Clinical Reports

Perioperative complications in patients with anthracycline chemotherapeutic agents

Frederick A. Burrows MD FRCP(C),
Paul R. Hickey MD, Steven Colan MD

The anaesthetic records of 68 patients ranging in age from 0.5 to 22 years were reviewed to determine the incidence of perioperative cardiovascular complications in patients with a history of anthracycline drug therapy. One hundred and eleven anaesthetics were retrospectively reviewed and seven cardiovascular complications (hypotension) were identified for an incidence of 6.3 per cent. Of these, only two could be definitely attributed to perioperative myocardial dysfunction. Both of these patients had a history of congestive heart failure. Three of four patients with a history of congestive heart failure developed complications. In evaluating possible preoperative predictions of perioperative cardiovascular complications, only a history of congestive heart failure bore a statistical significant relationship. There was no relationship between anaesthetic technique and perioperative cardiovascular complications. Two additional cardiovascular complications occurred more than 48 hours postoperatively and their significance is discussed.

Key words

ANAESTHETIC TECHNIQUES: general, inhalation;
COMPLICATIONS: cardiovascular; ANTINEOPLASTICS: doxorubicin, daunorubicin.

From the Departments of Anaesthesiology and Cardiology, Children's Hospital, the Departments of Anaesthesia and Pediatrics, Harvard Medical School, Boston, Massachusetts.

Address correspondence to: Dr. Frederick A. Burrows, Department of Anaesthesia, The Hospital for Sick Children, 555 University Avenue, Toronto, Ontario M5G 1X8.

The anthracycline chemotherapeutic agents, doxorubicin (Adriamycin®) and daunorubicin (Cerubidine®) have a broad spectrum of activity in the treatment of neoplastic disorders. With prolonged survival, an increasing number of patients with neoplasias undergo general anaesthesia; for operations combining aggressive surgery and chemotherapy of their neoplastic diseases, for related radiotherapy and diagnostic procedures (computerized axial tomography and myelography) particularly in small children, and for unrelated procedures. These agents are a problem for anaesthetists because of a dose-related and unpredictable cardiomyopathy, the most serious complication of their administration and frequently dose-limiting.¹⁻⁵

Cardiovascular complications and death have been reported during and after the administration of anaesthetics in patients receiving anthracycline drugs.^{6,7} Warnings of the possibility of cardiovascular complications in anthracycline-treated patients during anaesthesia have appeared in recent reviews of cancer chemotherapy.⁸ Although perioperative complications have been attributed to the cardiomyopathy induced by anthracycline drugs, the incidence and predictability of perioperative cardiovascular complications in such patients have not been reported.

Preoperative cardiological evaluations including patient history, physical examinations, electrocardiograms combined with echocardiographic studies have been used to try to identify those patients at risk for perioperative cardiovascular complications. The efficacy of these preoperative evaluations in identifying those patients at risk have not been evaluated. We examined the incidence of perioperative

cardiovascular complications in patients treated with anthracycline drugs and identified predictors of perioperative cardiovascular complications.

Methods

A retrospective chart review was completed of all patients treated with anthracycline chemotherapeutic agents, who had preanaesthetic cardiologic and echocardiographic assessment of cardiac function and subsequently received general anaesthesia at our institution, for an eighteen-month period. Data obtained included patient age, type of surgical procedure, anthracycline dose at the time of anaesthesia, time interval since last dose, evaluation of cardiac function by cardiologists and anaesthetists and history of congestive heart-failure.

Preoperative chest radiographs, electrocardiograms and two-dimensional M-mode echocardiograms were reviewed. Quantitative analysis of myocardial contractility by echocardiography was determined by the shortening fraction (SF). Shortening fraction is determined by measuring left ventricular dimensions at end-diastole (Dd) and end-systole (Ds) between the endocardial echoes of the posterior wall and left surface of the septum just below the tip of the mitral valve.¹⁹ This level provides the most accurate left ventricular minor axis dimension.¹⁰ The per cent shortening of the internal diameter or shortening fraction was calculated as:

$$\% \text{ SF} = \frac{\text{Dd} - \text{Ds} \times 100}{\text{Dd}}$$

A value of less than 29 per cent was considered indicative of abnormal left ventricular functioning indicating the onset of adriamycin-induced cardiomyopathy.

