Perioperative Cardiac Arrest at Siriraj Hospital Between 1999-2001

NAIYANA AROONPRUKSAKUL, M.D.*,
YOS THAPENTHAI, M.D.*,
ONUMA CHAIWAT, M.D.*,
JARIYA LERTAKYAMANEE, M.D.*,
MANEE RAKSAKIATISAK, M.D.*,
KEMCHART WANGTAWESAUP, M.D.*,
KAMHEANG VACHARAKSA, M.D.*

Abstract

Cardiac arrest during the perioperative period is a good indicator of the quality of anesthetic management. The incidence of perioperative cardiac arrest in Siriraj Hospital hasn't been reported before. Our objectives were to determine the incidence of perioperative anesthesia-related cardiac arrest and the results of cardiopulmonary resuscitation in these cases in order to find out how to improve our anesthetic care. This prospective study was undertaken between 1999-2001 by sending a questionnaire to those witnessing a cardiac arrest. The incidence of perioperative cardiac arrest was 8.2 : 10,000 instances of anesthesia with a mortality of 5.6 : 10,000 within 48 hours of the arrest. The incidence of perioperative cardiac arrest that was related to anesthesia was 0.7 : 10,000 instances of anesthesia and the anesthesia related mortality was 0.19 : 10,000 within 48 hours of arrest. Failed cardiopulmonary resuscitation occurred in of occasions 41.7 per cent. There was no difference between intraoperative and postoperative cardiopulmonary resuscitation. Twenty-one per cent of patients experiencing a cardiac arrest were discharged from hospital. Seventy-three per cent of events occurred in patients with an ASA rating 3-5 and most often the cause of arrest was massive or uncontrolled bleeding. In those patients with an ASA rating 1-2 there were no outstanding cause of arrest.

Key word : Cardiac Arrest, Perioperative Period, Anesthetic Quality, Incidence, Resuscitation

AROONPRUKSAKUL N, RAKSAKIATISAK M, THAPENTHAI Y, et al
J Med Assoc Thai 2002; 85 (Suppl 3): S993-S999

* Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

Cardiac arrest is a serious complication. There are a lot of factors that can lead to it. Anesthetic factors which lead to cardiac arrest are preventable. For the anesthesiology department of Siriraj Hospital, these data are powerful. The Incidence of perioperative cardiac arrest has not been reported before. As the cause of cardiac arrest can indicate the quality of anesthetic management, we are able to obtain important data which will help prevent future problems and can improve the quality of anaesthetic care given.

Finding the incidence of perioperative cardiac arrest is the first objective of the study. The second, is to find the incidence and cause of anesthesia-related cardiac arrest. We are also interested in the results of cardiopulmonary resuscitation in these cases and finding out how to improve our anesthetic care.

METHOD AND STATISTICS

In this study, we collected the data from patients who had experienced perioperative cardiac arrest (defined as the need for chest compressions or death within 48 hours of operation) from June 1999 to May 2001 at Siriraj Hospital. A questionnaire was designed on which specific details of all cardiac arrests were reported by the primary anesthetist. Information included was the patient's hospital number, sex, age, coexisting disease, American Society of Anesthesiologist's physical status (ASA), anesthetic technique, diagnosis, operation, previous cardiac arrest during that admission, and whether it was an elective or emergency operation. We also collected the details of resuscitation, time and place where the cardiac arrests occurred, result of resuscitation, and the primary cause of cardiac arrest.

After collecting these data, at least three anesthesiologists reviewed the data and categorized each cardiac arrest to be anesthesia-related using a numerical score as fully anesthesia-related (50-100%), minimally-related (5-49%), and not anesthesia-related (<5%).

Only a demograhpic analysis was used for analyzing the data because the number of cases was not large enough for any other method of analysis.

RESULTS

During the period June 1999 to May 2001, 50,952 anesthetics were administered, in which 42 cardiac arrest were reported. The incidence of cardiac arrest was 8.2 per 10,000 anesthetics given. The incidence increased dramatically during emergency surgery and in those with a higher ASA physical status (Table 1).

The Demographic data relating to patient's experiencing cardiac arrest within 48 hours of opera-

Table 1. Incidence of cardiac arrest related to ASA physical status, type of surgery and place.

