Epidemiol. Infect. (1990), **104**, 191–201
Printed in Great Britain

Human listeriosis in Britain, 1967–85, a summary of 722 cases

2. Listeriosis in non-pregnant individuals, a changing pattern of infection and seasonal incidence

J. McLAUCHLIN

The Division of Microbiological Reagents and Quality Control, Central Public Health Laboratory, Colindale Avenue, London NW9 5HT

(*Accepted 23 November 1989*)

SUMMARY

Clinical information was collected on 722 cases of *Listeria monocytogenes* infections in humans occurring in Britain between 1967 and 1985. This series comprised 34% (248 cases) associated with pregnancy and 66% (474 cases) in non-pregnant adults and juveniles. The cases not associated with pregnancy comprised: 76% in patients with severe underlying illness (of which 34% had central nervous system infections, and 42% bacteraemia without involvement of the central nervous system); 21% in previously healthy individuals (of whom 18% had meningitis); and 3% in patients without bacteraemia or involvement of the central nervous system. Cases occurred most often in male patients over 40 years of age. The overall mortality was 44%.

Overall, the pattern of infection has altered to a disease of higher incidence, affecting most often susceptible non-pregnant individuals and the unborn.

An annual increase in incidence of listeriosis occurred in the autumn in all categories of patients.

INTRODUCTION

Between 1967 and 1985, 786 cases of human listeriosis occurred in Britain from which subcultures of listeria were sent to the Division of Microbiological Reagents and Quality Control (DMRQC), Colindale (formerly the Standards Laboratory for Serological Reagents) [1]. By the end of 1985, strains from 722 of these cases remained viable and all were identified as *Listeria monocytogenes sensu stricto* [1]. Of these 722 cases, 248 were in association with pregnancy (see accompanying paper). This study summarizes the remaining 474 cases in non-pregnant individuals, and presents evidence for a changing pattern of infection and a seasonality in incidence for all the 722 cases.

METHODS

A case of listeriosis was defined as any episode of disease in an individual where a strain of *L. monocytogenes* was either isolated from a normally sterile anatomical

site, or was suspected by the clinician as causing disease. Cases were categorized into two groups: infection during pregnancy and the intra-uterine, perinatal and neonatal periods (Group 1); and in non-pregnant individuals older than 12 months of age (Group 2), no cases occurred in infants between 2 and 12 months. A single case was defined as either one or more episodes of listeriosis in a single patient, three patients who each had two episodes of listeriosis have been previously described [2].

The cases not associated with pregnancy were categorized into three groups: central nervous system (CNS) infections, where either *L. monocytogenes* was isolated from a site in the CNS or a clinical diagnosis of CNS infection was made; bacteraemic infections, where *L. monocytogenes* was isolated from blood cultures but CNS involvement was not reported; cases where *L. monocytogenes* was isolated from sites with no evidence of bacteraemia or infection of the CNS.

The seasonal variation in the incidence of listeriosis was estimated from the numbers of cases per month using the month of receipt of cultures in DMRQC.

RESULTS

Of the 722 cases in this series, 474 (66%) occurred in non-pregnant adults and juveniles. The mean age of these cases was 59 years (range of 1–97 years), and 265 (58%) were male and 189 (42%) female (in 20 patients the sex was not reported). An outcome was reported in 371 cases, where 164 (44%) were fatal. The mortality rate increased with age; i.e. 22% (12/54 cases) in 1- to 40-year-olds, 37% (41/111 cases) in 41- to 60-year-olds, and 54% (107/199 cases) in the over-60 years old group.

Information regarding other medical conditions was available in 337 cases. Of these, 76 (23%) were apparently previously healthy, and 261 (77%) had severe underlying illness. These concurrent conditions are summarized in Table 1. Male patients were represented more frequently than females in the alcohol related group and also in the diabetic group (14 males and 3 females in both instances). No other associations between the type of underlying illness and the site of infection or the sex of the patients were identified.

Overall, the 474 adult and juvenile cases comprised: 268 (57%) with CNS infections; 183 (39%) with bacteraemia without involvement of the CNS; 9 (2%) where the source of the isolate was known but which could not be categorized into the above two groups; and 14 cases where there was insufficient information to permit inclusion in any of the above groups. The last series of cases is not further discussed.