Patients were then classified into two groups, those with evidence of cardiomyopathy as determined by echocardiographic criteria but without a history of clinical symptomatology and those with a clinical history of congestive heart failure.

Perioperative cardiovascular complications were evaluated by two anaesthetists who were blinded to assessments of perioperative cardiac myocardial contractility, the cumulative anthracycline drug dose and treatment schedule of each patient. Cardiovascular complications during anaesthesia were defined as unexplained hypotension (a decrease in systolic blood pressure greater than 25 per cent of preoperative values) or unexplained conduction dis-

turbances, occurring up to 24 hours postanaesthesia. In addition to these early perioperative problems, patients' charts were reviewed for evidence of late postoperative cardiovascular complications, such as congestive heart failure or cardiovascular collapse occurring after 24 hours but within seven days of anaesthesia. The anaesthetic technique used in each case for induction and maintenance was recorded. No patients received intraoperative anthracycline drugs.

Statistical significance ($p < 0.05$) was determined using Student's *t* test for comparing the shortening fraction on echocardiogram, cumulative anthracycline dose, time interval since last dose, and age of patient for the groups with and without cardiovascular complications during their anaesthetics. Chi-square analysis was used to compare the incidence of a history of congestive heart failure with the incidence of cardiovascular complications, and to compare the incidence of cardiovascular complications with the various anaesthetic techniques, the incidence of electrocardiographic abnormalities and the incidence of chest radiographic abnormalities. Again, a *p* value < 0.05 was considered to indicate statistical significance.

Results

Preoperative cardiologic evaluations and echocardiographic assessments were obtained for 111 separate anaesthetics in 68 patients. When patients received more than one anaesthetic, the cumulative anthracycline dose, the time interval since the last dose, and/or the anaesthetic techniques were different. The differences allowed the evaluation of different anaesthetic techniques in the same patient as separate anaesthetics.

Sixty-six patients received doxorubicin therapy, two patients received daunorubicin therapy. Both of these agents are interchangeable in terms of the type of cardiac toxicity reported and the dose levels at which it appears⁵ and are therefore considered together in this study. The mean values and range of the patient's age, cumulative anthracycline dose, time interval between the last dose of anthracycline drug and the anaesthetic, and the shortening fraction are presented in Table I.

Abnormal cardiac function (cardiomyopathy) was identified by two-dimensional echocardiographic criteria in 18 patients receiving a total of 21 anaesthetics. Three patients were currently symptomatic

TABLE I Mean value and range for parameters examined in 111 anaesthetics

	Mean	Range
Age (years)	9.3	0.5–22
Anthracycline dose (mg·m ⁻²)	309	40–530
Time interval since last anthracycline treatment	54 weeks	4 days–7 years
Shortening fraction (%)	32.5	9–52

and one patient had a history of congestive heart failure but was presently asymptomatic on treatment (Table II). Please note that for clarity of presentation, each patient has been assigned a unique number which remains consistent throughout the paper.