	Total number of cases	Cardiac arrest		Anesthesia-related arrest	
		Number of cases	Incidence 1:10,000	Number of cases	Incidence 1:10,000
Total number of case	50,952	42	8.2	22	4.3
ASA					
I	27,938	0	0	0	0
II	19,224	11	5.7	8	4.2
III	3,475	13	37.4	8	23.0
IV	300	13	433.3	6	200.0
V	15	5	3,333.3	0	0
Type of surgery					
Scheduled	41,414	16	3.9	9	2.2
Emergency	9,538	26	27.3	13	13.6
Place					
Preinduction		1			
Intraoperative	5,0952	24	4.7	16	3.1
Postoperative	5,0952	17	3.3	6	1.2
Recovery room	-	1	-	1	-
Intensive care unit	-	12	-	3	-
Normal ward	-	2	-	1	-
Private ward	-	2	-	1	-

tion are shown in Table 2. Seventy-three per cent of cardiac arrest occurred in patients with an ASA classification III and higher (Table 3). General surgery experienced the greatest incidence (21.4%), followed by cardiovascular and thoracic surgery (16.7%) respectively. The cardiac arrest rate was significantly increased during emergency surgery but was not different with regard to the time of surgery (in an out of office hours). Concerning the age of the patients, although the pediatric group was the smallest group, this group had the highest incidence of cardiac arrest associated with anesthesia-related causes.

The leading causes of anesthesia-related cardiac arrest are presented in Table 3. Problems with the cardiovascular system were the leading cause of cardiac arrest, in which fifty per cent of event caused by massive or uncontrolled bleeding. There were 4 incidents of cardiac arrest which were judged to be fully anesthesia related. The first incident was caused by hypotension of unknown etiology, the second was caused by a misplaced endotracheal tube, and another 2 events caused by equipment problems.

After classifying the patients in two groups according to their ASA status (Table 4), we found that overall in seventy-three per cent of incident the patient's ASA status was 3-5 and most often the cause of arrest was massive or uncontrolled bleeding. However, for patients with an ASA status 1-2 there were no outstanding causes of arrest.

A comparison of the results of resuscitation during the perioperative period are shown in Table 5. It is surprising that the percentage of failed CPR is nearly the same between the intraoperative and postoperative period; 41.7 and 41.2 per cent respectively.

The incidence of mortality within 48 hours of arrest is shown in Table 6. Overall the mortality per 10,000 was 5.7 and the intraoperative mortality was 4.7, while anesthesia-related and anesthetic death rate were 2.5 and 0.19 respectively. Twenty-one per cent of patients who experienced a cardiac arrest were discharged from hospital.

Table 2. Demographic data of cardiac arrest patients.

Characteristic of cases	Cardiac arrest (n=42)	Anesthesia-related arrest (n=22)
Sex : M/F	22/20	13/9
ASA physical status		
II	11	8
III	13	8
IV	13	6
V	5	0
Age group		
Pediatric (<18 yr)	7	5
Adult (18-65 yr)	24	13
Geriatric (>65 yr)	11	4
Location of surgery		
General surgery	9	4
Cardiovascular, thoracic	7	1
Neurosurgery	5	3
Obstetrics	5	3
ENT	4	2
Orthopedics	3	3
Urosurgery	3	2
Pediatrics	2	2
Trauma	2	1
Plastic	1	0
Radiology unit	1	1
Type of surgery		
Scheduled/Emergency	16/26	9/13
Time of surgery		
Office hours/out of office hours	21/21	12/10

Table 3. Mechanism of cardiac arrest.

Mechanism of cardiac arrest	All cardiac arrest (n=42)	Anesthesia-related cardiac arrest (n=22)	Fully anesthesia-related cardiac arrest (n=4)
Cardiovascular			
Massive/uncontrolled bleeding	12	6	-
Heart failure	5	1	-
Pulmonary embolism	3	2	-
Septic shock	3	1	-
Hypotension unknown etiology	2	2	1
Pulmonary hypertension	1	1	-
Acute myocardial infarction	1	-	-
Respiratory			
Airway obstruction/problems	7	4	-
Respiratory arrest	1	1	-
Bronchospasm	1	-	-
Misplaced endotracheal tube	1	1	1
Equipment			
Central line insertion	1	1	1
Breathing circuit problem	1	1	1
Others			
Brain herniation	2	1	-
Multi organ failure	1	-	-

Table 4. Mechanism of anesthesia-related cardiac arrest related to ASA.