Central nervous system infections

The sources of isolates, the clinical symptoms and diagnoses for the CNS infections are shown in Table 2. Meningitis was diagnosed in 85% (227/268) of the cases. In this group, eight of the patients had chest infections, one was jaundiced [3], and one had endocarditis.

Bacteraemic patients

In this group of 183 patients, chest infections were recorded in 21 cases (11%), of whom 12 had pneumonia. Listeriosis affecting specific sites occurred in 11

Table 1. *Summary of underlying illness in 261 cases of listeriosis in non-pregnant adults and juveniles*

Underlying illness	No. of cases
Malignant conditions (total 105 cases)	
Leukaemia	34
Lymphoma	30
Other*	41
Inflammatory disorders†	60
Iatrogenic conditions (total 42 cases)	
Transplants‡	25
Prosthetic heart valves	5
CSF shunts	3
Other	9
Non-malignant conditions (total 33 cases)	
Diabetes	18
Anaemia	5
Other	10
Alcoholism and alcoholic liver disease	17
Other infections§	4

* The sites of malignancies were: 5 bronchus, 4 rectum, 4 bone-marrow, 3 breast, 2 stomach, 2 colon, 2 skin, 2 lung, 1 bowel, 1 bowel and lung, 1 abdomen, 1 prostate, 1 adrenal, 1 liver, 1 ovary, and 10 not stated.

† Thirty-seven of these patients were treated with either steroids, cyclosporin, azathioprine or with radiotherapy.

‡ The transplants comprised: 24 renal, 1 renal and pancreas.

§ This group comprised: 1 case with AIDS, 1 with active tuberculosis and 2 cases with chronic active hepatitis.

patients (6%), which were: osteomyelitis (1 case), rectal abscess (1), jaundice (2), and endocarditis (7, of which 4 had prosthetic heart valves).

Infections other than central nervous system or bacteraemia

In these nine cases, *L. monocytogenes* was isolated from: a cutaneous lesion (mixed infection with a Lancefield Group A streptococcus affecting the thumb of a butcher); an appendix taken during acute appendicitis (almost pure culture); ascitic fluid (one case); pericardial fluid (one); peritoneal dialysis fluid (one); ovarian cyst fluid (one); abscess fluid (2 cases, 1 from the liver, and 1 from the inguinal region); and 1 from heart valve pus taken at necropsy.

Four of the 7 cases had severe underlying illness, and a fatal outcome occurred in 5 cases.

Comparison of the central nervous system and the bacteraemic groups

The age distribution of these two groups of patients is shown in Fig. 1. The ratio of patients with CNS infections to those with bacteraemia alone was higher in the 1–60 years age group (143/196 cases, 73%) than in those >60 years of age (109/222 cases, 49%).

Chest infections occurred in 11% of the bacteraemic group (21/183 patients), and in 3% of the CNS infection (8/268 cases). Chest infections were more frequent in the older bacteraemic group and in males: in 15% (21/136) of all cases >50 years old, and 22% (16/71 cases) of males.

Table 2. *Sources of isolates of* L. monocytogenes *in 268 adult and juvenile patients with central nervous system infections*

Numbers of cases	Clinical symptoms/ diagnosis	Source of isolates of *L. monocytogenes* (numbers of cases)
227	Meningitis*	CSF (118), blood (43), CSF and blood (53), other (5)†, NS (8)
17	Meningoencephalitis/‡ Encephalitis	CSF (7), CSF and blood (1), blood (7), NS (2)
6	Brain abscess	CSF (2), blood (2), PM brain tissue (1), NS (1)
1	Cerebral haemorrhage	CSF (1)
2	Pyrexia	CSF (2)
15	Not stated	CSF (7), CSF and blood (8)

* Seven cases had chest infections (5 with pneumonia), 1 case had endocarditis.

† Sites of isolation were: CSF, blood and PM specimen (2 cases), meningeal swabs taken at necropsy (1 case), blood and high vaginal swab (1 case), see Hardie and Roberts, 1984 [3].

‡ One case had pneumonia.

CSF, cerebrospinal fluid; PM, post mortem; NS, not stated.

