Informing the Patient about Cardiopulmonary Resuscitation:

When the Risks Outweigh the Benefits

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CARDIOPULMONARY RESUSCITATION (CPR), a relatively new technique, was first described in 1960.[1] The American Heart Association standards for CPR were published in 1974 and in revised form in 1980 and 1986.[2-4] Cardiopulmonary resuscitation is unique in that it is the only procedure that is routinely done without patient consent, and, in fact, most hospital policies call for the initiation of CPR unless the patient has specifically refused it. Hospitals are now required by the Joint Commission on Accreditation of Health Care Organizations to have a policy that includes provisions designed to assure that patients' rights are respected when decisions are made to withhold resuscitative measures.[5] In order for physicians to obtain truly informed consent or refusal for CPR and to implement appropriately "do-not-resuscitate" (DNR) policies, they must be knowledgeable about the risks and benefits of CPR for patients with a variety of underlying illnesses. This review was undertaken to answer the following pertinent questions regarding CPR: How effective is CPR? What are its risks and complications? In which patients would the risks appear to outweigh the benefits?

CPR LITERATURE REVIEW

Cardiopulmonary resuscitation is defined for the purposes of this review according to the standards and guidelines published by the American Heart Association.[3] Successful resuscitation is defined as the restoration of cardiac rhythm lasting for more than one hour after cardiac arrest. Temporary survivors are those patients who were successfully resuscitated but who died prior to discharge from the hospital. Survivors are defined as those patients who were discharged from the hospital alive after successful resuscitation.

A computer-assisted literature search using the National Library of Medicine Medical Literature Analysis and Retrieval System (MEDLARS) database was performed using the subject headings "cardiopulmonary resuscitation" and "outcome or prognosis" and the subheading "adverse effects" to identify articles published between 1980 and the present in the English language. A manual literature search was used to identify major articles published from the first report of CPR in 1960 to 1980. Articles describing results of in-hospital CPR of adults on general medical and surgical floors, as well as in intensive care units and/or emergency departments, were included in the data analysis and figures, and were compared with articles describing outcomes of CPR in specific hospital locations, e.g., the coronary care unit or the shock unit, or in specific patient populations, e.g., the elderly or patients with a malignancy. Each article identified was analyzed for information about the following when available: number of patients; percentages resuscitated successfully and unsuccessfully; percentage surviving to discharge; percentage of temporary survivors; percentage alive six months after discharge; possible good and bad prognostic factors for successful resuscitation and survival (including patient age, underlying medical illnesses, patient functional status pre-arrest, location of arrest, duration of arrest, number of prior arrests, and cardiac arrhythmia at the time of the arrest); and complications of CPR.

CPR RESULTS

Success of CPR

Nineteen series describing patient outcomes after CPR on general medical and surgical floors, in intensive care units, and in emergency departments were identified and analyzed for survival of patients (Table 1).[6-25] The mean percentage of patients resuscitated successfully was 41%. Fourteen percent (33% of those successfully resuscitated) survived to be discharged from the hospital. There was no significant trend towards improvement in survival in the more recent studies as determined by linear regression analysis of the data using the least-squares method (Fig. 1). A mean of 27% of all patients undergoing resuscitation survived temporarily (67% of those successfully resuscitated), and there was no trend towards a decrease in the rate of temporary survival in the more recent studies (Fig. 2). CPR was not attempted on all patients who died in these series (Table 2), and in the two articles that commented on patient selection, CPR was used for patients with sudden, *unexpected* cardiac arrest and not for patients with chronic illnesses whose deaths were anticipated.[6, 19] Percentages of patients alive six months after discharge ranged from 5.3% to 18.5%, with a mean of 12%, in the eight series in which this data was available.[7, 9, 11-13, 15]