Mechanism of cardiac arrest	Cardiac arrest		Anesthesia-related arrest	
	ASA I-II	ASA III-V	ASA I-II	ASA III-V
Cardiovascular				
Massive/uncontrolled bleeding	3	9	2	4
Heart failure	-	5	-	1
Pulmonary embolism	1	2	1	1
Septic shock	-	3	-	1
Hypotension of unknown etiology	1	1	1	1
Pulmonary hypertension	-	1	-	1
Acute myocardial infarction	-	1	-	-
Total	5	22	4	9
Respiratory				
Airway obstruction/problems	2	5	1	3
Respiratory arrest	1	-	1	-
Bronchospasm	1	-	-	-
Misplace endotracheal tube	1	-	1	-
Total	5	5	3	3
Equipment				
Central line insertion	-	1	-	1
Breathing circuit problem	1	-	1	-
Total	1	1	1	1
Others				
Brain herniation	-	2	-	1
Multi organ failure	-	1	-	-
Total	-	3	-	1

Table 5. Results of resuscitation.

Result of resuscitation	Cardiac arrest			Anesthesia-related cardiac arrest		
	Number of cases	Failed CPR	%	Number of cases	Failed CPR	%
Intraoperative period	24	10	41.7	16	6	37.5
Postoperative period	17	7	41.2	6	1	16.7

Table 6. Outcome of patients after cardiac arrest.

Outcome of patients after cardiac arrest	Cardiac arrest (n=42)	%	Anesthesia-related arrest (n=22)	%
Death within 3 days of cardiac arrest	29	69.0	13	59.0
Still survived after 3 days of cardiac arrest	13	31.0	9	40.9
Discharged from hospital	9	21.4	8	36.4

DISCUSSION

In our study, we found the incidence of perioperative cardiac arrest per 10,000 anesthetics was 8.2, out of which the incidence of anesthesia-related arrest was 4.3 and the incidence of cardiac arrest in which anesthesia was a primary cause (fully anesthesia related) was 0.78. The incidence varies from other studies; for example, Keenan and Boyan[1] reported an incidence of intraoperative cardiac arrest from 1967 to 1974 of 27(per 10,000) and the incidence of cardiac arrest directly related to anesthesia was 17 while our intraoperative cardiac arrest rate was 4.7 and anesthesia as a direct cause of intraoperative arrest was 0.8 Cohen, et al[2] studied anesthetic outcome in four teaching hospitals between 1987-1989, the incidence of intraoperative cardiac arrest per 10,000 anesthetics varied from 4 to 26, and overall perioperative cardiac arrest rates varied from 11 to 26.

The incidence of cardiac arrest rose dramatically in patients with an ASA physical status of 3-5 and during emergency surgery. These finding can be used as to determine risk factors of an anesthesia-related cardiac arrest[1,3].

Our incidence of intraoperative cardiac arrest was quite a bit lower than in the two previous studies. To explain this, perhaps in part it may have been due to the vast improvement in intraoperative monitoring, equipment and a variety of new anesthetic medications over the past two decades.

The mortality rate is another indicator of the quality of care. Our mortality rate within 48 hours of operation per 10,000 anesthetics was 5.7 and the intraoperative mortality rate was 4.7, while anesthesia-related and anesthetic death rates were 2.5 and 0.19 respectively. Harrison[4] reported an anesthesia-contributed mortality rate of 2.2 per 10,000, while Biboulet, et al[5] Bodlander[6], Keenan and Boyan [1], and Arbous, et al[7] have reported only 0.6, 0.7, 0.9 and 1.4 per 10,000 respectively. Apparently the anesthetic mortality rate has a wide distribution because there is currently no unique definition of "anesthetic death".

