Sudden and Rapid Death During Psychological Stress

Folklore or Folk Wisdom?

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The life settings in which sudden death may occur can be classified into eight categories: [1] on the impact of the collapse or death of a close person; [2] during acute grief; [3] on threat of loss of a close person; [4] during mourning or on an anniversary; [5] on loss of status or self-esteem; [6] personal danger or threat of injury; [7] after the danger is over; [8] reunion, triumph, or happy ending. Common to all is that they involve events impossible for the victims to ignore and to which their response is overwhelming excitation or giving up, or both. It is proposed that this combination provokes neurovegetative responses, involving both the flight-fight and conservation-withdrawal systems, conducive to lethal cardiac events, particularly in individuals with preexisting cardiovascular disease; other modes of death, however, were also noted. Better understanding of the potentially lethal life situations and identification of individuals at risk may lead to the development of practical prophylactic measures.

FEW FOLKLORE notions have enjoyed as widespread and persistent popularity as those that ascribe sudden death to emotional shock. As far back as written records exist, people are described as dying suddenly while in the throes of fear, rage, grief, humiliation, or joy; a fate often believed by the devout to have been sanctioned by divine edict. Thus the Bible tells us that when Ananias was charged by Peter, "You have not lied to man but to God," he fell down dead; so did Sapphira, his wife, when told that "the feet of them which have buried thy husband are at the door and shall carry thee out" (5 Acts 3:6). Emperor Nerva is said to have died of "a violent excess of anger" against a senator who offended him, as did Valentinian while "reproaching with great passion" the deputies of a German tribe (1). Pope Innocent IV succumbed suddenly to the "morbid effects of grief on his system" soon after the disastrous overthrow of his army by Manfred, and King Philip V is said to have dropped dead when he realized the Spaniards had been defeated (2, 3). Chilon of Lacedaemon is alleged to have died from joy while embracing his son who had borne away the prize at the Olympic games (4). Benjamin Rush claimed that the doorkeeper of Congress, an aged man, died immediately upon hearing of the capture of Lord Cornwallis's army. "His death was universally ascribed to a violent emotion of political joy" (5). In more modern times the power of vengeful deities is no longer invoked, but the belief that intense emotional distress may induce sudden death persists unabated in the mind of the average man. Certainly novelists and playwrights have no compunction about arranging for their characters to succumb to a fatal heart attack or stroke in the midst of some emotional crisis. Nor does their public, scientifically so enlightened in many other ways, seem to find use of such literary devices implausible.

Among physicians over centuries the idea has also enjoyed wide credibility, and, indeed, in the 18th and 19th centuries medical writings abounded in such accounts (1, 3, 5-7). A well-known example is that of the redoubtable 18th-century surgeon, John Hunter, who apparently accurately predicted the

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manner of his own death when he said, "My life is at the mercy of any scoundrel who chooses to put me in a passion" (3, 8). But with the advent of scientific medicine in the late 19th century such notions, along with that of divine retribution, fell into disrepute as physicians embraced the more rational and objective view that "cause of death" was to be established at the necropsy table and in the laboratory. Since then consideration of the relationship between emotion and sudden death has virtually disappeared from the medical literature, or at best the idea is greeted with scepticism if not incredulity or downright ridicule. Yet the puzzling fact remains that, with only a little encouragement, many physicians in private conversations are quite ready to recount from their own practices examples of patients who apparently died suddenly under precisely such circumstances. Further, it is the rare physician who does not act on an inner conviction that certain patients, particularly those with heart disease, should be spared the dangers of undue emotional excitement. Why?

How is the persistence of such an idea to be explained? Does it merely represent another of those mass delusions to which man is all too prone, fostered perhaps by fortuitous coincidence or by a need to falsify the past? Or is it possible that it is an example of empirical folk wisdom, as was the case with the claims for the efficacy of foxglove for dropsy and lime juice for scurvy? Until quite recently any serious examination of this question has been discouraged by virtue of the dominance of single-factor concepts of disease causation, as well as by the exclusive bias toward cellular-biochemical mechanisms. The former requires proof that psychic factors constitute the *sole* cause of the death, and the latter virtually precludes consideration of psychological determinants altogether. Furthermore, and quite understandably, physicians have been reluctant to involve themselves in the more personal, psychological aspects of their patients' deaths. But the winds of change are now upon us and the taboo of studying death is disappearing, as evidenced by the recent emergence of thanatology as a discipline. Wide acceptance of multifactorial concepts of disease now makes possible the consideration of how disease and death may be induced through the interaction of many factors, including psychic and neural (9-11). New techniques, such as continuous monitoring, are providing heretofore unavailable physiological data on the process of dying, thereby illuminating the pathophysiologic processes that determine at what point in time a pathologic process may become lethal (for example, ventricular fibrillation in myocardial infarction), information that is not available at the postmortem table.

But more than theoretical considerations also justify such an inquiry. If psychic stress is indeed a factor potentially contributing to a lethal outcome in a vulnerable population, then identification of the population at risk, elucidation of the psychic determinants, and understanding of the mediating pathophysiologic mechanisms offer the promise that timely pharmacologic or psychotherapeutic intervention may be lifesaving. One population already identified as at risk from sudden death are men with previous myocardial infarction, angina pectoris, or known "risk factors" for coronary artery disease (12). It would be for precisely such a group that the possible role of psychic stress as a contributing factor to increased risk of sudden death deserves consideration, although proposals for "precoronary care" so far have not seriously considered such a proposition (12).