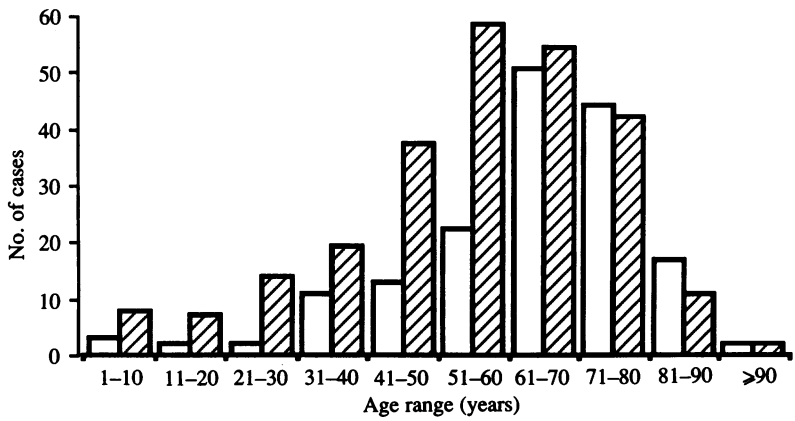

Fig. 1. Distribution of listeriosis cases amongst 10-year age groups. The numbers of cases are banded into 10 year age groups, and comprised 252 central nervous system infections (▨), and 166 cases involving bacteraemia only (□).

The distribution of CNS infections and bacteraemia alone between those patients who were otherwise healthy or with underlying illness is shown in Table 3. Patients without underlying illness were more likely to have CNS infections than bacteraemia alone, and those with bacteraemia usually had underlying illness. These associations were not related to the sex or the ages of the patients. Similar numbers of patients with underlying illness were included in the CNS and bacteraemic groups.

The proportions of cases with fatal outcomes (categorized according to underlying illness and type of infection) are shown in Table 4. Patients with CNS infections had a worse prognosis than those with bacteraemia alone in all

Table 3. *Proportion of 326 adult and juvenile patients with central nervous system infections or bacteraemia alone due to* L. monocytogenes *who were previously healthy or had underlying illness*

Other medical condition	Numbers of cases with: Bacteraemia alone (%)	CNS infections (%)	Total
Otherwise healthy	10 (7%)	62 (35%)	72
With underlying illness	140 (93%)	114 (65%)	254

CNS, central nervous system.

Table 4. *Mortality in 293 cases of listeriosis in non-pregnant adults and juveniles*

Medical condition	Numbers of patients died:survived (proportion of patients died): Total	Bacteraemia*	CNS infection
Total otherwise healthy	19:48 (0·28)	4:6 (0·40)	15:42 (0·26)
Total with underlying illness	102:128 (0·44)	48:79 (0·38)	54:49 (0·53)
Category of underlying illness			
Malignancies (total)	45:47 (0·48)	26:30 (0·46)	19:17 (0·53)
Leukaemia	12:17 (0·41)	7:12 (0·36)	5:5 (0·50)
Lymphoma	11:13 (0·45)	6:7 (0·46)	5:6 (0·45)
Other	22:17 (0·56)	13:11 (0·54)	9:6 (0·60)
Inflammatory disorders	24:31 (0·44)	10:18 (0·36)	14:13 (0·52)
Iatrogenic conditions	10:25 (0·29)	5:19 (0·20)	5:6 (0·45)
Transplants	4:18 (0·18)	2:12 (0·14)	2:6 (0·25)
Heart valve replacements	0:4 (0·00)	0:4 (0·00)	— —
Other	6:3 (0·67)	3:3 (0·5)	3:0 (1·0)
Non-malignant conditions	12:15 (0·44)	4:9 (0·30)	8:6 (0·57)
Other	11:10 (0·52)	3:3 (0·50)	8:7 (0·53)

CNS, central nervous system.

* Bacteraemia due to *L. monocytogenes* without evidence for the involvement of the central nervous system.

categories except the otherwise healthy group (of which there were only ten cases of bacteraemia alone). Amongst the different underlying illness categories, the highest mortality rates were found in the malignancies group, and the lowest in the iatrogenic categories.

