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Acute Heroin Fatalities in San Francisco

Demographic and Toxicologic Characteristics

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The mortality rate due to heroin overdosage in San Francisco has increased dramatically since 1968 and now stands as one of the highest in the United States. While the numbers of heroin fatalities in many eastern United States cities have declined substantially in the past few years, the figures for San Francisco and the other West Coast areas continue to increase. The group of heroin overdose victims from the 1970 through 1973 period is more predominantly Caucasian and younger than from the 1963 through 1965 period. In nearly all of the victims, the presence of morphine (a heroin metabolite) was noted in bile or urine, and in about half the results of blood alcohol tests were positive. Measurement of blood morphine concentrations in the victims showed no significant difference from the concentrations noted in a control group of heroin addicts dying from causes other than overdosage.

THERE HAVE BEEN numerous recent reports on the epidemic occurrence of heroin overdose fatalities in the metropolitan areas of the United States during the late 1960's and early 1970's.[1-7] The deaths are generally thought to be directly related to the incidence of intravenous heroin abuse, with the lack of dose standardization of the drug possibly playing a major role.[4] It is apparent from recent statistics that the problem has diminished significantly in many areas of the country in the last few years.[5,6] Law enforcement efforts, addict treatment programs and an increased awareness of the dangers of heroin may have contributed to the decline in the extent of heroin use and the number of fatalities resulting from the drug.

In direct opposition to this picture, however, are the findings in a number of West Coast cities—including San Francisco—which indicate that heroin fatalities are occurring at an ever increasing rate. The purposes of the present study are to describe San Francisco's problem in terms of the population involved and to present the results of forensic chemical examinations as related to the determination of the cause of death.

Methods

In each of the approximately 2,200 cases accepted annually by this office, a complete postmortem examination is given, including a toxicological screening for barbiturates and alcohol and other volatiles. Identification as a heroin overdose fatality is made on the basis of information gathered at the scene of the death and from the pathologic and toxicologic investigations. Gross findings such as hypodermic needle marks or pulmonary edema are used as indicators, while the

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presence of morphine (a heroin metabolite) in the blood, bile or urine of the victim is almost always a prerequisite to the decision that the victim died of narcotic poisoning.

The determination of morphine in biological fluids has been done since 1970 with a gas-liquid chromatographic method which is sensitive to as little as 0.05 microgram (μg) per ml of morphine.[8] Hydrolysis in normal hydrochloric acid solution for one hour is done on bile and urine specimens before extraction and thus morphine levels in these fluids represent total morphine content, that is, free morphine plus the pharmacologically inert morphine conjugates. Thin-layer chromatography of extracts of the bile and urine specimens is done to confirm the identification of morphine and to screen for the presence of other narcotic drugs.

Blood alcohol is measured using a gas-liquid chromatographic method which differentiates ethyl alcohol from other common volatiles.[9] Alcohol levels less than 0.02 percent were considered negative.

Results

Heroin fatalities occurred at a more or less regular annual rate in San Francisco until 1966, when the figures began a dramatic increase (Chart 1). Comparative figures for other leading cities in the United States (Table 1) indicate that San Francisco has had in the past few years a very high mortality rate (per 100,000 population) due to heroin overdosage. Based on the first six months of 1974, we expect this city's heroin mortality rate for the year to exceed 11 (per 100,000 people).

Table 2 presents some characteristics of heroin overdose victims from two four-year periods, 1962 through 1965 and 1970 through 1973. While the male to female ratio of the victims is similar to that reported in New York and Washington, D.C., the predominance of whites over blacks in the San Francisco fatalities is in contrast with the figures from these cities.[3,7] Furthermore, Table 2 indicates that the white to black ratio is on the increase, while the average age of the victims has fallen significantly in the last decade. Of the 217 victims included in this study, 160 had known addresses within San Francisco. An additional 40 had no known address, while 15 lived outside of the city and only 2 lived outside California. Figure 1 illustrates the residential pattern of the 160 San Francisco residents within the nine police districts and gives a breakdown of the number of victims within each district. As might be expected, the districts with the highest numbers of heroin fatalities are those with the greatest crime rates and the highest population densities. However, these points of residence do not necessarily represent the areas in which narcotics are purchased or used.