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TABLE 1

Studies Included in the Analysis of CPR Outcomes

Study	Year	Hospital	No. of Patients	ICU*	Med-Surg*	ER*	OR*	Cath Lab*
Klassen et al.[21]	1963	Royal Victoria Montreal	126	–†	+	–	–	–
Stemmler[6]	1965	University of Pennsylvania Philadelphia	103	+	+	+	–	–
Johnson et al.[7]	1967	Royal Victoria Montreal	552	+	+	+	+	+
Saphir[8]	1968	Buffalo General Hospital Buffalo	123	+	+	+	–	–
Hollingsworth[9]	1969	University of Virginia Charlottesville	368	+	+	+	–	–
Castagna et al.[10]	1974	Hollywood Presbyterian Hollywood	137	+	+	+	–	–
Messert and Quagleri[11]	1976	Madison VA Hospital Madison	183	+	+	+	+	+
Peatfield et al.[12]	1977	Central Middlesex Hospital London	1063	–	+	+	+	–
Coskey[19]	1978	St. Joseph Hospital Burbank	1155	+	+	+	–	+
Tweed et al.[23]	1980	Winnipeg Health Science Center Winnipeg	1187	+	+	+	–	–
DeBard[13]	1981	St. Elizabeth Hospital Dayton	925	+	+	+	–	+
Scott[20]	1981	Edinburgh Royal Infirmary Edinburgh	78	–	+	–	–	–
Hershey and Fisher[14]	1982	Cleveland Metropolitan General Hospital Cleveland	79	+	+	+	+	+
Bedell et al.[15]	1983	Beth Israel Hospital Boston	294	+	+	+	+	+
Sowden et al.[22]	1984	Royal Infirmary and Frenchary Hospital Bristol	108	+	+	+	–	–
Scaff et al.[16]	1984	Memorial Hospital Corpus Christi	242	+	+	–	–	+
Skovron et al.[25]	1985	Beth Israel Medical Center New York	208	+	+	+	–	–
Urberg and Ways[17]	1987	Grace Hospital Detroit	121	+	+	–	–	–
Kyff et al.[18]	1987	Mt. Carmel Mercy Detroit	272	+	+	+	+	+
		TOTAL:	7324					

*ICU = intensive care unit (including coronary care unit); Med-Surg = medical and surgical floors; ER = emergency room; OR = operating room; Cath Lab = cardiac catheterization laboratory.

†+ designates location in the hospital where results of CPR were included in the article and – designates locations where the results of CPR were excluded.

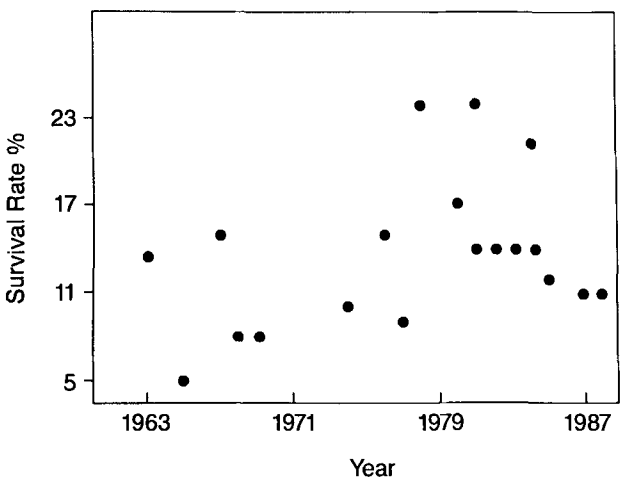

FIGURE 1. Survival rate for each study included in the review according to the year of publication.

The patients with the best survival rate had cardiac arrests secondary to an arrhythmias associated with myocardial infarction, congestive heart failure, or drug overdose or reaction (Table 3). Patients in whom intubation was not necessary during the resuscitation had a 49% survival in one series,[15] and there was an inverse relationship between the survival rate and the length of the procedure. Successful resuscitation requiring less than 15 minutes resulted in 56%[15] and 27%[16] survival rates in two series, whereas resuscitation lasting longer than 30 minutes resulted in no survivors in two studies[8, 15] and a 4.7% survival rate in a third.[16] In the 19 articles analyzed there was not a consistent effect of patient age or sex or location of the arrest on survival after CPR.