Seasonal incidence of listeriosis

The seasonal variation in incidence for the period 1981–5 is shown in Fig. 2, in which cases associated with pregnancy are also included. Cases are dated by the month when the cultures were received in DMRQC. The onset of illness in the patient was not used since this was known for only 44% (318/722) of the cases overall. However, in those where the onset was known (318 cases), cultures were

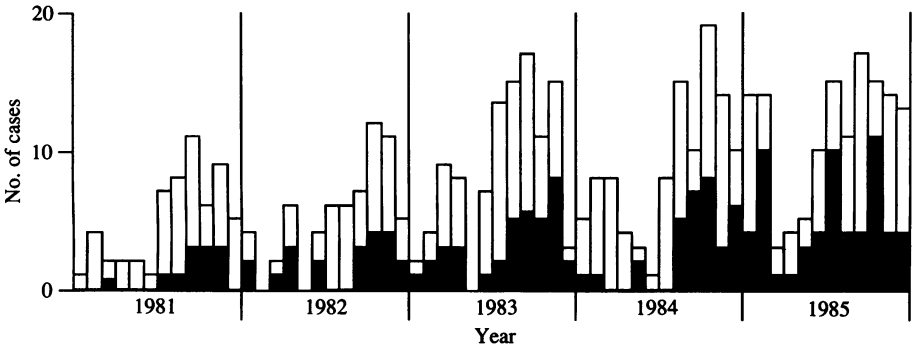

Fig. 2. Numbers of cases of listeriosis per month for the years 1981–5. Total 465 cases. ▨, Group 1 cases (associated with pregnancy); □, group 2 cases (non-pregnant individuals).

received in DMRQC within 1 month (30 days) after the onset of illness in 263 cases (83%), range 2–100 days.

The numbers of cases show annual seasonal peaks in incidence, the largest of these being in the autumn, with a smaller increase in the spring (Fig. 2). The pattern was similar in both the pregnancy and non-pregnancy associated cases.

DISCUSSION

In this series of cases, as with other studies [4—6], infection is more frequent in males, in patients over 40 years of age (Fig. 1), and the mortality rate increases with age. In contrast to the pregnancy associated cases (see accompanying paper), 77% of this group had other medical conditions which might predispose to infection, mostly through deficient or suppressed cellular immunity, e.g. malignancies and immunosuppressive regimes (Table 1). Because the incidence of underlying disease increases with age it was not possible here to ascertain if age alone may predispose individuals to infection.

In patients with CNS infections, meningitis was the most common clinical manifestation (85% of cases, Table 2), a similar finding to that of Nieman and Lorber [5]. Other clinical forms (e.g. meningoencephalitis, encephalitis and brain abscess) occurred less often (15% of cases). In a more detailed study, however, of 54 listeriosis cases affecting the CNS [7] (a high proportion of which are included in this study), two distinct clinical groups were recognized: those of a 'meningitis' group which occurred in 62% of the cases, and a 'meningo-encephalitis' group which occurred in the remaining 37%. The reasons for the difference between these two studies are almost certainly due to the imprecise nature of the questionnaire used here, and not to the clinical manifestation of listeriosis.

Almost all the remaining cases (39%) presented as listerial bacteraemia without CNS involvement. This is a higher proportion than those described in other studies, where CNS infections in adults and juveniles occurred in 62–78% of cases [4, 5, 8, 9]. Chest infection due to *L. monocytogenes* has been reported by others [10], and occurred relatively frequently in this study especially in patients over 40

years of age with bacteraemia alone. Further investigations are needed to assess the role of *L. monocytogenes* in this condition.