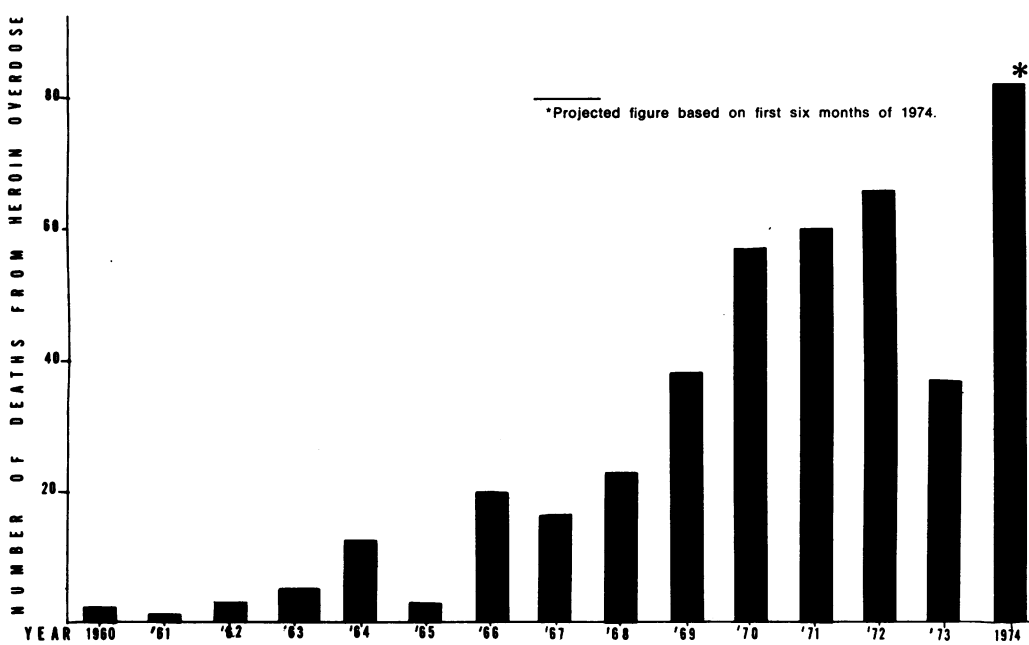

Chart 1.—Heroin overdose victims by year in San Francisco, 1960 through 1974.

TABLE 1.—*Heroin Deaths in Some Leading Population Centers, 1970 Through 1973*

Area	Population	1970 Total	1970 (Rate)	1971 Total	1971 (Rate)	1972 Total	1972 (Rate)	1973 Total	1973 (Rate)
San Francisco	700,000	57	(8.1)	60	(8.6)	66	(9.4)	37	(5.3)
New York City	8,000,000	708[3]	(8.8)	715*	(8.9)	719[10]	(9.0)	372†	(4.7)
District of Columbia	756,000	50[5]	(5.6)	65[5]	(8.6)	38[5]	(5.0)	5[5]	(0.7)
San Diego County	1,400,000	21[11]	(1.5)	24[11]	(1.7)	41[11]	(2.9)	73[11]	(5.2)

*Calculated from figure for first 9 months of 1971.[3]
†Calculated from figure for first 6 months of 1973.[9]

TABLE 2.— *Selected Characteristics of Heroin Victims in San Francisco, 1962 Through 1965 and 1970 Through 1973*

Inclusive Years	Total Deaths	Sex: Male	Sex: Female	Race: White	Race: Black	Race: Other	Average Age	(Range)
1962 - 1965	25	20 (80%)	5 (20%)	12 (48%)	10 (40%)	3 (12%)	38.5	(25-68)
1970 - 1973	217	173 (80%)	44 (20%)	133 (61%)	76 (35%)	8 (4%)	31.5	(15-65)

TABLE 3.—*Toxicologic Tests in Heroin Deaths, 1970 Through 1973*

Total Cases	Morphine Analyses: Blood Tested	Blood Positive	Bile or Urine Tested	Bile or Urine Positive	Ethyl Alcohol Positive	Other Drugs Positive
217	129 (59%)	79 (61%)	209 (96%)	204 (98%)	102 (47%)	61 (28%)

TABLE 4.—*Morphine Levels in Heroin Deaths Not Involving Other Drugs*

Classification	No.	Average Wt. (kg)	Average Morphine Concentrations Plus Standard Error (μg/ml): Blood	Bile	Urine	Average Blood Alcohol (Percent)
Overdose, negative alcohol	27	72	0.43±0.13	32.3±6.1	17.6±4.1	..
Overdose, positive alcohol	36	73	0.42±0.07	12.6±3.3*	13.5±8.7	0.13
Traumatic death, negative alcohol	6	73	0.48±0.18	82.8±33.4†	39.3±10.8	..

*Significantly lower than bile value of the overdose with negative alcohol group ($p<0.01$).
†Significantly higher than bile value of the overdose with positive alcohol group ($p<0.05$).

