Viral Hepatitis in the United States Navy and Marine Corps¹

CHARLES E. ALEXANDER

Occupational and Preventive Medicine Division,
Bureau of Medicine and Surgery, Department of the Navy,
Washington, D.C. 20372

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Two analyses of the Navy and Marine Corps experience with viral hepatitis are reported. The first is longitudinal in nature and shows that over the past 100 years the syndrome has been common and at a relatively steady rate of 100–400 cases/100,000 average strength/year. The second is an examination of cases in calendar year 1974 for demographic, geographic, and occupational patterns. There is a strong inverse relationship between disease occurrence and age. Each type of viral hepatitis shows a distinct geographic distribution. Navy personnel in health-related occupations had a greater risk of acquiring viral hepatitis than did other persons on active duty. Differences among other occupational groups were found, but valid interpretations could not be made because of the small numbers of cases in each category.

INTRODUCTION

In the last quarter of the nineteenth century, many pages of the annual reports of the Surgeons General of the Navy (1, 2) were devoted to extensive discussion of yellow fever, an illness that was declining sharply in the naval forces afloat over the period. By comparison, only single-line entries in statistical tables appear for illnesses labeled as "icterus" and "hepatitis acuta." These clinical syndromes together discomfited nearly 3 out of every 1000 sailors and marines each year. Yellow fever had been well-defined and had a case-fatality ratio of terrifying size. Another reason for archival obscurity may have been the very familiarity of icterus and acute hepatitis. The patients customarily recovered. The vast bulk of them could be treated aboard, without the medical or administrative bother of transferring them to hospitals or dispensaries ashore. This paper will seek to examine the evolution of viral hepatitis in the Navy and Marine Corps over the past 100 years and to assess the epidemiologic parameters of the disease syndrome as it occurs among those individuals today.

MATERIALS AND METHODS

In the longitudinal analysis, cases were those reported in the annual reports of the Surgeons General of the Navy (1) and the U.S. Navy Medical Statistics (2) for what is presumed to be viral hepatitis. Reliable data are not available for 1963 and 1965. Nomenclature has changed a number of times in 100 years; these changes are noted on Fig. 1. Incidence rates were calculated from the following population bases: 1874–1894, annual average total force afloat; 1895–1910, annual average total forces afloat and ashore from which reports were received; 1911 to present, average strength, extended active duty Navy and Marine Corps. Rates are expressed throughout the paper as "cases/100,000 average strength/year," though normally only a numerical value will be stated, e.g., "119" instead of "119 cases/100,-

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000/year.” Yellow fever cases are those given in the same reports as “febris flava” or “yellow fever.”

To assess the current status of viral hepatitis, cases for calendar year 1974 were obtained in a computer printout from the Navy Medical Data Services Center, Bethesda, Md. These cases were those of Navy and Marine Corps personnel on extended active duty that were reported to the Center with a disposition diagnosis assigned in calendar year 1974 of viral hepatitis, International Classification of Diseases, Adapted (ICDA) code 070. Five subcodes were reported in 1974 and they were grouped as follows: 070.1 and 070.2, viral hepatitis type A; 070.5 and 070.6, viral hepatitis type B; and 070.9, viral hepatitis, type not specified. These subcodes were introduced in 1973 in the United States, and 1974 represents the first complete year since the change.

The population base chosen for the 1974 analysis was that of the Navy and Marine Corps on 30 June, 1974. However, several data sources were required to assemble descriptive data on race, sex, age, military occupation, paygrade, and geographic location. In some instances, the only available data were collected 3 to 12 months after 30 June, 1974, and these data were adjusted to fit the 1974 base. The adjustments were real but small. In each instance, they did not exceed approximately 0.5% of the population and probably are of no great consequence as used in this paper.

In the analysis of the age distribution of cases, age-standardized rates were calculated by applying the specific rates for each group, separated into Navy and Marine Corps, to the combined population of the Navy and Marine Corps.

An additional adjustment was made for the analysis of age. In October and November, 1974, an outbreak of viral hepatitis A at the Naval Training Center, San Diego, resulted in 133 cases of the disease; these were principally among recruits. Twenty-one of these recruits, known to have had hepatitis A, had their diagnosis mis-coded as viral hepatitis B. The cases were reassigned to the hepatitis A group. Because of the difficulty of manual sorting of the data, this was done for only the age analysis.

Incidence rates were calculated for each of the official broad occupational groups in the Navy. Within the Navy, data on paygrade were available for each occupational group and further analysis was possible. Marine Corps personnel were divided into many more categories than Navy personnel. The author contrived broad classifications for them; differences in rates among groups may reflect this methodology.