But before the mechanisms mediating such psychophysiological accidents can be studied it is first necessary to identify and classify the kinds of life circumstances and psychological reactions with which sudden death is alleged to be associated and to establish the prevalence of each association. To carry out such a survey would require access to a large population of sudden death victims whose deaths could be investigated in respect to the life settings in which the deaths occurred as well as to the patients' emotional reactions to the situations. The obvious practical impossibility of accomplishing this in a reasonable time, especially when still ignorant of how often sudden death actually is preceded by emotional upset, prompted us to turn first to a more readily available population whose deaths were already considered to be related to disrupting life events, namely, those reported from time to time in the daily press. Over a 6-year period we succeeded in collecting 170 such items, mostly from the Rochester press but also from newspapers here and abroad, wherever the author happened to be, as well as from interested colleagues who sent clippings. Only reports with clear reference to a precipitating life situation were used, and all instances in which suicide was even a remotely possible explanation were scrupulously excluded. Most deaths occurred within an hour of the event reported, although all the victims were considered still to be reacting emotionally to the event at the moment of their demise. In 16 instances we were able to get additional information from witnesses, attending physicians, the medical examiner, or the hospital.

This material is ample enough to permit identification and classification of the kinds of life circum-

Table 1. Age and Sex Distribution

Age	Men	Women	Total
yr	←	*no.*	→
10	0	1	3*
11 to 20	2	2	4
21 to 30	1	3	4
31 to 40	6	3	9
41 to 50	18	1	19
51 to 60	26	6	32
61 to 70	17	17	33
71 to 80	12	16	31*
80	8	7	15
Not specified	9	8	20*
Total	99	64	170*

* Including cases where sex was not specified.

stances alleged to precipitate sudden death. Its reliability will be discussed later.

Results

The total of 170 examples include 99 men, 64 women, and 7 persons whose gender was not specified (Table 1). As a group the men were younger than the women, 59% being under 61 years of age, compared with only 25% of the women. The peak period for men was at 45 to 55 years old and for women, 70 to 75 years. There were three children under 10 years old and four teenagers.

The life settings in which death was reported to have occurred could be divided into eight major categories (Table 2). Groups 1 to 5 represented various kinds of losses and groups 6 and 7, situations of personal danger or threats. Group 8 ("happy ending") and perhaps some of group 7 included people who died at times of relief, pleasure, or triumph. Settings of loss accounted for 102 deaths (59%); danger, 58 (34%); and "happy ending" for 10 (6%). Relatively speaking, women were more often reported as dying in relationship to a loss and men more often in response to danger. Thus, among the 64 women, 73% succumbed in relation to loss situations, whereas the figure for the 99 men was 54%. This difference between the sexes is more striking in the first two categories, which include all the sudden deaths occurring within 16 days of the loss of a close person. This accounts for 62% of the deaths among the women but only 31% among the men. The only category of loss in which men outnumber women is loss of self-esteem, of which there were nine instances among the men (9%) and none among the women. In contrast, 37% of the men were reported to have died suddenly in a situation of danger; this accounts for only 24% of the women's deaths.

SUDDEN DEATH IMMEDIATELY UPON THE IMPACT OF THE COLLAPSE AND DEATH OF A CLOSE PERSON

The impact of the collapse and death of a close person accounted for 36 deaths, 11 men and 25 women or 11% of the men and 39% of the women in the series. The typical story is of an elderly person collapsing and dying within moments of finding, or hearing the news of, a close person, usually the spouse, who had collapsed or died. Ten of the 11 men and 23 of the 25 women were over 60 years of age, indicating no age differential between the sexes for this category. Two were teenagers, a 14-year-old girl who dropped dead when told of her 17-year-old brother's sudden death and an 18-year-old girl who succumbed upon being told of her 80-year-old grandfather's death; he had helped raise her. Some survivors are reported to have collapsed after exclaiming that they could not go on without the deceased; others were in some phase of frantic activity, mouth-to-mouth resuscitation, trying to get help, or on a quick dash to the hospital. Ten of

Table 2. Distribution of Life Settings Among Men and Women

Setting	Men	Women	Gender Not Specified	Total
	←	*no.*	→	
On the impact of the collapse or death of a close person	11 (11%)	25 (39%)		36 (21%)
During period of acute grief (within 16 days)	20 (20%)	15 (23%)		35 (20%)
Threat of loss of close person	10 (10%)	6 (9%)		16 (9%)
During mourning or anniversary	4 (4%)	1 (2%)		5 (3%)
Loss of status or self-esteem	9 (9%)	0	1	10* (6%)
Personal danger or threat of injury, real or symbolic	27 (27%)	14 (22%)	5	46* (27%)
After danger is over	10 (10%)	1 (2%)	1	12* (7%)
Reunion, triumph, "happy ending"	8 (8%)	2 (3%)		10 (6%)
Total	99 (100%)	64 (100%)		170* (100%)

* Including cases where sex was not specified.

the persons whose demise precipitated the sudden death were described as having been ill for some time before their death, thereby contributing an element of more sustained concern or apprehension as well. Sometimes the death was in response to the loss of valued possessions, as the elderly woman who collapsed and died when informed that her house had been destroyed by fire.