Underlying Conditions Associated with Low Survival Rates. On a consistent basis from series to

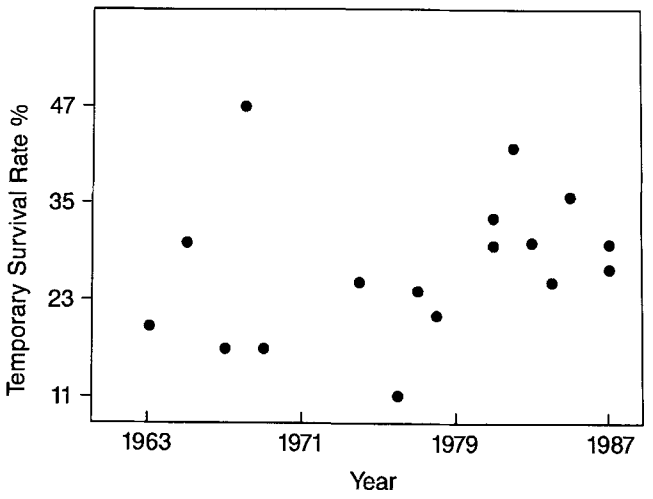

FIGURE 2. Temporary survival rate for each study in the review according to the year of publication. Data are not available for two articles.[9, 23]

TABLE 2

Percentages of Patient Deaths in Which CPR Was Attempted

Study		Deaths (%)
Stemmler[6]	1965	14
Peatfield et al.[12]	1977	9
Coskey[19]	1978	24
Tweed et al.[23]	1980	30
DeBard[13]	1981	28
Hershey and Fisher[14]	1982	20
Bedell et al.[15]	1983	30
Taffet et al.[30]	1988	33

series, patients with malignancies, neurologic disease, renal failure, respiratory disease, and sepsis had a less than 10% survival rate, and frequently there were no survivors of CPR with these conditions (Table 4). Patients who had asystole as the cause for their arrest,[9, 10, 22] multiple organ failure,[18] or more than one prior arrest[8, 10, 16] also had very low survival rates. Patients who were homebound or in a nursing home prior to the arrest had a survival rate of less than 5%.[14, 15, 17]

Success of CPR in Specific Locations and Populations. The efficacy of CPR in the elderly has been studied in several series and a major review.[26-30] In a German series reporting resuscitation results in 1978, 335 patients were resuscitated, of whom 239 (71.3%) were more than 60 years old.[26] The success rate for CPR was 33.4% and the survival rate for patients under the age of 60, 16.9%, was better than that for those over 60, 5.4%. Patients with malignancies and other terminal conditions were excluded from resuscitation in this study. Ninety-two percent of the 13 elderly survivors had either a myocardial infarction or cardiac arrhythmia as their underlying medical condition.

In an English series of 52 elderly patients with a mean age of 75.6 years who were resuscitated, there was a 27% success rate, with a 17.3% survival rate.[27] All patients successfully resuscitated had ischemic heart disease as their underlying medical condition. None of five patients with strokes and none of seven patients with chronic bronchitis were successfully resuscitated. Of the nine survivors, five had been living fully and four partially independently prior to the arrest. Patients with terminal malignancies, coma, and chronic illnesses who were totally dependent on others were excluded from resuscitation in this study.

In an American series of 292 resuscitated patients from 1967–69, of whom 162 (55.5%) were over the age of 60, the survival rate for patients over the age of 60 was equal to that for those under 60, 23%.[28] However, the over-60 group included a significantly greater percentage of patients with myocardial infarction, a condition associated with a better prognosis in patients undergoing CPR, and the under-60 group included a significantly greater percentage of patients with liver disease, neurologic disease, or cancers, conditions associated with a worse prognosis in patients undergoing CPR.