Two patients with congestive heart failure were monitored preoperatively with radial and pulmonary arterial lines. The decision for such monitoring was based on the patients physical status; one patient (Table II, #2) was currently New York Heart Association (NYHA) Class III with a SF of nine per cent. She had previously been treated in the intensive care unit for congestive heart failure and it was felt the pulmonary arterial line would assist intraoperative and postoperative management. The second patient (Table II, #1) was currently NYHA Class IV. The patient was currently in the intensive care unit undergoing therapy for congestive heart failure. She was intubated and receiving dopamine. The pulmonary arterial line was *in situ* to assist

TABLE II History of patients with congestive heart failure

Patient	Age	Current symptoms	Current medications	Duration of symptoms
1	21	Yes	Digoxin Furosemide Hydralazine	<two weeks
2	17	Yes	Digoxin Furosemide Spironolactone	>one year
3	17	No	Digoxin	Currently resolved
4	12	No	Digoxin Chlorothiazide Spironolactone	Currently resolved

< – less than

> – greater than.

management in the intensive care unit. None of the other patients were monitored with pulmonary arterial lines. The need for radial arterial monitoring in the remaining patients was determined by the anaesthetist in the usual fashion.

Table III presents in greater detail the anaesthetic techniques employed in the patients with a history of congestive heart failure.

During the 111 anaesthetics and operative procedures, seven episodes of hypotension were identified, one in each of seven separate anaesthetics (Table IV). One episode was probable anaesthetic overdose in which the patient received Halothane

TABLE III Anaesthesia and surgery in patients with congestive heart failure

Patient	Procedure	Induction	Maintenance	Length of surgery	Disposition
1	Tracheostomy Gastrostomy	D(0.4 mg·kg ⁻¹) MS(1.5 mg·kg ⁻¹)	O ₂ /MS/PAN	2 h 30 m	ICU Ventilated Inotropic support Afterload reduction
2	Thoracotomy	D(0.4 mg·kg ⁻¹) F(50 µg·kg ⁻¹)	N ₂ O/F/MET	2 h 25 m	ICU Ventilated Inotropic support Afterload reduction
3	Open Reduction Internal fixation Femur	P(4 mg·kg ⁻¹) MS(0.2 mg·kg ⁻¹)	N ₂ O/F/(8 µg·kg ⁻¹)/PAN	6 h 15 m	Extubated. To Ward
4	Thoracotomy	P(4 mg·kg ⁻¹)	N ₂ O/MS(0.2 mg·kg ⁻¹)/PAN	2 h 50 m	Extubated. To Ward

Abbreviations: D—Diazepam, MS—Morphine, F—Fentanyl, P—Thiopentone, h—Hours, m—Minutes, ICU—Intensive Care Unit, PAN—Pancuronium, MET—Metocurine.

TABLE IV Clinical history and anaesthetic techniques in the patients experiencing cardiovascular complications

<i>Patients</i>	<i>Procedure</i>	<i>Age</i>	<i>Ind</i>	<i>Main</i>	<i>R</i>	<i>AD</i> (mg·m ⁻²)	<i>I</i> (weeks)	<i>SF</i> (%)	<i>Hx CHF</i>	<i>C</i>
1	Tracheostomy Gastrostomy	21	D/N	O ₂ /N	Pan	426	277	27	+	↓ BP
2	Thoracotomy	17	D/N	N ₂ O/N	Met	450	32	9	+	↓ BP
3	Open reduction Internal fixation Femur	17	P/N	N ₂ O/N	Pan	450	251	28	+	↓ BP
5	Thoracotomy	10	D/N	N ₂ O/N	Met	45	1	37		↓ BP
6	Laparotomy	3	H	H	Met	40	4	38		↓ BP
7	Thoracotomy	5	H	N ₂ O/N	Pan	210	2	32		↓ BP
8	Thoracotomy	7	P	E	Pan	438	185	37		↓ BP

Abbreviations: Ind—Induction, Main—Maintenance, R—Relaxant, AD—Anthracycline Dosage, I—Time Interval since last Anthracycline Treatment, SF—Shortening Fraction, Hx CHF—History of Congestive Heart Failure, C—Complications, P—Thiopentone, N—Narcotic, D—Diazepam, H—Halothane, E—Ethrane, Met—Metocurine, Pan—Pancuronium, +—Positive History, ↓ BP—Hypotension.