Sufficient information is available to document the cause of the death as cardiac in seven instances and as cerebral hemorrhage in one. Fourteen more were presumed by the newspaper to be cardiac in origin.

An 88-year-old man, without known heart disease, became upset and excited, wringing his hands, upon being told of the sudden death of his daughter. He did not cry but kept asking, "Why has this happened to me?" While talking with his son on the phone he developed acute pulmonary edema and died just as the doctor reached the house.*

A 71-year-old woman arrived by ambulance at the emergency room, accompanying her 61-year-old sister who was pronounced dead on arrival. The patient collapsed at the instant of receiving the news. An electrocardiogram showed AV dissociation or a nodal rhythm with retrograde conduction, left bundle block and myocardial damage. Shortly she developed ventricular fibrillation and died.†

The wife of the owner of the motel in which Martin Luther King was assassinated collapsed the same day with a cerebral hemorrhage and died the following day.

SUDDEN DEATH DURING ACUTE GRIEF

Thirty-five people died within a period of hours to up to 16 days after the death of a close person; 20 men and 15 women, approximately the same percentage in both sexes. Seventy percent of the women were over 60 years old compared with only 39% of the men. Again the commonest loss was the death of the spouse, but sometimes symbolic relationships were involved.

A dramatic example is the death of the 27-year-old army captain who had commanded the ceremonial troops at the funeral of President Kennedy. He died 10 days after the President of a "cardiac irregularity and acute congestion," according to the newspaper report of the medical findings.

A 39-year-old pair of twins who had been inseparable died within a week of each other; no cause of death was mentioned.

A 64-year-old woman who was said never to have recovered from the death of her son in an auto accident 14 years earlier died 4 days after her husband was murdered in a holdup.

In one case the victim was also involved in a minor accident, but suffered no injury.

A 69-year-old man, returning home from visiting the grave of his wife who had been buried the day before, bumped lightly into the rear of the car ahead of him. While waiting in his car for the police to complete their report, he was noticed by a witness to get out, walk around, and then get back into the car and slump over the steering wheel, dead.

Exertion may have been a contributing factor in the case of the 47-year-old man who died while helping to dig the grave for a friend.

Four of the deaths in this category were documented to be cardiac in origin, and 12 are presumed to be cardiac, 2 being persons known to have heart disease.

A 52-year-old man had been in close contact with his physician during his wife's terminal illness with lung cancer. Examination, including electrocardiogram, 6 months before her death showed no evidence of coronary disease. He died suddenly of a massive myocardial infarction the day after his wife's funeral*.

Three people with malignant disease, but not terminal, had a sudden worsening in their condition upon a sudden loss and died within hours.

A 22-year-old girl with malignant paraganglioma had been deteriorating but was still able to take drives with her mother. On one such outing the mother was killed when thrown from the car in an accident; the girl was not injured. Within a few hours she lapsed into coma and died. Necropsy showed widespread metastases but no evidence of trauma†.

A 31-year-old woman had been having headaches, nausea, and visual difficulties for a brief period when her neighbor and close friend, also 31 years old, died suddenly. Two days later the patient lapsed into coma and died. Necropsy revealed a glioma of the right frontal lobe.

Five other people were noted to have been ill for some time before the loss that immediately preceded their own death.

A 56-year-old minister who had retired because of "ill health," died 4 days before he was to have conducted memorial services for a close friend.

A 74-year-old man who for 3 months had been seriously ill with emphysema died 2 days after his 40-year-old son dropped dead of a coronary; he had not been considered terminal up to that point.

SUDDEN DEATH DURING THREAT OF LOSS OF CLOSE PERSONS

There were 10 men and 6 women whose sudden death occurred during times when they were con-

* I am indebted to Dr. Stanley Jackson, Mt. Morris, N.Y., for this information.

† I am indebted to Drs. Robert Davis and Herbert Constantine of Providence, R.I., for this information.

* I am indebted to Dr. Albert Chase, Los Angeles, Calif., for this information.

† I am indebted to Dr. John F. Edland, Medical Examiner, Monroe County, N.Y., for necropsy findings.

cerned about the illness or injury of close persons. Eight of the men and two of the women were under 60 years of age.

In 11 of the 16 people in this category the threat of loss was abrupt and dramatic, which no doubt accounts for their appearance as news items.

A 40-year-old father slumped dead as he cushioned the head of his son lying injured in the street beside his motorcycle.

A 53-year-old woman dropped dead while visiting her sister who was in the hospital, about to undergo surgery.

A 67-year-old woman died while waiting to hear news of friends in a disastrous nursing home fire in which several died.

A 43-year-old man died 4 hours after his 15-year-old son, faking a kidnap call over the phone, said "If you want to see your son alive, don't call the cops."

The less dramatic cases involved people who had been burdened with prolonged and serious illness of family members. Personal experience suggests that deaths under such circumstances actually are considerably commoner than may be inferred from newspaper reports (10, 13).

Again, most of the deaths—12 of the 16—were ascribed to "heart attacks"; but only one is documented with certainty.

One patient, a 31-year-old woman, died of an unexplained intra-abdominal hemorrhage. She had been concerned about the ill health of her neighbor and close friend when she herself suddenly took ill and died within a few hours. The neighbor died 2 days later of a brain tumor (*see* above).

SUDDEN DEATH DURING A PERIOD OF MOURNING OR ON THE ANNIVERSARY OF A DEATH

Five cases connected with mourning or an anniversary were encountered, four men and one woman.