In a comprehensive review of CPR in the elderly, it was concluded that the success and survival rates for CPR do not decrease with advancing age.[29] Exclusion criteria for resuscitation and data on the percentage of dying patients in whom CPR was attempted were not included in many of the articles cited by the reviewers. In an article published since the review, none of 68 patients over the age of 70 years who was resuscitated survived, compared with 22 of 261 younger patients (8.4%).[30] The authors did a meta-analysis on an addi-

TABLE 3

Conditions Associated with the Highest Survival Rates

	Survival Rate (%)	References
Ventricular fibrillation after myocardial infarction	26–46	17,22,32
Drug reaction or overdose	22–28	12,23
Ventricular arrhythmia	19–50	9,15,17

TABLE 4

Conditions Associated with the Lowest Survival Rates

Condition	Survival Rate (%)	References
Malignancy	0–3.5	8,* 12,* 14,* 15, 17,* 22,* 30*
Neurologic disease	0–6.7	7, 8,* 9, 12, 15,* 18, 22,* 26*
Renal failure	0–10	7,* 8,* 9, 15, 18, 20,* 21*
Respiratory disease	0–7	12, 15,* 18, 21, 26,* 32
Sepsis	0–7	8,* 17, 30

*Survival rate for the disorder was 0%.

tional eight articles in the literature and found that patients more than 70 years old had a significantly lower probability of survival after CPR than did those with age less than 70 years old. Clearly, further research into the effect of age on outcome after CPR is required.

The success rate of CPR in a cancer patient population was 64.6% and the survival rate was 14.6%.[31] Although the success rate of CPR in this population with disseminated disease was 56.5% (13 of 23), none of the patients survived to discharge. Survival in patients with newly diagnosed or localized disease was 32% (7 of 22).

The success rate for CPR in a prospective study of myocardial infarction patients admitted to a coronary care unit was 39.3% (11 of 28).[32] If patients in cardiogenic shock, for whom the success rate was 0%, are excluded, then the success rate was 52.4% and the survival rate was 33%. The success rate in patients with ventricular fibrillation as the arrhythmia causing the cardiac arrest was 50% and their survival rate was 43.8%. Twenty-five percent of patients with asystole as the cause of their cardiac arrest were resuscitated successfully, but none survived.

Fifty of 132 patients (38%) in a shock research unit were successfully resuscitated, and six (4.6%) survived to discharge.[33] One of 65 patients with respiratory failure and none of 34 patients with metabolic acidosis from shock survived. Five of 33 patients in whom the arrest was preceded by an adverse drug reaction or an accident with airway management or interruption of mechanical ventilation (15.2%) survived.

Complications of CPR

Two-thirds of the 41% of patients from the series listed in Table 1 who were successfully resuscitated died prior to discharge. In studies in which temporary survival was examined, most temporary survivors were found to die a week or less after resuscitation,[6, 15] though 16 patients remained in a vegetative state for up to six weeks before dying.[7, 11] Altered mental status 24 hours after resuscitation was an extremely poor prognostic sign associated with a less than 2% survival.[15] A few percent to 14.3% of survivors were in a chronic vegetative state post-arrest and survived for up to 26 months.[10, 12, 15] Eight and six percent, respectively, of resuscitated patients suffered "brain damage" in two other series,[19, 22] and three of 23 survivors (13%) in the latter study had "cerebral impairment" at the time of discharge, which lessened over three months in two.