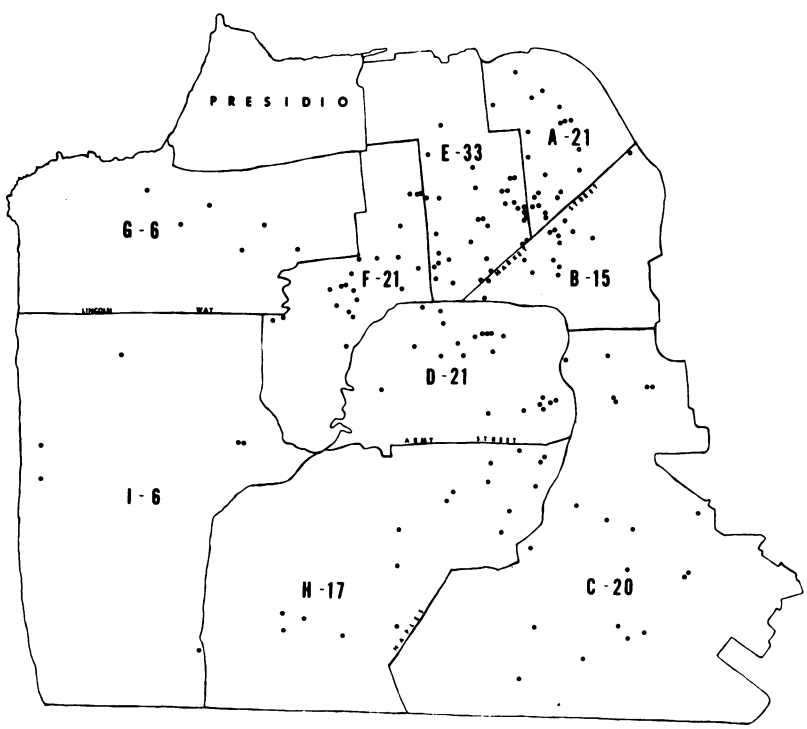

Figure 1.—Residential distribution of heroin overdose victims in San Francisco, 1970 through 1973, by police districts.

Table 3 presents the extent of toxicological testing done on the body fluids of the 217 heroin overdose victims. Bile or urine was analyzed for total morphine content wherever these fluids were available, and a positive result was a primary indicator of a narcotic death. In every case, tests were made for alcohol and other drugs, and the high percentage of positive results in this group is consistent with other similar studies.[3,7]

Blood morphine levels were analyzed as an experimental measure whenever time was available. While less than two thirds of the blood specimens tested were positive for morphine (>0.05 μg per ml), sufficient numbers were obtained to permit an evaluation of morphine concentrations in blood, bile and urine. The averages of these concentrations are presented in Table 4 for three subject groups: overdose victims, overdose victims with positive blood alcohol and a group of heroin addicts dying from traumatic causes. In none of the subjects were significant levels of other drugs besides alcohol found. Average blood levels for the three groups were remarkably similar. The bile and urine values for the overdose victims with alcohol were generally lower than the corresponding values for the overdose victims without alcohol (only the bile average was significantly different), while generally higher bile and urine levels were noted for the traumatic death group.

Comment

It is evident from the results of this study that San Francisco's heroin problem is rising to very significant proportions, and that it is involving an increasingly larger percentage of young white men living in the central sections of the city. While the reasons for this increase in numbers have not become evident, some law enforcement officials have suggested that the extensive efforts of the United States Drug Enforcement Administration to control the supply of heroin to the East Coast have resulted in a diversion of relatively high-grade narcotics to West Coast ports. Although the trend in the past few years has been toward higher concentrations of heroin in drug samples discovered at overdose death scenes, such discoveries are still relatively rare, and not enough of these samples have been analyzed to permit any conclusive statements.

The results of the blood level study indicate that morphine blood levels per se are meaningless in attempting to assign a cause of death in a Medical Examiner's case, since morphine levels found in narcotics users dying of causes other than overdose averaged slightly higher than those of the overdose victims. However, a positive finding for morphine in blood is certainly a further indication of narcotics use and is probably indicative of usage within the four hours before death.[12] Several investigators have shown an inverse relationship between blood morphine levels and the time of survival following heroin administration.[7,12]

Historically, morphine in the bile or urine of suspected overdose victims has only been reported as positive or negative, and attempts at relating the actual concentrations to severity of narcotic effect have usually proven fruitless.[12,13] However, our results (Table 4) show some interesting differences in bile and urine morphine levels. The high levels seen in the group of addicts dying from traumatic causes suggest that these persons had been maintaining a certain level of heroin administration in the recent past, since bile and, to a degree, urine morphine levels represent the end result of the relatively slow processes of liver metabolism and excretion.[12] The lower levels seen in the two overdose groups appear to substantiate the findings of Greene and co-workers[7] that a widespread lack of opiate tolerance was shown in the District of Columbia's overdose deaths. Although this sort of correlation can be made on the basis of the average of a number of cases, it would be impractical to attempt to do it in individual cases because of the great variation seen in individual levels.

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