A particularly poignant case is that of a 70-year-old man who dropped dead during the opening bars of a concert held to mark the fifth anniversary of his wife's death. She was a well-known piano teacher, and he had established a music conservatory in her memory. The concert was being given by conservatory pupils.

A 17-year-old boy collapsed and died at 6 AM, 4 June 1970; his older brother had died at 5:12 AM, 4 June 1969, of multiple injuries incurred in an auto accident several hours earlier. The cause of the younger boy's death was massive subarachnoid hemorrhage caused by a ruptured anterior communicating artery aneurysm*.

SUDDEN DEATH DURING LOSS OF STATUS OR SELF-ESTEEM

Ten people died in relationship to loss of self-esteem or status. Nine were men; the gender of the tenth, an elderly victim of a swindle, was not specified.

A 57-year-old man died 2 weeks before the demolition of the hotel where he had been employed for more than 30 years. A friend said, "He was a lonely man, it was his whole life."

A 56-year-old man died a week before the closing of a highly successful business he and his brother had founded with a $500 loan 32 years earlier.

Two men, confidently expecting promotions to important positions, dropped dead when their expectations were dashed.

A well-known 41-year-old sports figure was supremely confident that he would be appointed manager of a professional team and had already indicated so to the press. He was with his family awaiting notification when the disappointing news reached him. Visibly crestfallen, he walked out of the house with his brother-in-law, when purely by chance a stranger jumped into the brother-in-law's car and sped off. Impulsively he leaped into his own car and gunned away from the curb in pursuit. He was found dead slumped over the wheel a few blocks away.

A physician, 53 years old, who had suffered a myocardial infarction a couple of years earlier, reacted with outrage when told by his chief that he was not to be the choice to succeed him. He soon composed himself, but 4 days later, a few hours after a chance meeting with his chief, he again became angry in the presence of witnesses; he collapsed and died but not before ECG had shown ventricular fibrillation.

A 52-year-old college president who prided himself on his support of black students died when a group of black students occupied the administration building.

A 57-year-old state legislator died 48 hours after being convicted of bribery and sentenced to prison.

The 41-year-old director of a relief organization under investigation for fraud died a few hours after being forced by court order to turn over the records of the group to a detective.

A newspaper reporter who had for years stoutly defended the name of a high public official long since dead died suddenly at a banquet commemorating the anniversary of the latter's 101st birthday. One of the invited speakers had stunned the audience by taking the occasion to make charges about the personal life of the official being honored. The reporter rose to his feet in a vigorous defense of the man he so much admired, expressing himself with great feeling and resentment: One account claims that the truth of the charges was publicly acknowledged at the banquet, to which the reporter commented sadly, "In Adam's fall we sinned all." He died a few minutes later.

Six of these nine men are known and three are presumed to have had coronary heart disease before their deaths.

SUDDEN DEATH IN A SETTING OF PERSONAL DANGER OR THREAT OF INJURY, REAL OR SYMBOLIC

There were 46 deaths in a setting of personal dan-

* It was Dr. John F. Edland, Medical Examiner, Monroe County, N.Y., who recalled that a young man with the same surname had been killed in an auto accident the previous year and thereby established from his files the remarkable coincidence of the time of death on the first anniversary of the brother's death.

ger or threat of injury; 27 men, 14 women, and 5 whose sex was not specified. Referred to by some as "scared to death," this group accounts for 27% of the male deaths and 22% of the female deaths. Three quarters of the men were under 60, compared with only half of the women.

The types of situations reported included natural and man-made disasters, such as earthquakes, storms, shipwrecks, explosions, fires, and riots. Some of the victims were on the fringe or merely spectators while others were in the midst of the action or seeking refuge.

Although fear was emphasized or implied in most of these accounts, two women involved in shipwrecks "gave up" when realizing that their children had been swept overboard.

Occasionally the minor repetition of an earlier incident was responsible, as the 50-year-old man who had survived a major earthquake only to die sitting at his desk during a minor tremor a few months later.

The youngest reported cases were a 3-year-old child who died when caught in a severe downpour and a terrified 4-year-old girl who died while having some milk teeth extracted.

Three deaths were ascribed to viewing particularly gory scenes on television.

Other deaths involved more personally directed dangers or threats, such as being held up, threatened by hoodlums, or fighting fires.

A 63-year-old security guard died after being bound by robbers.

Some victims were merely observers.

A woman seeing some teenagers outside her apartment beating and robbing a bus driver died while phoning the police.

Three deaths occurred in the courtroom or in relationship to questioning.

A 35-year-old man accused of robbery told his lawyer, "I'm scared to death!"; then collapsed and died.

A 55-year-old man died after supplying the police with the license number of a murder suspect.

A 61-year-old attorney died while talking with the police about the murder of his client by her estranged husband.

A few deaths were in relation to rather minor incidents.

A 66-year-old man whose car broke down on the expressway died while trying to flag down passing motorists.

A 52-year-old city official died after giving a speech in a hotel; his predecessor had died under the same circumstances at the same hotel a year and a half earlier.

A 45-year-old man died as he stepped to the dais to give a speech at a testimonal dinner.

Two people died remonstrating with other people.

A women died while arguing with the mother of a 13-year-old boy who had exploded firecrackers on her lawn.

A 61-year-old man shouted at boys who had been throwing stones at him and then collapsed when he went into a nearby store to phone the police.