Depression was a common but temporary problem in patients who survived CPR and usually cleared within six months of the arrest.[15] In the one study looking at survivor functional status six months after discharge, it was noted that the number of patients homebound more than doubled from four to 14 (from 12% to 42%) and that new retirement was chosen by more than half (five of nine) of the patients employed pre-arrest.[15] At least half of the newly homebound patients reported that fear of another arrest led them to limit their activities so that they would have immediate access to medical care. A significant number of successfully resuscitated patients, 31% to 48%, chose not to undergo CPR again.[15, 18, 26]

Understandably, trauma was unavoidable and chest pain was an almost universal complaint of survivors of CPR.[6, 15] In one study in this series in which autopsies were done on patients who did not survive, complications of the CPR were found in 31%[8]: hemopericardium in 14.5%, fractured ribs in 13%, aspiration in 6.5%, and fractured sternum in 3% were the most common findings. Likewise, 20% of patients resuscitated suffered fractured ribs and/or sternum in a series examining survivors and nonsurvivors.[21]

Sixty-three successfully resuscitated patients were studied prospectively to determine the complications of CPR.[34] Ninety percent of the arrests were due to myocardial infarctions or ventricular arrhythmias and 25(40%) of the patients survived. Cardiac disease was responsible for 74%, pneumonia 18%, and brain death 8% of the deaths in this study. More than half of the deaths occurred in the first week after CPR. Twenty of the 63(32%) patients sustained injuries from the resuscitation, including rib and/or sternal fractures in 13 and flail chest in six. All six patients with flail chest died. Complications noted postresuscitation included pneumonia in 29 patients (46%), congestive heart failure in 31(49%), gastrointestinal hemorrhage in 25(40%), liver enzyme abnormalities in 18(29%), seizures in 19(30%), cerebrovascular accidents in five (8%), sepsis in four(6%), acute renal failure in four, and adult respiratory distress syndrome in three(5%). All of the patients with sepsis, acute renal failure, and respiratory distress syndrome died prior to discharge.

Autopsy series of patients in whom CPR was unsuccessful confirm the findings quoted in the above studies. Twenty-one to 46% of patients have had one or more complications of resuscitation, including most commonly fractured ribs and/or sternum, bone marrow emboli to lung, pulmonary edema, anterior mediastinal hemorrhage, aspiration, and gastric dilatation.[35-39]

Neurologic complications of global ischemia occurring with cardiac arrest and resuscitation potentially include brain death, a persistent vegetative state, seizures, impaired higher intellectual functions, amnestic syndromes, cortical blindness, bibrachial paresis, postanoxic myoclonus, hypoxic ischemic leukoencephalopathy, and spinal stroke.[40] Since there are few follow-up studies on the neurologic function of survivors of CPR, the true frequency of these complications is unknown. Several studies have examined neurologic prognosis in comatose resuscitated patients.[41-43] In one study, 15% of 150 patients regained independent function but not necessarily their prearrest functional

level.[41] None of 52 patients lacking pupillary reflexes at 24 hours became independent, and only three regained consciousness; no patient lacking corneal reflexes after 24 hours regained consciousness in this study. Of 63 patients resuscitated in a coronary care unit, 25 (40%) survived to discharge.[42] There was a strong correlation in this study with level of consciousness on the second day post-arrest and recovery; 23 of 29 patients who were awake or drowsy but able to respond to voice survived, compared with two of 27 patients who at best could be aroused briefly in response to a physical stimulus. Four patients died in a persistent vegetative state and three of brain death in this series. In another study, seven of 85 patients remaining comatose for more than 24 hours after resuscitation survived, but all with cerebral impairment; none of 44 patients comatose for more than seven days after resuscitation regained consciousness.[43] Twenty of 181 (11%) patients in this series died of brain death.

