse and the phone call was 9.9 minutes, 4.9 minutes, 6.8 minutes and 4.5 minutes respectively and the time from collapse to the arrival of the emergency medical service on the site of the SCA was 16 min, 10.7 min, 11.6 minutes and 7.7 minutes respectively (table 2). Mean interval from the collapse to first delivered external electrical shock was 14.2 ± 5.3 minutes.

Among 180 patients transferred to the hospital, 138 (28%) died either within 48 hours (108 patients) or after a hospital stay of 8 ± 5 days (30 patients). Finally, 42 patients were discharged from the hospital.

According to whether VT, VF, PEA or asystole was the first documented cardiac rhythm on site, related survival rates were 50%, 17%, 5% and 1% respectively (table 2). Survival rate was 15% when SCA occurred on street or in a public area, 5% at home ($p < 0.001$) and 0% at work place. Table 3 summarises pertinent data related to the survival rate of the patients.

Clinical characteristics of survivors

The age of the 42 survivors of SCA (9%) was significantly lower 55.5 ± 17.5 years than non survivors ($p < 0.007$); 34 were males (81%). Forty survivors (95%) had a witnessed SCA and the estimated elapsed time between the event to the start of resuscitation was significantly lower as compared to non survivors (9.1 ± 1 vs 12.5 ± 0.5 min; $p < 0.005$). They were discharged after a hospital stay of 36 ± 30 days. Twenty of these survivors (48%) were already known for a cardiovascular disease: 12 had an old myocardial infarction (29%), 4 a hypertension, two a hypertrophic cardiomyopathy, one a WPW syndrome and one was known to have a permanent atrial fibrillation. Their left ventricular ejection fraction was $38 \pm 11.9\%$. Twenty-one of these survivors (50%) underwent an emergent coronary procedure during the first four hours of hospitalisation and 6 (14%) underwent the implantation of an internal cardioverter-defibrillator during further hospital stay. Finally, 13 survivors (31%) suffered from residual neuropsychological disabilities diagnosed by a neurological examination during the hospital stay.

Discussion

To the best of our knowledge, this is the first study to report specific epidemiological data regarding out-of-hospital SCA in Switzerland. Our data are roughly in accordance with other

previously reported studies in Europe [9–13]. The calculated mean annual incidence of out-of-hospital SCA in our study is 0.4 per 1000 inhabitants; it is in the lower range of values of other published studies reporting an incidence varying between 0.36 and 1.3‰ [11, 12]. This is probably mainly linked to the fact that this observational study considered only SCA for which an emergency physician or an ambulance was required on site; furthermore, patients <20 years old or with a chronic terminal disease were – as proposed by others [9] – excluded from our study.

Globally, CPR was initiated in a low proportion of events (25%); this proportion is significantly lower when SCA happens at home (16%) compared to public places (40%); this could reflect the panic reaction of close relatives in such a tremendous stress and is also suggested interestingly by a significantly higher survival rate when the witness is a friend (17%) compared with a family member of the patient (4%). The absence of knowledge in “when and how” to perform CPR is certainly another explanation of the low CPR initiation rate. This lack of information is also reflected in the estimated interval between the witnessed event and the phone call to the emergency services (7.6 ± 8.5 min); the shorter the delay the better the outcome as shown in table 2. Of note, even when a healthcare professional is the first witness, initiation of CPR is not 100% but only 92%; on the other hand, the outcome is significantly better. Inefficient and low early CPR rate results in a very high death rate on site (63%) and a very low final survival rate (9%) after out-of-hospital SCA; this in accordance with several published studies both abroad and in our country [5, 9–12]. Furthermore, in our study, 15 events occurred at work and all patients deceased suggesting also an important lack of information and specific teaching concerning CPR at work (table 1 and 3). We report a significant better outcome of SCA in public areas (15%) compared with home events (5%) [12]. It can be best explained by higher rates of witnessed events, bystander CPR and probably also a lower rate of comorbidities [12].

The circadian pattern of out-of-hospital SCA is similar to previously reported data concerning cardiovascular events [14] (fig. 3). We also report a trend to a higher event rate on Monday and Thursday (fig. 2); this well known increase of sudden cardiac death on Monday has been correlated with the mental stress of starting a new working week and the related increase in activity [15].

The yearly distribution shows a trend to a lower incidence of events during August which can be related to our holiday period (fig. 1) [16].

The hospital stay of out-of-hospital SCA survivors was 36 ± 30 days; almost half of these patients were known for a pre-existing cardiac disease. They had undergone numerous invasive cardiologic interventions including emergency coronary angiography and stenting and internal defibrillator implantation. In order to take optimal care of these unstable, high risk patients, a complete cardiologic team, ready to perform invasive procedures and so allow the best chances for SCA patients, must be on hand 24 hours a day in order to complement the emergency and intensive care staff [17].

Our study shows mild or modest neuropsychological impairment in 31% of survivors; this proportion is close to 50% already reported [18]; this implies an appropriate clinical follow-up of these patients including rehabilitation strategies [19]. Importantly, as published by Saner et al., patients surviving from out-of-hospital cardiac arrest without severely compromised mental status enjoy a good quality of life [20].

In conclusion, the outcome of out-of-hospital SCA in our country remains poor and is comparable to data published several years ago [5, 6]. In order to really improve clinical outcome for patients with out-of-hospital SCA, a strong effort in public information and education is needed to shorten as much as possible the delay until the arrival of the rescue team on site. As a high proportion of these patients had known cardiac disease and as the majority of out-of-hospital SCA occurs at home, the patients and their close relatives should be regularly informed by the practitioner or the cardiologist to react immediately when premonitory symptoms appear and to call for help without any delay [24]. Of importance, our study suggests that family members react inadequately wasting precious minutes trying to act under a tremendous emotional shock; this best explains the long elapsed time to the call for the ambulance. Specific information and courses in CPR should also be delivered at work as no patients could be successfully reanimated when out-of-hospital SCA happened at work. Every company should teach its employees how to act when facing an out-of-hospital sudden cardiac arrest and should regularly check their practice. Furthermore, an easy and rapid access to public automatic external defibrillators has been shown to significantly improve the survival rate for out-of-hospital SCA [25]; however, as the ma-

jority of SCA occur at home the global impact of the use of automatic external defibrillators could be lower than expected [24]. Accordingly, a national information campaign is currently underway: hopefully the next studies undertaken in the field of out-of-hospital cardiac arrest in our country will prove its benefit.

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