Three deaths were definitely owing to heart disease and four to intracranial hemorrhages, two subarachnoid and two intracerebral. Twenty-eight deaths were ascribed to heart attacks without corroborating evidence, although four persons were known to be under treatment for heart ailments at the time of death.

SUDDEN DEATH AFTER THE DANGER IS OVER

There were nine men and two women who were reported to have died soon after a dangerous situation was over. Four of the men and both of the women were more than 60 years old.

Four men died within from minutes to a few hours after automobile accidents in which they suffered no or only minor injuries.

A 71-year-old man died while talking with firemen after fire trucks answered a false alarm at his home.

A 48-year-old newspaper reporter covering one of the manned moon flights died immediately after the splashdown had been safely accomplished.

One man died at an evacuation center after being removed from an area of mud slides, and another man, 55 years old, collapsed immediately after he walked uninjured from a railroad car partly overturned in a train wreck.

A 72-year-old woman died after chasing a purse snatcher; she was sitting on a bench talking to a policeman a short time afterwards when she fell over dead.

A 64-year-old woman, who had been shoved and slapped by a robber holding up a grocery store, died suddenly the next day from a dissecting aneurysm of the ascending aorta with cardiac tamponade.

Besides the dissecting aneurysm, two other deaths proved to be related to heart disease; seven were implied to have such origin, one in a man known to be under treatment for heart disease.

SUDDEN DEATH AT TIMES OF TRIUMPH, SUCCESS, OR "HAPPY ENDING"

There were eight men and two women in the category of death at times of triumph, success, or "happy ending." Two men and two women died during reunions after long separations.

A 60-year-old ex-prisoner collapsed and died when he returned home to his family after serving a 15-year sentence.

A 55-year-old man died when he met his 88-year-old father after a 20-year separation; the father then dropped dead.

A 76-year-old woman died as she stepped from a bus

and embraced her daughter whom she had not seen for 5 years; another woman of 75 died suddenly after a happy week of renewing ties with her family, whom she had left behind in Russia 60 years before and had not seen since.

Two men, aged 49 and 54 years, suffered "fatal heart attacks" immediately after celebrating family anniversaries, which had been postponed pending their recovery from earlier coronary attacks.

A 70-year-old man died 6 hours after his wife came home from the hospital, presumably recovered from a heart attack. She herself then had another attack and died 13 hours later.

Three men died at the peak of triumph.

A 56-year-old man collapsed and died while receiving congratulations for scoring his first hole-in-one.

A 75-year-old man, who hit the twin double for $1,683 on a $2 bet, died as he was about to cash in the winning ticket.

A 63-year-old operatic singer died while acknowledging an ovation.

Discussion

RELIABILITY OF DATA

The most immediate question concerns the reliability of such news items, the reporting of which obviously is determined by their dramatic quality or anticipated reader interest. Certainly most of the diagnostic explanations offered can be discounted, except for those few instances where necropsy findings are reported or where this investigator obtained the information directly from a reliable professional source. But in respect to reported life settings a considerably higher level of confidence seems justified. In the first place, the distribution of significant life events noted among the first 100 items was not significantly altered by the addition of 70 more (10). This would encourage us to believe that even if reporting were inaccurate in some of the items, the overall distribution is essentially correct. Further, the kinds of life events correspond closely with those that we have already noted to precede illness in general (10, 13). And finally, the 16 instances in which we were able to obtain independent data yielded elaboration but no fundamental contradiction of the basic information reported in the press. Thus, although the information derived from the press is sparse at best, and some items may be partly or even totally incorrect, there, nonetheless, is a consistency about the kinds of circumstances reported that is impressive. Completely unknown at this point is how often sudden death is preceded by such events.

Most of the accounts in the medical literature are anecdotal, and the earlier writings, emphasizing mainly situations that they believed were evocative of intense grief, rage, fear, or triumph (1, 3, 5, 6, 8, 14, 15), closely resemble those reported in the press. The more modern accounts are chiefly preoccupied with the importance of rage (16-18) or fear (16, 19-26), whereas reference to the shock of loss, overwhelming grief, or humiliations is infrequent (27-29). "Dying of fright" is the most popular concept. Barker (19) describes 42 persons, 28 men and 14 women, drawn from his own experience and from the literature, all alleged to have died of fright. The ratio of men to women is almost identical with that found in our series. Prominent among his cases are persons who had entertained a deep conviction of the inevitability of their own deaths at a particular time or under particular circumstances, sometimes based on predictions made by fortune tellers years earlier. One such patient died postoperatively of acute meningococcemia (20). Walters' patient (21), convinced that she would die in her 42nd year as had her mother and aunt, became increasingly panicky as the anniversary of her mother's death approached. She collapsed on that date and died the next day, in the 7th month of her 42nd year.

Terrified patients who died immediately before a minor surgical procedure or during induction of anesthesia are cited by a number of writers; of the four who were necropsied, three showed no abnormality, and the other had a pulmonary embolus (3, 16, 22, 23, 25, 26, 30). A number of reports concern patients with heart disease who succumbed in situations of fright or excitement, including watching a wrestling match, during ward rounds, and upon administration of last rites (2, 17, 18, 31-35). Helpern reports 12 patients who died suddenly of subarachnoid hemorrhage during an altercation (17).

Deaths from fright among primitive peoples in response to voodoo and witchcraft are discussed by Yawger (36), Cannon (37), and Burrell (38).

