Salmonella Carriers Among Microbiology Laboratory Workers And Their Supporting Staff

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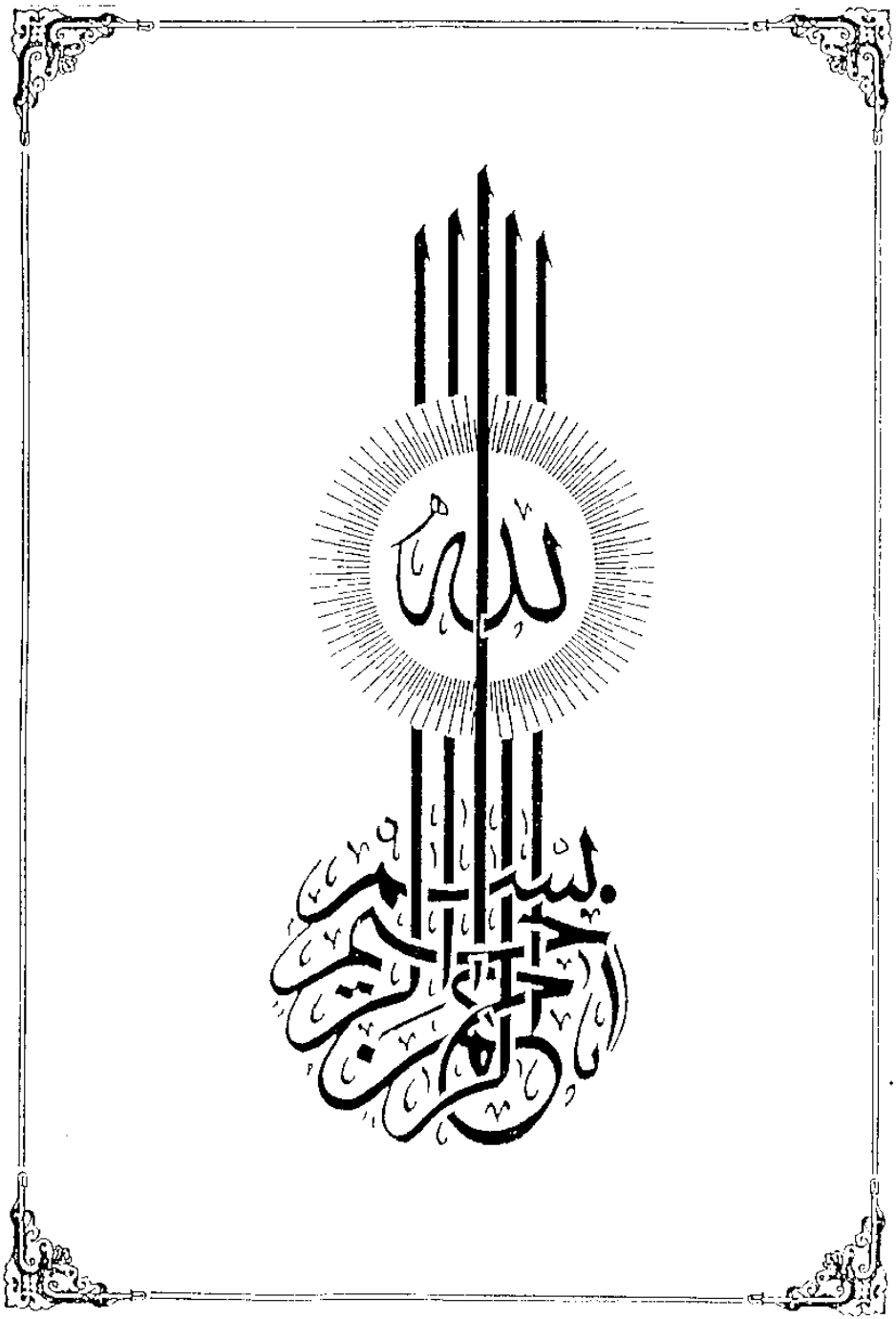

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Laboratory - acquired infections caused by bacterial, viral, fungal and parasitic agents have been recognised since the beginning of this century. Typhoid bacillus was the first organism to attract sufficient attention as a cause of laboratory infection. *(Pike, 1979).*

The laboratory is becoming a significant reservoir for Salmonella typhi in the United States *(Blaser et al., 1980)*. Most of the laboratory acquired cases of typhoid fever are due to exposure to strains of Salmonella typhi used for proficiency testing or educational purposes rather than isolates from ill patients *(Blaser & Lofgren, 1981).*

Jacobson et al., (1985) reported that microbiologists are at greatest risk of acquiring bowel infections.

Chronic asymptomatic faecal carriers are an important reservoir of infection *(Thomas, 1990)*. Most chronic typhoid carriers have serum Vi antibodies. Therefore, Vi bacterial agglutination or Vi haemagglutination tests have been used for screening for the typhoid carrier state *(Chau & Tsang, 1982).*

The aim of this study was to :

1 - Estimate the incidence of Salmonella carriers among laboratory staff (medical staff, chemists, technicians & workers) and among persons not engaged with the laboratory work to see to what extent the laboratory workers are exposed to infection with potentially pathogenic organisms in comparison to non laboratory workers.