three per cent with positive pressure ventilation. Losses of circulating volume, or surgical manipulations possibly contributed to the hypotension observed in four other cases. In the other two episodes exacerbation of primary myocardial dysfunction was the aetiology of the hypotension observed. These were the two patients with radial and pulmonary arterial monitoring (Table II, patients 1, 2). Myocardial dysfunction was manifest by systemic hypotension with unchanged right heart filling pressures and a progressive increase in pulmonary arterial diastolic and occlusion pressures. Both patients were successfully treated with dopamine and afterload reduction (sodium nitroprusside). Both patients were admitted to the intensive care unit and were subsequently weaned from intravenous support agents and ventilatory support, and were eventually discharged from hospital.

No unexplained conduction abnormalities were detected in any patient. Three of the complications occurred in patients with abnormal cardiac function preoperatively. All three had a history of congestive heart failure. The remaining four patients were assessed preoperatively as having normal cardiac function. There were no early complications in any of the patients with abnormal cardiac function, without a history of congestive heart failure.

The incidence of intraoperative hypotension was 6.3 per cent. The mean shortening fraction, time interval since the last anthracycline dose, and age were

not significantly different between those patients with and those patients without intraoperative complications. The incidence of a history of congestive heart failure was significantly greater ($p < 0.001$) in those patients with cardiovascular complications than in those without (Table V).

Preoperative evaluation revealed abnormal electrocardiograms and chest radiographs in four patients, all of whom had a clinical history of congestive heart failure. The incidence of abnormal electrocardiogram findings or chest radiograph findings was significantly greater ($p < 0.001$) in those patients with cardiovascular complications than in those without (Table V). The incidence of cardiovascular complications was not associated with any specific anaesthetic induction or maintenance technique (Table VI).

Two late complications were identified (Table VII). Both patients were suffering a relapse of acute lymphocytic leukemia. Both patients had normal cardiac function as assessed by history, physical examination, electrocardiograph, and chest radiograph. One patient had a normal shortening fraction (33 per cent) as assessed by two-dimensional echocardiography. The other had decreased cardiac contractility with a shortening fraction of 17 per cent. Both of these patients developed evidence of congestive heart failure and low cardiac output requiring inotropic support and diuretics. The patient with the normal shortening fraction was diagnosed

TABLE V Preoperative indices and their relationship to perioperative cardiovascular complications

<i>Patients</i>	<i>Age*</i> (years)	<i>AD*</i> (mg·m ⁻²)	<i>I*</i> (weeks)	<i>SF*</i> (%)	<i>History of CHF</i> (incidence)	<i>Abnormal CXR</i> (incidence)	<i>Abnormal ECG</i> (incidence)
Study group (111)	9.3±0.6	309±14	54±7	32.5±0.5	3.6%	3.6%	3.6%
CV Complications (7)	11.4±2.6	294±74	107±47	29.7±3.8	42.9%†	42.9%†	42.9%†

*Mean ± standard error.

†p < 0.001 between the two groups.

Abbreviations: AD—Anthracycline Dosage, I—Time Interval since last Anthracycline Treatment, SF—Shortening Fraction.

as having developed viral myocarditis. His shortening fraction decreased to eight per cent, and he died ten days post-surgery. The second patient developed congestive heart failure on the second postoperative day, which responded to digitalis and furosemide. It is doubtful the stress of anaesthesia and surgery contributed to the late development of congestive heart failure due to the nature of the concurrent disease, but we are unable to state this conclusively.

Preoperative evaluation by cardiologists, anaesthetists and assessment of cardiac contractility by two-dimensional echocardiography did not reliably predict those patients at risk for perioperative cardiovascular complications except in those patients with a history of congestive heart failure.

Discussion

Cardiovascular complications were infrequent (6.3 per cent) during the operative course of these anthracycline-treated patients. These complications were restricted to hypotension events, two of which

required intervention with inotropic support and afterload reduction. There was no apparent association with anaesthetic agents.