A somewhat different emphasis concerns the sudden death of persons who have lost the will to live and who display a calm acceptance, even a welcoming, of death rather than panic (26, 39-43). Cannon (37) and Burrell (38) believed this to be important in some voodoo deaths, as did Barker (19) of some of the persons who felt their deaths to have been preordained. Weisman and Hackett (44) designate this as "predeliction to death." A well-documented press account (not included among the 170) tells of a very independent, unmarried man in his 70's who made elaborate preparations for his own death and burial, including the purchase of a burial plot, casket, and headstone, as well as supervising the landscaping of the plot. Witnessess agreed that he went about these arrangements with determination and good spirits. One week after a medical checkup had pronounced him in good health, he called his family

together and, over their protests, distributed his belongings, saying "I don't need anything anymore." Virtually as the last item was disposed of he dropped dead before his astonished relatives*.

Although the old literature makes frequent references to sudden death at times of joy or triumph, few documented cases are available from more recent writings. Patients with coronary artery disease have been reported to die suddenly on being reunited with a relative after a long separation, on holding a royal straight flush in a poker game, and one patient died while celebrating his doctor's verdict that his heart was sound (28, 31).

OVERWHELMING EXCITATION, LOSS OF CONTROL, AND GIVING UP AS THE COMMON DENOMINATORS

When the data gathered from the literature and from the 170 press reports are examined together, certain characteristics of the lethal life situations seem to emerge. For the most part they involve events that are impossible for the victim to ignore, whether this be because of their abrupt, unexpected, or dramatic quality or because of their intensity, irreversibility, or persistence. In other terms, the individual is experiencing or is threatened with overwhelming excitation. In keeping with this is the general impression that such situations are commonly marked by intense emotions of one sort or another. Implicit also is the idea that the person no longer has, or no longer believes that he has, mastery or control over the situation or even over himself; or else he fears that he will lose such control as he may have. This may be inferred from the frantic and sometimes disorganized activity displayed by some and from the paralysis or inactivity exhibited by others. This would suggest either that the person feels overwhelmed and at a loss about what to do or that he is in conflict about or without confidence in the effectiveness of what he is doing or proposes to do. At times this reaction would seem to progress to the point of believing that there is nothing that can be done to change the situation or that it is no longer worthwhile even to try to do so; some persons may then expect and wait for death quite calmly. In brief, the responses range from struggling to cope with what is experienced as an overwhelming situation all the way to giving up completely, even to the point of accepting death with equanimity.

But to test such an assumption, knowledge of the victim's mental status before the fatal event is necessary; it cannot be inferred from the life circumstances alone. For obvious reasons such information is difficult to obtain, but fortunately there are a few accounts in the literature of patients who were undergoing psychotherapy or were even being interviewed at the time of their death. In general such reports support the thesis. They also indicate that, although many different affects may be exhibited at different times in the period immediately preceding death, the most consistent and pervasive are the giving-up affects, helplessness or hopelessness (13).

Saul's (45) three patients died suddenly in situations of impasse, where they could neither fight nor escape.

A 45-year-old man found himself in a totally unbearable situation and felt forced to move to another town. But just as he was ready to make the move difficulties developed in the other town that made the move impossible. In an anguished quandary, he, nonetheless, boarded the train for the new locale. Halfway to his destination, he got out to pace the platform at a station stop. When the conductor called, "All aboard," he felt he could neither go on nor return home; he dropped dead on the spot. He was traveling with a friend, a professional person, with whom he shared his awful dilemma. Necropsy showed myocardial infarction.

Another man, 40 years old, fell dead at his desk when his pleas to his mother to help him with his gambling debts were met with an adamant "No!" Gangsters had threatened to beat him up if he did not immediately pay up. Immature and dependent, he had leaned on his wealthy parents for financial support and employment. But they suffered financial reverses, he lost his job, and his wife left him. He turned to gambling to satisfy his craving for money and self-esteem. His mother's refusal closed the last door. Necropsy demonstrated myocardial infarction.

A 33-year-old woman with a history of occasional mild asthma developed status asthmaticus and died suddenly. She had developed paranoid delusions about her husband; she believed she could not live with him or near him for fear of his plots, yet could not leave him either. Every solution seemed impossible.

Coolidge (46) describes the death of a 45-year-old woman undergoing psychoanalysis who had a growing belief that death was the only solution for an intolerable situation. She felt a hopeless inability to resolve the problems of an unhappy marriage that she believed would destroy her, and she felt too old and too afraid of being alone to break away to start life anew. She collapsed an hour after what she interpreted as a rejection by her analyst and within several minutes after a rejection by her husband. This had been preceded by the deaths within 7 months of both parents and a disappointing visit to her only daughter. Rushed to the hospital, she was pulseless and found to be in ventricular fibrillation.

Bauer (16) gives the account of the sudden death during an interview of a 27-year-old asthmatic woman. The patient apparently died of cardiac standstill and did not exhibit asthma either before or during the interview. She had been reluctantly drawn into a discussion of her

* McDermott Jack: "The Man Who Died on Time." *Life*, ca. 1958. Unfortunately, the clipping in my possession is undated.

psychological problems, including the humiliation of a seduction, an illegitimate baby, and a rape attempt by her brother. As she recounted how she had been increasingly rejected by and cut off from her family and had had to quit junior college and take menial jobs only to lose them because of asthmatic attacks, she became increasingly excited, cried, hyperventilated, and finally collapsed unconscious just as she was saying, "Naturally I always lost my job and had no hope anymore to recover. That's why I wanted to die and want to die all the time, because I am no good, no good!"