2 - Study the correlation between stool culture method and Vi antibody titration in order to choose a simple, rapid and economic method for detection of Salmonella carriers.

Review of Literature

Laboratory Acquired Infetions

For over a century laboratory workers have occasionally become infected by the microorganisms with which they were working, and some of these infections have resulted in death. Because reporting laboratory - associated infections has been largely voluntary, there is no way to arrive at an accurate estimate of the number of persons involved. The incidence of such infections increased as new agents were discovered and as more and more workers were involved in handling infectious agents. In recent years increasing attention has been given to safety in the infectious disease laboratory. Attempts have been made to define the extent of the problem, to determine the causes of accidental infections, and to devise safe equipments & procedures. *(Pike ,1979).*

The most important infective agents were Mycobacterium tuberculosis, Salmonella typhi, Brucella species and serum Hepatitis virus. *(Pike, 1979 & Harrington, 1982).*

Sources of laboratory associated infections

Richardson and Barkley (1985) said that laboratory - acquired infection was associated with ingestion, exposure of mucous membranes of the eyes, nose or mouth to infectious fluids and parenteral inoculation.

Jacobson et al. (1985) mentioned that the sources of laboratory associated infections can be difficult to categorize. Broad general categories have been utilized. Sometimes the source of the infection is obscure. Working with the culture was utilized as a category when it was known only that the victim worked directly with the infectious agent.

Recognized accidents accounted for one - fifth of the total laboratory acquired infections and included those from needle and syringe, sprays, spills, injury from broken objects, pipette aspiration, bites and scratches. *(Pike ,1976 & 1979).*

Pike (1979) defined two general types of accidents occurred with the needle and syringe - selfinoculation and spray from the needle or the syringe when the two were separated by pressure.

Phillips (1969) found that accidental inoculation, sprays and aspiration through pipettes accounted for 4%, 1.2% and 4.7% of the total laboratory associated infection respectively.

Jacobson et al. (1985) said that in clinical & diagnostic laboratories another major source of infection is aerosol production associated with procedures. *Pike's studies (1979)* indicated that aerosol was responsible for 13% of the 3,900 cases he analyzed. Aerosols are particles produced that are 5 μm or less in size. These can penetrate into intraalveolar spaces, but larger aerosols or droplets present a hazard of infection by direct contact *(Jacobson et al., 1985).*

Stern et al.(1974) showed that with centrifuging, only small amounts of contamination by aerosols actually occur. After hand vortex mixing and mechanical vortex mixing, minimal aerosol was detected.

Pouring operations have been shown to produce considerably more aerosol than pipetting. Accidents, such as dropping tubes of blood or spilling serum, produce large amounts of aerosols. Aerosols may also be liberated when infectious materials are macerated, ground, and blended and when ampules of lyophilized organisms are opened. Plunging a loop

into a flame, lyophilization, animal or egg inoculation and harvesting have all been shown to produce aerosols. *(Jacobon et al.,1985).*

Incidence of laboratory associated infections in relation to type of work

Among the 1342 cases analysed by *Sulkin & Pike (1951),*infections resulted more often from diagnostic work (33.9%) than from other activity. Working with pathological materials of unknown character and the large numbers of diagnostic procedures were suggested as possible explanation *(Long, 1951).*

Pike (1976) found that, diagnostic work accounted for only 17% of the infections, whereas 59% were associated with research.

Sulkin & Pike (1951) and Phillips (1965) mentioned that the majority of infections have occurred in trained scientific personnel and technical assistants, but students, dishwashers, animal care takers, and clerical and maintenance personnel have also been infected with microorganisms handled in the laboratory.

Jacobson et al. (1985) found that micorbiologists were at greater risk of acquiring infection with an annual incidence of 9.4 per 1,000 followed by generalists (5.2 per 1,000) and phlebotomists (3.1 per 1,000), Shigellosis was acquired only by microbiologists and accounted for more than half of their infections. Hepatitis infection, however, was not associated with any particular laboratory specialty.

(1) Bowel Infections :

A - Salmonellosis

Harrington (1982) said that Salmonella typhi was one of the first organisms to be closely associated with laboratory - acquired infection. Between 1915 and 1939, Kisskalt reported 165 cases from Germany. Sporadic reports from elsewhere have suggested that typhoid fever remains a potentially serious threat, though in Britain only 12 cases of laboratory - acquired infection were noted between 1964 and 1979, accounting for 0.9% of all cases not acquired abroad. In the United States of America, (1964 - 1979) laboratory - acquired Salmonella typhi infections account for 2% of indigenous infection, and, disturbingly, most of these cases were acquired during laboratory proficiency - testing procedures to identify "unknown" organisms. The next most common source was Salmonella typhi cultures used for teaching purposes.