**EVOLUTION OF VIRAL HEPATITIS, 1874–1974**

In the past 100 years, over 72,000 sailors and marines have been admitted to the sick list because of viral hepatitis. In the same 100 years, only 259 persons in the naval service were admitted for yellow fever. From Fig. 1, one can note an almost stable range of the incidence rate of hepatitis between 100 and 400 cases/100,000/year. Even the metamorphosis of the diagnostic label from icterus and hepatitis acuta through many intermediate titles to today’s viral hepatitis A and B has had little impact on the frequency of the disease syndrome.

An abrupt drop in incidence from previous levels occurs in 1917 and 1918. This decline may be exaggerated by the effect of an extremely rapid expansion of the service population at the time of World War I; a sevenfold increase occurred in the 2-year period.

Following World War I, the disease incidence climbed gradually to an all-time high of 550 in the year 1928. The start of this steep rise was coincident with the onset of
FIG. 1. Navy and Marine Corps, all forms of viral hepatitis, 1874-1974, and yellow fever, 1874-1919.
Prohibition and its production of illicit and often adulterated alcoholic beverages. It should be noted, however, that the decrease in rate began several years before Prohibition's demise.

No appreciable change in incidence took place from 1932 through the end of the Korean War in 1954. Because few sailors and marines received any of the lots of hepatitis-contaminated yellow fever vaccine in 1942, no Navy and Marine Corps outbreak occurred comparable to that of the 35,000 or more cases in the Army for that year attributable to vaccine use.

Beginning in 1955, the hepatitis rate decreased abruptly, thus paralleling the situation in the U.S. civilian population. An all-time low rate of 78 was reached in 1962. Rates continued relatively low until 1967, unlike those in the general population, which began an upward climb in the early 1960's. No single factor has been identified to explain this fall and failure to rise at the start of the 1960's. Immune serum globulin prophylaxis against viral hepatitis A was not in common use in the Navy and Marine Corps until 1963-1964, when servicewide directives were published on its use.

During the United States' involvement in Vietnam, viral hepatitis incidence rates rose to nearly 200. Reported rates of serum hepatitis changed from 1 or 2 to 16-17/100,000 average strength/year over the course of the war, but this accounts for only a small part of the overall rate increase. Immune serum globulin was used in large quantities for personnel in the combat zone. Without its use, the number of viral hepatitis A cases reported would have been greater and the impact of serum hepatitis (hepatitis B) on the overall incidence rate proportionately lessened. Diagnostic rubrics lagged behind knowledge of disease causation and epidemiology, and this situation was particularly evident at the precise time when increase in drug abuse had become a national and Armed Forces issue. It cannot be said with certainty that parenteral infection from injection of habituating drugs played a major role in the overall rate increase during the Vietnam years. Furthermore, viral hepatitis B occurrence is not prima facie evidence of drug misuse in a patient, as documented by Wenzel and co-workers (3) in studies at a large Marine Corps base.

CURRENT STATUS OF VIRAL HEPATITIS IN THE NAVY AND MARINE CORPS

(A) Incidence and Demographic Distribution

In calendar year 1974, viral hepatitis among active duty personnel accounted for 1175 hospitalizations at a rate of nearly 160/100,000 personnel annually. The distribution of the diagnoses is seen in Table 1. The table also shows the United

| TABLE 1 |
|-----------------|---------|-------------------|
| Viral Hepatitis: Navy and Marine Corps, 1974 | | |
| | Number | Rate | Rate in U.S. Population |
| Hepatitis A | 835 | 113.7 | 19.54 |
| (ICDA 070.0, 070.1) | | |
| Hepatitis B | 227 | 30.9 | 5.15 |
| (ICDA 070.5, 070.6) | | |
| Hepatitis, type unspecified | 113 | 15.4 | 3.95 |
| (ICDA 070.9) | | |
| Total | 1175 | 159.9 | 28.64 |

All rates, number/100,000 population/year.
TABLE 2
Navy and Marine Corps, 1974 (30 June): Population Characteristics

| Group   | Size    | Sex (%) | Race (%) | Grade (%) | Age (Average, Years) |
|---------|---------|---------|----------|-----------|----------------------|
| Total   | 734,652 | Men 97.2| White 86.1| Officers 12.2| Officers 30.2       |
|         |         | Black 10.0|          |           |                      |
| Women   | 2.8     | Other 3.9|          | Enlisted 87.8| Enlisted 23.0       |
| Navy    | 545,903 | Men 96.7| White 87.5| Officers 13.0| Officers 29.9       |
|         |         | Black 7.7|          |           |                      |
| Women   | 3.3     | Other 4.8|          | Enlisted 87.0| Enlisted 23.6       |
| Marines | 188,749 | Men 98.5| White 82.2| Officers 9.9 | Officers 31.2       |
|         |         | Black 16.7|         |           |                      |
| Women   | 1.5     | Other 1.4|          | Enlisted 90.1| Enlisted 21.4       |

States rate calculated from the general population of both sexes and all ages and races. The Navy and Marine Corps population is overwhelmingly male (97%), predominantly white (86%), and narrowly concentrated in the young adult age groups (75% are from 17 to 30 years of age). There are approximately 7.2 enlisted persons for every officer. The demographic characteristics of the groups are compared in Table 2.