Dunbar (47) writes of an ambitious 45-year-old professional woman who finally was offered "the perfect job." For years she had had nightmares that showed her in an unfavorable light: someone betrayed her, got her down, or she made a stupid mistake that laid her open to defeat. After 2 months in her new job she became upset by a woman in her department who seemed extremely jealous and threatened to interfere with her promotion to a top administrative post. One night at 3 AM she awakened with a scream, sat bolt upright, and gasped, "That woman, she got me at last." Necropsy revealed no cardiac disease.

Mathis' patient (48), a 53-year-old man, died suddenly in an acute asthmatic attack within an hour of defying his mother's prediction of "dire results" if he went against her will. His first asthmatic attack had occurred 9 months earlier when, with his wife's support, he for the first time made a major decision counter to his mother's wishes. It was at that time that his mother first forecast terrible consequences for his disobedience, "Something will strike you!" Thereafter frequent severe asthmatic attacks, three convulsions, and numerous hospitalizations, coupled with frequent reminders by the mother of dire results, culminated in his feeling hopeless about his condition. His fatal attack came after psychotherapy had enabled him to make a decision without consulting his mother. When he told his mother, however, she ended the conversation with another reminder of her dire warning, regardless of what he or the doctors believed. He died an hour later.

Knapp and associates (49) report on the setting of sudden death in an asthmatic patient undergoing psychoanalysis at the time. He died on the day he was to resume treatment after a summer interruption. The treatment had been interrupted on a note of doom, where every further step in the treatment seemed to face him with further loss; at every level he was a loser, and to him the doctor had become an accuser instead of an ally. The authors suggest that for this patient death was in some way a welcome solution for his dilemma.

The one kind of situation preceding sudden death that at first glance might seem to be in contradiction to this formulation is associated with joy and triumph. Yet some clearly involve sudden intense excitement, whereas others, particularly reunions after long separations, commonly are preceded by longer or shorter periods of anxious and often painful waiting and anticipation. These circumstances, as well as the narrow escapes from danger, are also conducive to the reawakening of disturbing memories and fantasies of past losses and threats and, hence, may evoke giving-up feelings, at least momentarily. Other cases may involve long-sought goals being achieved at last, after which the person feels let-down and gives up. Feldman (50) applies similar reasoning to explain crying with a "happy ending." The tears, he suggests, reflect not happiness, but sadness for all that has been missed while waiting for the happy outcome.

SUDDEN DEATH AMONG ANIMALS

Sudden death under situations of psychologic stress is by no means confined to humans. Trappers and zoo keepers long have known that animals may die when escape becomes impossible or when the animal is transferred from a familiar to an unfamiliar locale, is immobilized, or is exposed to unexpected or excessive stimulation. Deaths also occur after fights without injury and after the deaths of mates (51-55). Captive wild rats, as well as ruffed grouse, may die when subjected to an intimidation display by cage mates attempting to establish dominance (3, 85). Even the cockroach, prevented by pinning from escaping the threatening pose of a dominant roach, also pinned down, may die, even though there is no actual physical contact (56). We reported the death of a llama within minutes after seeing her mate of 13 years shot and killed (10). In a much-quoted study, Richter provoked sudden death in wild rats by subjecting them in rapid succession to restraint, trimming of the whiskers, and immersion in a swimming jar under a jet of water (54, 57). He evoked the concept of "giving up" as an explanation, since rescuing the animal just as it sank in the water enabled it to swim as long as unstressed rats; the rats, so to speak, discover that their situation is not hopeless after all.

POSSIBLE MECHANISMS OF DEATH

We can only speculate about the mechanisms of death in these cases. Most would agree that effective cardiac arrest, whether caused by ventricular asystole or by ventricular tachyarrhythmias, is probably responsible for the death of those who collapse and die within minutes, as was the case with most of the patients in this series (34, 58). The literature indicates that up to 65% of sudden deaths occur in individuals with diseases of the heart and aorta, chiefly arteriosclerotic heart disease (24). Spain, Bradess, and Mohr (59) found that death could be attributed to coronary disease in 91% of men and 52% of women who die within an hour. Yet, although most patients, both men and women, fall in the age groups in which sudden death from coronary disease is commonest, other diseases known to be lethal also occurred, and no doubt some

patients would have been found on necropsy to be free of any demonstrable disease, cardiac or otherwise (24, 60).