Although cardiac arrest in pediatric patient is not common, we found that 16.7 per cent of victims were children, in whom 71.4 per cent were anesthesia-related problems. The cardiovascular and respiratory systems were the leading causes of arrest. Morray, et al[3] showed the incidence of cardiac arrest in pediatrics per 10,000 anesthetics was 2.7. Major causes of cardiac arrest in pediatrics were medical-related and cardiovascular problem. The ratio of anesthesia-related cardiac arrest was 51.9 per cent (150/289 cases); these can be explained by the fact that 40 per cent of enrolled institutions were children's hospitals, which have more experience in dealing with children. Salem, et al[8] reported major factors leading to arrest that were identical to our study.

Intraoperative cardiac arrest accounted for 72.7 per cent (16 events) of anesthesia-related cardiac arrest. Eighty-seven per cent of events occurred during the maintenance period, the leading causes

were cardiovascular (43.7%) and respiratory problems (25%). In the cardiovascular problem group, five out of seven patients had perioperative cardiovascular problems and cardiac arrest occurred with massive or uncontrolled bleeding. Another cardiac arrest occurred with stable hemodynamics in a 3 month-old with gut obstruction after a Kasai's operation. Morray, et al[3] has shown that one of the most common cause of perioperative cardiac arrest in pediatrics was as an unclear etiology of cardiovascular problem in which more than half of this group had congenital heart disease and had an ASA physical status of 3-5. These findings raise our concerns that in patients with a pre-existing cardiovascular problem undergoing surgery with potential bleeding or a pediatric patient with congenital heart disease or an ASA physical status of 3-5 were more likely to have an intraoperative cardiac arrest. Thus, we should be careful to anesthetize these patients only after proper preoperative preparation and to remain very vigilant during the intraoperative period.

Twenty-five per cent of all intraoperative arrests resulted from respiratory events. The most common etiology was airway obstruction or being unable to ventilate the patient. Interestingly, three patients (75%) had preoperative pulmonary disease, after experiencing a short period of hypoxia as a result of inadequate ventilation, cardiac arrest occurred. These finding raise our concern that to providing good care of the respiratory system both oxygenation and ventilation are important to prevent cardiac arrest in patients with a low pulmonary reserve.

In the four incidents of cardiac arrest that were fully related to anesthesia, fifty per cent were equipment-related and the rest occurred in newborns and elderly patients. It seem that half of these events were preventable.

These are a few limitations to our study; firstly, was underreporting especially in postoperative period, though we tried to solve this by a semi-voluntary technique, rewarding, etc. Secondly, delayed-reporting, we did not use voluntary report as a consequence data may be invalid or incomplete. Finally, duration of this study was quite short, 2 years period, so the number of cases were not large enough to identify risk factors that contributed to the anesthesia-related cardiac arrests.

SUMMARY

The incidence of perioperative cardiac arrest within 48 hours per 10,000 anesthetics was 8.2, the incidence of anesthesia-related arrest was 4.3 and the incidence of fully anesthesia related cardiac arrest was 0.78. The mortality rate per 10,000 anesthetics was 5.7 and intraoperative mortality rate was 4.7, while the anesthesia-related and anesthetic death rates were 2.5 and 0.19 respectively. Seventy-three per cent of events were in patients with an ASA status 3-5 and the most frequent cause of arrest was massive or uncontrolled bleeding. In patients with an ASA status of 1-2 there were no outstanding cause of cardiac arrest. Proper preoperative evaluation and preparation with high vigilance during the intraoperative period will prevent these serious complications.

(Received for publication on February 19, 2002)

REFERENCES

1. Keenan RL, Boyan CP. Cardiac arrest due to anesthesia: A study of incidence and causes. JAMA 1985; 253: 2373-8.
2. Cohen MM, Duncan PG, Pope WD, et al. The Canadian four-centre study of anaesthetic outcomes: II, Can outcome be used to assess the quality of anaesthesia care. Can J Anaesth 1992; 39: 430-9.
3. Morray JP, Geiduschek JM, Ramamoorthy C, et al. Anesthesia-related cardiac arrest in children: Initial findings of the pediatric perioperative cardiac arrest (POCA). Anesthesiology 2000; 93: 6-14.
4. Harrison GG. Death attributable to anaesthesia: A 10-year survey 1967-1976: Br J Anaesth 1978; 50: 1041-6.
5. Biboulet P, Aubas P, Dubourdieu J, et al. Fatal and nonfatal cardiac arrests related to anesthesia. Can J Anaesth 2001; 48: 326-32.
6. Bodlander FMS. Deaths associated with anaesthesia. Br J Anaesth 1975; 47: 36-41.
7. Arbous MS, Grobbee DE, et al. Mortality associated with anaesthesia: A qualitative analysis to identify risk factors. Anaesthesia 2001; 56: 1141-53.
8. Salem MR, Bennett EJ, Schweiss JF, et al. Cardiac arrest related to anesthesia: contributing factors in infants and children. JAMA 1975; 233: 238-41.