DISCUSSION

Cardiopulmonary resuscitation was developed for the treatment of patients with sudden, unexpected death.[2] When first described, CPR was intended for the treatment of cardiac or respiratory arrest in the setting of acute myocardial infarction, drowning, drug sensitivity, or intoxication, including anesthesia induction, electrocution, hypoxia from airway obstruction or suffocation, and cardiac catheterization.[3, 44] It was used selectively in the 1960s and early 1970s, but there has been a trend towards more widespread application in recent years (Table 2), prompted by the adoption of hospital policies requiring the performance of CPR in all cases unless a DNR order has been written.[45]

This review has shown that survival after CPR is high in hospitalized patients with conditions for which the procedure was initially indicated, such as cardiac arrhythmias in the setting of myocardial infarction or ischemia, and drug reactions including overdose, especially when it is considered that without the procedure the survival rate would be zero. On the other hand, the review confirms and enlarges upon the observations in previous reports[10, 11, 14, 15, 18] that patients with certain underlying conditions have a very poor survival rate should they experience a cardiac or respiratory arrest, even with the application of CPR (Table 4). The failure of the more recent studies of outcome after CPR to show an increased survival rate (Fig. 1) results from the application of CPR to an increasing percentage of patients who die in the hospital (Table 2). However, CPR survival rates have not decreased in recent years, because of an increase in survival of patients with cardiac conditions, due to earlier recognition of cardiac arrest with the more widespread use of cardiac monitoring equipment in hospitals.[19]

There are limitations to the analysis in this review, since the technique of CPR was performed by different personnel in different hospitals at different points in time on different percentages of deaths. Only four of the 19 articles reviewed were prospective studies;[8, 11, 15, 22] the remaining studies were retrospective. Also it is not clear that all patients counted as survivors in the various studies had experienced a full cardiac or respiratory arrest; some patients were neither breathless nor pulseless[13] and others were suspected of having had a seizure or syncopal episode.[11] The sizes of the patient populations varied in the 19 articles reviewed, as did the causes of the arrests. Data were not always available in each study on underlying conditions, age, sex, time from CPR to death of temporary survivors, and complications. Psychological state and functional status of survivors were examined in only one study.[15] Despite these limitations, there was significant agreement throughout the studies comprising this review on conditions associated with high and low survival rates and on the low survival rate of patients undergoing CPR more than one time or for more than 30 minutes. In most cases the biases present in this analysis would have inflated the survival rate, which, nonetheless, was low, and led to an underestimate of the complications of CPR.

Most guidelines, including those of the Joint Commission on Accreditation of Health Care Organizations, call for the patient's consent if CPR is to be withheld.[5, 45, 46] Often patients do know what they want with regard to resuscitative measures and they welcome the opportunity to state their preferences.[47-50] Patient participation in the decision-making process is maximized if the physician discusses the issue of CPR early in the hospitalization or prior to the need for admission, since if the physician waits until a medical crisis occurs, the patient may no longer be able to participate due to an abnormal mental status.[50] It would be ideal if physicians could inquire of every patient with a chronic, progressive condition his or her wishes regarding CPR and record these wishes in the medical record. Patients also may take the lead in expressing their preferences by giving advance directives in a living will or by specifying someone with a durable power of attorney for health care for themselves.

Patient education with as accurate a description of prognosis and the risks and benefits of alternate treatment options as is possible is the key to informed decision making by the patient. Based on the results of this review, a profile of the risks of CPR emerges that physicians should disclose to their patients. The average patient has a slightly less than 50% chance of being resuscitated, and if resuscitated, has a greater than 50% chance of dying prior to discharge. The resuscitated patient can be predicted to endure one or more of the following complications: temporary survival, often with prolonged mechanical ventilation in an intensive care unit; pain from rib and/or sternum fractures; pneu-

monia; pulmonary edema; permanent neurologic damage; and if the patient survives, depression, a reduction in functional status, and fear of another cardiac arrest. Patients should also be informed that about a third of patients resuscitated successfully refuse further CPR and may wish that the initial resuscitation had not been performed. As always when disclosing information regarding a procedure or treatment, the physician should make the presentation to the patient in a manner that is considerate of the patient's physical and emotional condition and that provides reassurance that the physician has kept the best interests of the patient in mind.