The relationship between the age of the patient and the incidence of viral hepatitis is striking. Figure 2 presents the rates of each category of hepatitis for various age
groups of Navy and Marine Corps personnel, and Fig. 3 compares the age-specific rates for each service by type of viral hepatitis.

Viral hepatitis A occurred at a significantly higher rate in the Navy than in the Marine Corps, when adjustment was made for age (122 vs 110.6; \( P = 0.04 \)); this reflects the outbreak in Navy recruits at San Diego. Conversely, marines had a significantly higher incidence of viral hepatitis B than sailors (33.9 vs 25.4; \( P = 0.003 \)) and of unspecified types of viral hepatitis (23.1 vs 12.9; \( P < 0.001 \)) when age-standardized rates were compared. One reason for part of the difference between the Navy and Marine Corps in hepatitis B incidence could be the proximity and convenience of laboratory facilities capable of testing for HBsAg. Marines are

### TABLE 3

| Population       | Hepatitis A | Hepatitis B | Hepatitis, unspecified |
|------------------|-------------|-------------|------------------------|
| Navy             | 111.7       | 27.3        | 12.3                   |
| Marine Corps     | 119.2       | 41.3        | 24.4                   |
| Men              | 115.5       | 30.4        | 15.5                   |
| Women            | 78.3        | 53.8        | 14.7                   |
| Whites           | 116.6       | 32.0        | 15.3                   |
| Blacks           | 114.8       | 30.1        | 21.9                   |
| Others           | 66.3        | 14.0        | 3.5                    |
| Officers         | 45.6        | 2.2         | 10.0                   |
| Enlisted         | 123.1       | 34.9        | 16.1                   |

*Number/100,000 population/year.*
primarily stationed ashore and may have greater opportunity for such testing than many sailors who become ill while at sea. Viral hepatitis of unspecified type shows an unusual pattern by age that suggests that two or more separate diseases may be grouped in the same classification.

Table 3 presents the incidence of the three categories of viral hepatitis by service, sex, race, and grade; rates are not standardized by age. When men were compared with women and whites with nonwhites, no significant differences were found (at the 5% level of significance) in the rates of hepatitis A, hepatitis B, undifferentiated viral hepatitis, or the aggregate of all types of viral hepatitis. The difference in rates between officers and enlisted personnel was highly significant for hepatitis A, hepatitis B, and the aggregate of all forms of viral hepatitis ($P < 0.0001$) but was not significant for hepatitis, type unspecified ($P = 0.099$).

(B) Geographical Distribution

The geographical areas of duty assignment of the cases are shown in Fig. 4. The most populous naval districts also had the highest domestic rates of viral hepatitis A. The 11th Naval District, containing the San Diego training center at which the large outbreak occurred, had the greatest incidence. The 6th Naval District, in southeastern United States, was second; within its borders, a smaller outbreak occurred early in 1974. Viral hepatitis A was frequent among sailors stationed in the Far East, particularly in Guam. It is not surprising that sailors in ships of the Pacific Fleet, which deploy to the Far East periodically, had a larger incidence rate than those in the Atlantic Fleet.

FIG. 4. Navy and Marine Corps, 1974, viral hepatitis A by U.S. Naval Districts.
The pattern of viral hepatitis B is quite different, as may be seen in Fig. 5. The disease occurs predominantly among those in the lowest two paygrades (E-1, E-2) who have just completed recruit training and are in their initial technical training programs. The highest domestic rates are thus seen in those four naval districts conducting the bulk of such training: 5th, 6th, 9th, and 11th. If the E-1 and E-2 cases are excluded, the worldwide distribution of cases is of near-uniform concentration.

Viral hepatitis, type unspecified, displays a bizarre distribution (not illustrated), again indicative of a diagnostic wastebasket; 69\% of the cases arose from 35\% of the population (6th and 11th Naval Districts and the Naval District of Washington).

(C) Economic and Career Distribution

Because paygrade and years of service are very strongly age related, no new insights are gained from their analysis. Incidence is exceptionally high in paygrades E-1 and E-2. Similarly, it is high during recruit and initial technical training, both completed during the first year of service. Age of enlisted personnel in the lowest two paygrades range from 17 to 21 years.