The association of *L. monocytogenes* bacteraemia without involvement of the CNS in patients with underlying illness (Table 3) has also been noted in other studies [8, 5, 11]. The majority of healthy adults appear relatively unsusceptible to serious infection by *L. monocytogenes*. A high proportion of adult and juvenile cases occur in immunologically predisposed individuals (Table 1). Serious disease in mothers of listeriotic infants is rare despite challenge by high numbers of *L. monocytogenes* (see accompanying paper). Since *L. monocytogenes* is often found in foods for human consumption [12–14], individuals are frequently exposed to this bacterium and the attack rate for serious disease is very low. Accidental laboratory acquired infection is rare, resulting in spontaneously resolving ocular or mild cutaneous lesions [15, 16]. Listeriosis in veterinarians attending listeriotic animals has occurred, resulting in relatively mild localized cutaneous lesions [17, 18]. However, as demonstrated in this and in other studies, listeriosis does take place in the otherwise healthy individual, and almost always occurs as meningitis. It is possible that subclinical listeriosis takes place, and the reported clinical spectrum of disease may reflect an underdiagnosis of infection rather than the true range of affected individuals. Where groups of patients are subjected to more intensive investigation (e.g. transplant patients and pregnant women), *L. monocytogenes* bacteraemia appears more frequent than in the general population. In addition, the patients with serious underlying illness are not only more likely to be medically investigated, but may suffer more serious forms of listeriosis when infected. In the previously healthy individuals, however, subclinical infection is unlikely to be diagnosed, and when more serious forms of the diseases occur (i.e. meningitis), the symptoms are sufficiently severe for microbiological investigation to take place with subsequent diagnosis of listeriosis. The increased frequency of CNS infections as compared to bacteraemia alone in the under-60-year-olds in this study (Fig. 2) may have a similar explanation: i.e. bacteraemia in the under-60-year-olds may be of a less severe nature and less likely to be as intensively medically investigated than CNS infections in this group.

The overall mortality rate in this study was 44%, with 47% in the CNS group and 40% in the bacteraemic group, and is comparable with the 47% mortality rate described by Humbert and co-workers [4]. However, lower rates (29–37%) have been reported by other workers [5, 8, 19–21]. Variation in mortality rates with different underlying illnesses has been noted by others [5], and in this study ranged from 48% for patients with malignancies to 29% for patients with iatrogenic conditions (Table 4). However, since the causes of death were not ascertained in this study, mortality cannot be assumed to be due to listerial infection. Mortality rates between 29 and 37% were described in the three recent North American outbreaks of listeriosis in non-pregnant individuals [22–24].

One case of listeriosis (meningoencephalitis) in this series occurred in a patient with AIDS. Other cases in AIDS patients have been reported [25–36]. It has been estimated that in the USA, the risk of patients with AIDS acquiring listeriosis is several hundred times higher than in the general population [37].

The numbers of reports of listeriosis in Britain have dramatically increased during the course of this study (1967–85) and subsequently [1, 38–41]. This

increase may be due to the recognition of a disease which has always been present, facilitated by better reporting of cases and improvements in isolation and identification of *L. monocytogenes*. However, it also seems likely that a real increase in incidence has occurred, possibly through changes in food shopping and eating habits [40], together with a change in the pattern of infection.

The proportion of cases not associated with pregnancy appears to be increasing. Seeliger, Emmerling and Emmerling [42] reported that 80% of cases of listeriosis in Germany during the early 1960s were associated with pregnancy. A more recent survey of listeriosis in Germany (1969–85) by this same group, found 54% of cases in newborns or associated with pregnancy [43]. Recent surveys in Europe and North America [6, 20, 44], have given similar proportions of non-pregnant and pregnancy associated cases to those described here. The incuriosity among medical and microbiological staff towards the premature, under-weight and sickly infant has been noted by other authors with regard to other 'emerging' pathogens of the very young [45–47], and may also contribute to the apparent increase in neonatal and foetal listeriosis.

In a survey of 534 culture proven cases up to 1957 in Germany [15], 85% (458 cases) of these were meningitis, meningoencephalitis or granulonatosis infantiseptica (the central nervous system infections in the neonatal and adult/juvenile groups were not considered separately). In addition, the group of adult and juvenile patients Seeliger [15] refers to as having the 'typhoid/pneumonic' form of listeriosis, accounted for only 5% (25/534) of all the cases. The pattern of infection described here was somewhat different. Central nervous system infections in all ages comprised 71% of all cases, and the adults and juveniles with bacteraemia only and underlying illness comprised 28% of all cases. The septicaemic infectious mononucleosis form, as originally described by Nyfeldt in 1929 [48], was described in 7% (40 patients) in the series of 534 cases described by Seeliger [15]. This form of listeriosis (together with the oculoglandular and the cutaneous forms) were either not reported or occurred very rarely in the cases in this or in other recent series [4, 5, 49]. The changing pattern of listeriosis in non-pregnant individuals may be due to an apparent increase in the incidence of some malignancies (probably due to better diagnosis) and an increase in the life expectancy of these patients, e.g. those with leukaemia and lymphoma [50, 51]. In addition there has been a vast increase in numbers of patients treated with immunosuppressive regimes over the past 25 years.