Be that as it may, when looked at from the psychological perspective, it seems likely that conditions conducive to rather profound neurogenic cardiovascular influences existed in these people at the time of death. Most writers have tended to stress excitatory phenomena, which are well known to be associated with pronounced sinus tachycardia and ventricular irritability (61-63). But such are not present in all cases, certainly not in those who accept death calmly (19, 37, 38, 44). More consistent are inhibitory phenomena, as exemplified in the various aspects of giving up. This leads us to suggest that some of the lethal influences may involve rapid shifts between sympathetic and parasympathetic cardiovascular effects; that is, when uncertainty, both in a psychological and physiological sense, is prominent*. Elsewhere we have discussed this concept in terms of two major biological defense systems, flight-fight and conservation-withdrawal, which are separately represented in the central nervous system (64, 65). Gellhorn has pointed out that under the influence of increasingly strong stimuli and states of heightened central excitability, parasympathetic responses may ultimately become dominant, with the result that stimuli that previously elicited sympathetic responses may now elicit parasympathetic responses (67). This would indicate a shift from a flight-fight (ergotropic) to a conservation-withdrawal (trophotropic) pattern. This relationship is well illustrated in vasodepressor syncope, which characteristically occurs in settings in which the impulse to flee is inhibited, at which point tachycardia commonly is replaced by bradycardia (68, 69). Richter (54, 57) invokes a parasympathetic influence to explain the death of rats during stress, whereas Wolf (70) relates sudden death to the primitive diving reflex. In either event, these are ideal conditions for the development of cardiac arrest and lethal arrhythmias, especially in the presence of preexisting coronary artery disease. James (71) has pointed out how both neurogenic adrenergic and cholinergic activity, in conjunction with local myocardial factors, may lead to various escape rhythms. With slow heart rates, such as may be neurogenically induced through vagal mechanisms, there is increased dispersal of refractory periods at various points on the ventricular surface, facilitating the development of reentrant extopic activity and ventricular fibrillation. A-V block caused by ischemia or injury of the A-V node or His's bundle may be exaggerated to the point of prolonged, even fatal aystole, as demonstrated by the sensitivity to carotid sinus massage in patients with myocardial infarction (69). In the presence of QT prolongation, whether related to a hereditary defect, to acquired potassium or calcium deficiency, or to phenothiazines, single or multiple ventricular premature beats may lead to ventricular fibrillation (72). James (73, 74) calls attention to the importance of this mechanism as an explanation of sudden death in infants and young athletes and emphasizes the role of emotion.

The fact that all of such electrocardiographic changes, including QT prolongation, premature beats of any origin, and ventricular fibrillation, have been provoked experimentally in animals and in humans by stimulation of the central nervous system, from cortical as well as subcortical areas, leaves no doubt of the existence of higher neural mediating systems (75-79). Finally, the occurrence of similar electrocardiographic or rhythm disturbances in patients with cerebrovascular accidents and during psychological stress is consistent with such a psycho-neurocardiovascular circuit (33, 80-87)*. Further, the specific psychological situations during which such arrhythmias occur correspond closely with what we have postulated to be important for sudden death. Thus, Meinhardt's (85) patient developed complete right bundle block, complete atrioventricular block, or third degree heart block, when he felt there was nothing he could do about his anger at being neglected. Marmor and Kert's (84) patient developed paroxysmal ventricular tachycardia in situations in which he had over-committed himself and felt in danger of being humiliated or exposed; he eventually died in such an attack. Wolf's (70) success in predicting sudden death among coronary patients on the basis of depression and long-term frustration in job and family settings, along with an inability to find meaningful satisfaction in social and leisure activities, constitutes further evidence of the importance of giving up and inhibitory phenomena.

* In a paper on the influence of uncertainty on conditioned heart rates of monkeys, called to my attention after the above was written, Miller and Caul (66) have shown that when both positive and negative stimuli are preceded by a warning signal programmed in such a way that the animal cannot predict which stimulus is coming, the positive (painful) stimulus results in bradycardia rather than tachycardia.

* Since this paper was written, Corley and co-workers (88) have successfully produced bradycardia, ventricular arrest, and sudden death in squirrel monkeys by subjecting them to a prolonged (8 hours "on" and 8 hours "off" for 72 hours) Sidman avoidance schedule or one in which the animals had only the last 5 seconds of the 40-second interval to make the avoidance response. The ECG showed an initial sinus tachycardia, followed by progressive bradycardia, QRS lengthening, T-wave inversion, and a descending ventricular pacemaker. This shift from a sympathetic to a parasympathetic response with prolonged stimulation or with sharp restriction of available responses conforms well with the thesis proposed above.

Conclusion

The dramatic circumstances preceding sudden death discussed in this paper cannot be construed as evidence for a cause-effect relationship. On the other hand, when the cases are analyzed for underlying shared characteristics, a unifying hypothesis emerges that is congruent with other clinical data and with accepted physiological principles. Further, the hypothesis is testable by experiment as well as clinical means. Indeed, the experiments of Miller and Caul (66) and of Corley and associates (88) provide ready-made models whereby the thesis can be examined and physiological mechanisms elucidated. From the clinical perspective Dr. William Greene and his associates in the Myocardial Infarction Research Unit have already begun a study of diagnosed myocardial infarct patients who succumb before reaching the hospital (89), and we are planning a survey of unselected sudden deaths reported to the Medical Examiner's office. Such studies will disclose data on the frequency with which sudden death is preceded by the psychologic state postulated in this paper. Other types of studies, such as the careful evaluation of monitored patients who develop potentially lethal arrhythmias and investigation of the circumstances and point in time when patients with fatal illnesses become moribund, should serve to extend our understanding of these relationships and the possible mechanisms involved. It is hoped also that this paper will encourage other physicians to study these problems and particularly to make more careful observations of incidents encountered in their practices and report these in the scientific literature, where they can be subject to critical evaluation. Only by such scientific scrutiny does it become possible to establish what part of folklore is fantasy and what part is fact. Certainly the use of "folklore" or "old wives' tales" as pejorative labels, as some skeptics are wont to do, is hardly compatible with the scientific attitude requisite for the study of natural phenomena involving life and death.

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