(D) Occupational Distribution

There has been concern expressed recently in the medical literature (5, 6) over the impact of hepatitis infections among medical and dental professionals. In 1974, the incidence rate of viral hepatitis A among Navy Hospital Corpsmen was substantially higher than that for all enlisted personnel (187 vs 121.3). Those Corpsmen in the lowest three paygrades have a combined rate of 314 cases/100,000/year, 60\%
greater than the rate of 197 for all enlisted persons in the lowest three paygrades. Dental technicians had a slightly higher rate than the general enlisted rate (148 vs 121.3) but interpretation must be guarded because the dental technician rate is based on only six cases. Likewise, the occurrence of hepatitis A in six medical officers and one dental officer resulted in an incidence rate nearly three times greater among these health professionals than that of all officers (135 vs 51).

Viral hepatitis B incidence rates among medical and dental personnel are also well above the Navy enlisted personnel rate of 31/100,000/year. Hospital Corpsmen had a rate of 77. The rate for dental technicians was 99. Too few officers (one medical officer, one line officer) had hepatitis B to permit meaningful analysis.

When the type of viral hepatitis was not specified, incidence rate for Hospital Corpsmen was 64 compared with a rate of 13/100,000/year for Navy enlisted personnel generally. No dental technicians were affected.

The experience of other occupational groups in the Navy and in Figs. 7 and 8 for the Marine Corps. Only medical and dental enlisted personnel in the Navy had noticeable deviation from the average rate for hepatitis B so that figure is not included. As a whole, Navy ordnance personnel had a viral hepatitis A rate below the Navy average (71 vs. 121.3) but those ordnance personnel in paygrades E-1, -2 and -3 had a much greater rate (282), even when compared with the servicewide paygrade rate of 197. Among the administrative group in the Navy, radiomen in paygrades E-1, -2 and -3 were found to have a singularly high incidence rate of 357, based on 26 cases. Further study revealed that 13 of the 26 cases had occurred among radiomen on Guam over a 7-month period, for reasons yet to be determined. In fact, 17 of 31 cases of all types of hepatitis among E-1, -2 and -3 radiomen occurred on Guam in 1974.

Marine Corps occupational groupings that had hepatitis A rates above the Marine Corps average were motor transport personnel, 225/100,000/year; utilities personnel (5 cases), 224; combat troops (infantry, artillery, etc), 214; ordnance personnel, 182; and aviation personnel, 176. The Marine Corps rate as a whole was
119.2. Viral hepatitis B, in sharp contrast, is concentrated in the ordnance and electronic groups (rates of 142 and 122, respectively) and in "basic marines," with a rate of 171. The comparable Marine Corps rate for hepatitis B was 41.3.

For both Navy and Marine Corps, the number of cases in each occupational group are relatively small and several years' experience will be needed to permit valid conclusions about occupational patterns.

CONCLUDING REMARKS

The uncertainty of diagnosis has been a major difficulty in understanding the occurrence and distribution of viral hepatitis A and B. There may be yet other
distinct viruses causing identical clinical manifestations, as discussed by Mosley (7). Subclinical and borderline clinical cases of both diseases occur and, for hepatitis A, are the rule rather than the exception. Any careful and extensive epidemiological study must consider them in some detail. The influence of drugs, therapeutic or habitual, and toxic substances, including alcohol, on the clinical manifestations of hepatitis A and B infections should be explored when diagnosis becomes more precise and the statistical data base for hepatitis is more reliable than at present.

Occupational analysis shows distinct promise as an epidemiological tool and for applying effective preventive measures. The question of prophylactic immune serum globulin administration to health-related specialists, such as Hospital Corpsmen and dental technicians during their first year of service, should be debated as a means of reducing man-days lost from work and overall hepatitis incidence.

SUMMARY

Viral hepatitis, under many titles, has ranged in incidence in the Navy and Marine Corps from 100 to 400 cases/100,000 average strength/year over the past 100 years; altogether, over 72,000 cases have been admitted to the sick list. Rates became lower immediately following the Korean War and remained so until the Vietnam War period. Currently, Marines have higher rates of viral hepatitis B and unspecified viral hepatitis than do sailors, but they have a lower rate of viral hepatitis A. Rates for all forms of viral hepatitis are inversely related to age. Sex and race differences are not significant. For each category of viral hepatitis, a distinct geographical pattern exists. Navy personnel, both officer and enlisted, in health-related occupations have much higher rates for both hepatitis A and B than Navy personnel in general. There are differences in rates for other occupational groups, but the rates are often based on small numbers of cases and inferences must be made only with great caution.

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