Treatment recommendations must be individualized for each patient, but it is clear from this review that many patients with malignancies, neurologic disease, renal failure, respiratory disease, and sepsis have a less than 5% chance of survival and a much greater than 50% chance of multiple complications from CPR. In these patients the performance of CPR is futile and can be predicted to cause much greater harm than benefit. In general, when a treatment has very little chance of benefit and a very high probability of causing harm, the physician is not obligated to propose or provide the treatment.[52] Thus, patients with chronic, progressive conditions whose deaths are anticipated pose an exception to the usual practice of providing CPR to all hospitalized patients, and the physician serves no useful purpose by offering the choice of CPR or no CPR to them.[53] In such cases, it is the responsibility of the physician to inform the patient that the risks of CPR outweigh the benefits and to present a realistic treatment plan, including DNR status, that will maximize the patient's comfort, peace, and dignity in his/her final days and minimize pain and suffering. In the event that the patient disagrees with the physician's plan, the physician should recommend to the patient that another physician or the hospital ethics committee be consulted for a second opinion. Hospital ethics committees are developing expertise on the subject of withholding and withdrawing life-sustaining treatments and are consulted appropriately when there is a conflict between physician and patient with regard to the use of CPR.

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REFLECTIONS

Waiting for HIV

I AM SCARED — probably more afraid than at any other time in my life. I am secluded in my office with a dictaphone in one hand and the results of my HIV antibody test clenched in the other. I feel as though my fate is concealed in this envelope.

Like many of my colleagues in health care, I have intermittently worried about contracting HIV infection from my patients. Because persons with AIDS are sometimes cruelly and unfairly ostracized, I have often hoped to comfort them with human contact unencumbered by gloves, gown, or goggles. I have been splattered with their secretions but usually felt safe in the belief that casual contact does not transmit the agent. Even now I have little apprehension about caring for HIV-infected patients, although I adhere more strictly to the recommended precautions.

A few years ago, a psychiatric patient, whom we had been asked to evaluate because of a positive RPR, complained to me of dysuria. No urethral discharge could be expressed. While I was inserting a wire loop into his urethra, he became agitated; as I withdrew the wire, it bent and then recoiled, splashing his urethral fluid into my right eye. I never learned his HIV antibody status.

Many months have passed since a medical student sullenly approached me to discuss a personal crisis. He had used intravenous drugs in New York City ten years previously. Since that time he had had only one sexual partner, to whom he was presently engaged. After noticing bilateral axillary adenopathy he had sought medical advice. His ELISA and Western blot tests for HIV antibody had been positive; his fiancee's ELISA had repeatedly been negative.

Recently I saw that medical student again at a conference. I recalled all the sweat, sputum, and other secretions from AIDS patients with which I had had contact. I remembered the urethral discharge hitting my eye. I relived that moment for the first of innumerable times.

If I were positive, in whom could I confide? More than rejection from my wife, I fear how the anxiety and mistrust might destroy us. Could she still kiss me? Would I still unhesitatingly offer my children a sip from my cup? The sense of impending doom seems more terrible than the doom itself. My three sons are all under six. If disaster were to befall me in the near future, two of them would not remember me. To miss their future would be unfathomably painful.

Perhaps I should blindly destroy the envelope. I argue that my lifestyle is not such that it would be changed on a rational basis because of the results. Moreover, I am not in any high-risk group. Curiously, I begin to contest my own innocence, as we doctors often doubt our patients' denials of drug use and sexual promiscuity.

I understand Bayes' theorem. A positive result, which would hang over me like the sword of Damocles, would be as likely a false as a true positive. Still, I can't sleep. Every headache is cryptococcal meningitis; every cough, Pneumocystis. The moment must be forced to its crisis.

HIV antibody is: "NEGATIVE"!

My relief is palpable. I am happy for my family and myself. But I'm still scared. — MARK J. DINUBILE, MD, *Department of Medicine, Cooper Hospital/University Medical Center, Camden, NJ 08103*