As a retrospective study, these data are necessarily limited. It was not always possible to determine the aetiology of the cardiovascular complications; some of the events may have been due to hypovolemia, surgical manipulation, or injudicious use of depressant anaesthetic agents in anthracycline-treated patients who did not have appreciable cardiomyopathy. This study then probably overestimates the incidence of hypotension cardiovascular complications during anaesthesia which are related to anthracycline cardiomyopathy *per se*.

It is possible that the anaesthetic techniques were chosen on the basis of the echocardiographic findings, clinical history of cardiac function, and anthracycline dosage, all of which were available to the anaesthetist prior to anaesthesia. This type of bias is intrinsic to a retrospective study and calls into question the lack of relationship between

TABLE VI Anaesthetic techniques and cardiovascular complications

<i>Induction techniques</i>					
	<i>Inhalation</i> (halothane)	<i>Thiopentone</i>	<i>Diazepam</i> <i>narcotic</i>	<i>Neurolept</i>	<i>Ketamine</i>
No complications	39	56	4	2	2
Complications*	2	2	3	0	0
<i>Maintenance techniques</i>					
	<i>Halothane</i>	<i>Ethrane</i>	<i>N₂O</i> <i>narcotic</i>	<i>Neurolept</i>	
No complications	41	7	53	3	
Complications*	1	1	5	0	

*—no significant difference (p > 0.05) between groups (Chi-square analysis).

TABLE VII Clinical history and anaesthetic techniques in patients with late complications

	Procedure	Age (years)	Ind	Main	R	AD (mg·m ⁻²)	I (weeks)	SF (%)	Hx CHF	C
9	Central Line	14	P	N ₂ O/N	dTc	441	141	17	—	CHF
10	Thoracotomy	6	P	H	—	315	5	33	—	CHF

Abbreviations: Ind—Induction, Main—Maintenance, R—Relaxant, AD—Anthracycline Dosage, I—Time Interval since last Anthracycline Treatment, SF—Shortening Fraction, Hx CHF—History of Congestive Heart Failure, C—Complications, P—Thiopentone, N—Narcotic, H—Halothane, dTc—Tubocurarine Chloride.

anaesthetic technique and cardiovascular complications. The cardiovascular complications then occurring in anthracycline-treated patients receiving potent inhalational agents may be underestimated, and those seen with other techniques overestimated. However, despite the anaesthetist's knowledge of the patient's cardiovascular status preoperatively hypotension still occurred in 6.3 per cent of cases. This implies that the current preoperative predictors, other than the presence of a history of congestive heart failure, are not accurate enough to predict those who will develop cardiovascular complications.

The high incidence of cardiovascular complications intraoperatively associated with a history of congestive heart failure (75 per cent) seems obvious, but the lack of relationship of cardiovascular complications with the time interval since the last anthracycline dose, the cumulative anthracycline dose level, the shortening fraction as determined by two-dimensional echocardiogram and age is not obvious. Neither is the occurrence of congestive heart failure in two patients in the week following uncomplicated anaesthesia and surgery obviously explained. These findings are best explained by considering the cardiac dysfunction induced by anthracyclines which is well documented in the literature.⁸⁻¹⁷

Anthracycline-induced cardiac dysfunction may present in both acute and chronic forms. Arrhythmias are common acutely after the administration of anthracycline drugs and can include heart block, premature ventricular contractions and ventricular tachycardia.¹¹⁻¹⁴ The absence of arrhythmias in the present study is not unexpected. No patient in this study received an anaesthetic until at least three days after anthracycline administration and in no case was intraoperative anthracycline given. However, since hard copy printout of the electrocardiogram

during anaesthesia was rarely used and arrhythmias are frequently missed on video displays, their occurrence may have been underestimated. Acute myocardial injury may be produced by anthracycline administration and produce a sudden decrease of myocardial contractility. This can be mild or can produce severe myocardial damage and death; recovery can be minimal to complete. Although a number of anaesthetics in our study were administered within a week after therapy with anthracyclines, there was no relationship between intraoperative cardiovascular complications and the time interval since the last dosage. Smith *et al.*⁶ reported the death of a patient within 24 hours of an uncomplicated general anaesthetic during which intraoperative doxorubicin (Adriamycin®) was administered. This case appears to represent a severe acute myocardial injury from the intraoperative administration of doxorubicin; we warn against the administration of anthracycline drugs during an anaesthetic.