Grist & Emslie (1987) reported 3 cases of Salmonella infections in the staff of 193 British clinical laboratories during 1984 - 1985, the first was a case of typhoid fever due to Salmonella typhi of the same phage type as that isolated from the patient's blood and faeces under routine diagnostic study, the second was a case of Salmonella typhimurium infection during diagnostic work with faeces containing Salmonella typhimurium, the third was Salmonella virshow infection during routine investigation of food born infection outbreak.

Blaser et al. (1980) mentioned that as a part of educational and proficiency exercises thousands of students and laboratory personnel have been exposed to Salmonella typhi. A definite case of laboratory-acquired

typhoid fever was defined as one affecting a person who had culture - proven Salmonella typhi infection, a history of exposure to a laboratory in which Salmonella typhi was being handled, an interval between exposure to the organism and onset of illness compatible with the incubation period for typhoid and documentation that the laboratory strain and the person's isolate of Salmonella typhi were the same bacteriophage type. A probable case was defined as one affecting an individual who fulfilled all the above criteria except that the laboratory strain was not available for bacteriophage typing. Twenty-four cases of laboratory-acquired typhoid fever were identified in the United States during a 33 months period from January 1, 1977, to September 30, 1979. Twenty-three cases had Salmonella typhi isolated from their blood, six had Salmonella tyhpi isolated from blood and stool and one had the organism isolated from blood, stool and urine. The remaining case had Salmonella typhi isolated from stool alone. The strains that caused illness for 21 patients were voluntarily introduced into the laboratory for educational testing or research purposes. The other three strains entered the laboratories in patient specimens as part of routine clinical examination. Twelve students were exposed to Salmonella typhi while studying an "unknown organism", another five were merely present in the laboratory at the time, three individuals were exposed to the organism while working on clinical specimens from hospitalized patients with typhoid fever, four individuals had other known exposure : cleaning glassware, reconstituting lyophilized cultures, using Salmonella typhi for quality control of media, and working with organisms under pressure for vaccine production. Five of the cases were medical technology students, one was an undergraduate, and one was a medical student. The experience in microbiology of the other patients ranged up to 20 years. For only seven

cases could breaks in technique be identified : eating or smoking in the laboratory (two patients), pipetting by mouth (two patients), an accidental spill (one patient), failure to use a bacterial hood when working with cultures of 10^{11} organisms under pressure (one patient), and the frequent presence in the microbiology laboratory of a worker from the adjacent chemistry laboratory (one patient). Although laboratory - acquired typhoid represented only a small proportion of the reported cases of the disease in the United States, laboratory exposure to Salmonella typhi accounted for >11% of those cases of no obvious source of infection (i.e., foreign travel, exposure to a known carrier, or part of an outbreak). Thus, the laboratory has become a significant reservoir of Salmonella typhi.

Pipetting by mouth had been well - recognized as a cause of accidentally acquired typhoid fever, especially in the past when live bacteria were used in the Widal test *(Pike, 1978)*. As late as 1971 in England, 65% of laboratories permitted pipetting by mouth *(Harrington, 1978)*. In the United States laboratory workers who would not pipette viable cultures by mouth commonly do so for formalin-treated bacterial cultures, although the culures may still be viable *(Blaser et al., 1980)*.

In 1971, 30% of English laboratories allowed smoking and 6% allowed eating in the laboratory *(Harrington and Shannon, 1977)*. Such practices ignore the ubiquity of environmental contamination in microbiology laboratories : agar media containing cultures of Salmonella left at room temperature extruded water containing 10^1 - 10^5 salmonella were incubated in water baths, 11% of the baths became contaminated *(Harvey and Price, 1975)*.

Hornick et al. (1970) studied typhoid fever in volunteers, a dose of

10^5 organisms given by mouth infected only 28 percent of volunteers (infecting dose $[ID]_{28}$) after a median incubation time of nine days. *Blaser & Feldman (1980)* in their studies mentioned that a smaller dose was associated with an even longer incubation period. This finding suggested that for the laboratory - acquired cases the actual ID was less than 10^5 organisms, perhaps representing an ID_5 or ID_1 and for every case of typhoid reported, several persons were probably exposed to low doses of organisms but only a few became ill.

Marion et al. (1980) reported four cases of typhoid fever in Massachusetts Departement of public health between January 1, 1977, and December 31, 1979. Proficiency - testing specimens were the source of infection for each of the four patients. None of them gave a history of recent travel to a typhoid endemic area or of contact with a patient with typhoid or a carrier.Two of them actually performed the proficiency testing and the others worked in close proximity to persons performing the tests. The four patients all became ill within a few weeks of the introduction of the proficiency testing specimens containing Salmonella typhi into their laboratory. Most important, the phage type of Salmonella typhi isolated from their blood was the same as that in the proficiency - testing specimens. Neither of the phage types involved is commonly isolated from sporadic cases.

Laboratory infections with salmonella are most commonly associated with ingestion or accidental self inoculation of the infectious agent *(MMWR, 1979)*, and 80% of laboratory acquired - infections were due to aerosols. *(Liberman, 1979)*.

During ongoing surveillance of laboratory acquired enteric infections