อุบัติการณ์ของการเกิดภาวะหัวใจหยุดเต้นในโรงพยาบาลศิริราช ระหว่าง พ.ศ. 2542–2544

นัยนา อรุณพฤกษากุล, พ.บ., มานี รักษาเกียรติศักดิ์, พ.บ.*,*
ยศ ทับเป็นไทย, พ.บ., เข็มชาติ หวังทวีทรัพย์, พ.บ.*,*
อรอุมา ชัยวัฒน์, พ.บ., กำแหง วัชรักษะ, พ.บ*, จริยา เลิศอรรฆยมณี, พ.บ.**

ภาวะหัวใจหยุดเต้นในช่วงระหว่างและหลังผ่าตัดเป็นภาวะแทรกซ้อนที่รุนแรง และสามารถใช้เป็นตัวบ่งชี้สำหรับการประเมินคุณภาพการดูแลผู้ป่วยได้ การศึกษานี้ได้จัดทำขึ้นโดยมีวัตถุประสงค์เพื่อหาอัตราการเกิดภาวะหัวใจหยุดเต้นในภาพรวมและที่เกี่ยวข้องกับการให้ยาระงับความรู้สึก อัตราการตายและผลการช่วยฟื้นชีพในช่วงนี้ การศึกษานี้ได้เริ่มทำตั้งแต่เดือนมิถุนายน พ.ศ. 2542 ถึงเดือนพฤษภาคม พ.ศ. 2544 โดยได้จัดส่งแบบสอบถามให้แก่ผู้ที่อยู่ในเหตุการณ์ ผลการศึกษาพบว่าอุบัติการณ์การเกิดภาวะหัวใจหยุดเต้นในโรงพยาบาลศิริราช ในช่วงระหว่างและหลังผ่าตัด 48 ชั่วโมง เท่ากับ 8.2 : 10,000 อุบัติการณ์การเสียชีวิตหลังจากการเกิดภาวะหัวใจหยุดเต้นเท่ากับ 5.6 : 10,000 ส่วนอุบัติการณ์การเกิดภาวะหัวใจหยุดเต้นที่เกี่ยวข้องกับการให้ยาระงับความรู้สึกนั้นเท่ากับ 0.7 : 10,000 และอุบัติการณ์ตายเท่ากับ 0.19 : 10,000 ส่วนผลการช่วยฟื้นชีพพบว่าไม่ลำเร็จร้อยละ 41.7 และไม่แตกต่างกันเมื่อเปรียบเทียบการช่วยฟื้นชีพในห้องผ่าตัดหรือนอกห้องผ่าตัด นอกจากนี้ในภาพรวมพบว่าการเกิดภาวะหัวใจหยุดเต้นพบในกลุ่มผู้ป่วยหนัก (ASA III–V) ร้อยละ 70 สาเหตุส่วนใหญ่เกิดจากการเสียเลือดปริมาณมากหรือไม่สามารถห้ามเลือดได้ ส่วนในกลุ่มผู้ป่วยอาการไม่รุนแรง (ASA I–II) ไม่พบสาเหตุที่ชัดเจนซึ่งชักนำให้เกิดภาวะนี้

คำสำคัญ : หัวใจหยุดเต้น, อุบัติการณ์, อัตราตาย, การช่วยฟื้นคืนชีพ, การระงับความรู้สึก

นัยนา อรุณพฤกษากุล, มานี รักษาเกียรติศักดิ์, ยศ ทับเป็นไทย, และคณะ
จดหมายเหตุทางแพทย์ ฯ 2545; 85 (ฉบับพิเศษ 3): S993–S999

*ภาควิชาวิสัญญีวิทยา, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10700