The chronic cardiomyopathy associated with anthracycline drugs is a dose-related phenomenon.^{1,2,13-16} Clinically apparent cardiomyopathy reportedly occurs in only one to two per cent of patients (adults and children) receiving less than 550 mg·m⁻² of anthracycline drug and becoming frequent as dosage increases over that amount.¹³⁻¹⁵ Patients who will develop cardiac dysfunction are not easily identified. None of the patients in our study received more than 550 mg·m⁻², but 5.8 per cent developed congestive heart failure, presumably due to anthracycline therapy since all were young. Development of clinically apparent cardiomyopathy at doses less than 400 mg·m⁻² is uncommon;² of our patients receiving less than this amount only one developed congestive heart failure, at a cumulative dose of 315 mg·m⁻². By utilizing other studies such as two-dimensional echocardiography or nuclear angiography, left ventricular dysfunction (cardio-

myopathy) can be demonstrated at cumulative doses as low as $120 \text{ mg} \cdot \text{m}^{-2}$, although no clinical manifestations generally are present in patients having received this dose.⁴ Cardiac function in patients who have developed congestive heart failure may improve for up to six months once therapy with anthracyclines is discontinued and may revert to normal at rest as evaluated by two-dimensional echocardiography. Normal resting function however does not imply normal cardiac reserve, as further studies of these patients have revealed abnormal responses to exercise and stress.^{4,18} This unpredictable nature of the anthracycline-induced cardiac dysfunction explains the lack of association between cumulative dose and cardiovascular complications in our study with its relatively small number of cases. The utilization of more sensitive monitoring techniques such as intraoperative transoesophageal echocardiography or pulmonary arterial lines may have revealed a greater incidence of increased intraoperative myocardial dysfunction; however, only two of our patients had indications for the use of pulmonary arterial monitoring, and the small size of most of our patients precludes the use of transoesophageal echocardiography. Preoperative electrocardiograms and chest radiographs were reviewed and it was found that the incidence of abnormalities suggestive of cardiomyopathy was significantly greater in the group with clinical incidence of congestive heart failure and with the higher incidence of intraoperative complications. However, when we looked at the group of patients experiencing intraoperative complications, abnormal electrocardiograms or chest radiographs provided no further indication over the clinical history of congestive heart failure or a propensity to develop intraoperative and cardiovascular complications. This agrees with early work of Lewis *et al.*⁹ who determined only non-specific electrographic changes during doxorubicin therapy in asymptomatic patients. Abnormal electrocardiograms were only obtained from patients with clinically diagnosed congestive heart failure, electrocardiograms, remained normal despite shortening fractions as low as 20 per cent in asymptomatic patients. In patients without symptoms, our data on chest radiographs is similar. Cardiovascular assessments by chest radiographs were reported as normal in all patients reviewed excepting those with pre-existing congestive heart failure. Likewise, studies have also revealed

the inaccuracies of the preoperative echocardiographic indices of left ventricular function because of their preload or afterload dependencies. The current development of load-independent indices may improve the accuracy of preoperative prediction of left ventricular function and therefore of prediction of perioperative cardiovascular complications.¹⁸

Increasing patient age has been shown to increase the risk of development of anthracycline-induced cardiac dysfunction,¹⁹ but this was not evident with the narrow age range in this study.

The combination of anthracycline drugs with other chemotherapeutic drugs as cyclophosphamide, actinomycin D, mitomycin and dacarbazine and the association with upper abdominal and mediastinal radiotherapy, is associated with an increased incidence of cardiac toxicity.²⁰ Because of the small numbers of cases and complications in our study, we did not feel that statistical evaluation of drug combinations and drug radiotherapy combinations would be valid.

Congestive heart failure occurred in two patients in the late postoperative period (Table VII). Neither of these patients had a history of congestive heart failure nor had received any chemotherapy since surgery. In one patient it is clear that viral myocarditis was responsible for the postoperative development of congestive heart failure. It remains unclear why congestive heart failure occurred more than 24 hours postoperatively in the second patient. It is possible that the stress of anaesthesia and surgery was partly responsible for this episode and emphasizes the need for intensive perioperative care of these patients.

From our study, several statements regarding anaesthetic management can be made. We demonstrated that there is no age, dose of anthracycline or anaesthetic technique that increases the risk of perioperative complications. Likewise, there is no apparent minimum or maximum time interval since the administration of the last dose of anthracycline that will increase or decrease the risk of perioperative cardiovascular complications. We did not, however, examine the patients who had received anthracycline agents within four days of anaesthesia and surgery.

The presence of the association of a history of congestive heart failure and perioperative complications brings into question appropriate monitoring. The two patients monitored with pulmonary arterial

lines were NYHA Class III and IV. In both patients, the information obtained from the pulmonary arterial monitoring enabled rapid diagnosis and appropriate treatment of the hypotension. The third patient was not monitored with a pulmonary arterial line. This patient was asymptomatic and it is difficult to state if pulmonary arterial monitoring would have provided essential information. Inotropic agents were not necessary, the blood pressure responding to fluid administration. The fourth patient was asymptomatic while receiving digitalis and diuretics and did not experience complications. From our study, these patients demonstrating clinical symptoms of congestive heart failure are most likely to benefit from the information obtained from pulmonary arterial monitoring. Although our study demonstrated no advantage of one anaesthetic technique over another, the limitations of our study were presented and we recommend a technique not affecting myocardial contractility. We have no information on advantages or disadvantages of regional anaesthetic techniques, although well-managed regional anaesthesia may be of benefit due to minimization of myocardial depression and good postoperative analgesia, their ready acceptance in paediatric patients may be difficult.

We conclude that cardiovascular complications in the perioperative period in anthracycline-treated patients who have no history of congestive heart failure are uncommon and those complications that do occur do not appear to be related to specific anaesthetic agents. Routine preoperative cardiologic and echocardiographic evaluation of these patients did not help us to identify those patients at risk for perioperative cardiovascular complications, except in the group with a clinical history of congestive heart failure.

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Résumé

Les dossiers anesthésiques de 68 patients dont l'âge varie de 0.5 à 22 ans ont été revisés afin de déterminer l'incidence des complications cardiovasculaires péri-opératoires chez les patients ayant été traités par l'anthracycline. Une revue rétrospective de 111 dossiers anesthésiques identifie sept complications cardiovasculaires (hypotension) pour une incidence de 6.3 pour cent. Parmi celles-là, seulement deux ont été définitivement attribuées à une dysfonction myocardique péri-opératoire. Ces deux patients avaient des antécédents d'insuffisance cardiaque congestive. Trois des quatre patients avec des antécédents d'insuffisance cardiaque congestive ont développé des complications. Lors de l'évaluation des indices pré-opératoires pouvant indiquer une complication cardiovasculaire péri-opératoire, seuls des antécédents d'insuffisance cardiaque congestive démontraient une relation statistiquement significative. Aucune relation n'a été démontrée entre la technique anesthésique et les complications cardiovasculaires péri-opératoires. Deux complications cardiovasculaires additionnelles sont survenues après un délai supérieur à 48 heures post-opératoires et leur significativité est discutée.