Thus listeriosis appears to have changed not only to a disease of higher incidence, but also to one affecting susceptible non-pregnant individuals and the unborn.

A consistent seasonality in incidence was observed, with an increase in the numbers of all cases occurring in the late summer and autumn, and a smaller peak during the spring in some years (Fig. 2). Studies in other countries have reported a similar unexplained annual seasonality [6, 9, 21, 41, 52]. Possible explanations for this seasonality include greater exposure of individuals to *L. monocytogenes*, or to exposure to other agents which increase susceptibility to infection. In the recent outbreak in the Lausanne region of Switzerland [53], the cheese implicated in the outbreak was only produced during September and October (the majority of the cases occurring during October to December). Data from an outbreak associated

with soft cheese in California [24], showed an average incubation period of 30 days (range 1–91 days) between ingestion and onset of symptoms. Thus, if listeriosis is predominantly a food-borne infection, primary exposure to *L. monocytogenes* leading to infection in a high proportion of the cases occurs in mid-summer and also (although to lesser extent) in mid-winter. This assumes also that exposure occurs within 1 month before onset of symptoms, and that strains of *L. monocytogenes* are received in DMRQC 1 month after their isolation. However, it remains to be ascertained if the seasonal incidence of listeriosis in Britain is related to food-manufacturing practices.

ACKNOWLEDGMENTS

I should like to gratefully acknowledge the support and useful discussion from Mr J. J. S. Snell and Dr A. G. Taylor, DMRQC, Central Public Health Laboratory Colindale; Professor A. Audurier, Hopital Trousseau, Tours, France; and Dr A. P. MacGowan, Bristol Royal Infirmary, Bristol.

REFERENCES

1. McLauchlin J. *Listeria monocytogenes*, recent advances in the taxonomy and epidemiology of listeriosis in humans. J Appl. Bacteriol 1987; **63**: 1–11.
2. McLauchlin J, Audurier A, Taylor AG. Aspects of the epidemiology of human *Listeria monocytogenes* infections in Britain 1967–1984; the use of serotyping and phage typing. J Med Microbiol 1986; **22**: 367–77.
3. Hardie R, Roberts W. Adult listeriosis presenting as acute hepatitis. J Infect 1984; **8**: 256–8.
4. Humbert G, Duval C, Fessard C, Meunier M, Ledoux A. Aspects actuels des listeriose en France: a propos d'une statistique de 824 cas I. Lyon Medical 1977; **237**: 275–89.
5. Nieman RE, Lorber B. Listeriosis in adults: a changing pattern. Report of eight cases and review of the literature, 1968–1978. Rev Infect Dis 1980; **2**: 207–27.
6. Goulet V, Leonard JL, Celers J. Etude épidémiologique de la listériose humaine en France en 1984. Rev Epidémiol Santé Publique 1986; **34**: 191–5.
7. Pollock SS, Pollock TM, Harrison MJG. Infection of the central nervous system by *Listeria monocytogenes*: a review of 54 adult and juvenile cases. Q J Med 1984; **53**: 331–40.
8. Louria DB, Hensle T, Armstrong D, et al. Listeriosis complicating malignant disease. Ann Intern Med 1967; **67**: 261–81.
9. Moore RM, Zehmer RB. From the Center for Disease Control: listeriosis in the United States, 1971. J Infect Dis 1973; **127**: 610–1.
10. Ananthraman A, Israel RH, Magnussen CR. Pleural-pulmonary aspects of *Listeria monocytogenes* infection. Respiration 1983; **44**: 153–7.
11. Gray ML, Killinger AH. *Listeria monocytogenes* and listeric infections. Bacteriol Rev 1966; **30**: 309–82.
12. Pini PN, Gilbert RJ. The occurrence in the UK of *Listeria* species in raw chickens and soft cheeses. Int J Food Micribiol 1988; **6**: 317–26.
13. Sizmur K, Walker CW. *Listeria* in prepacked salads. Lancet 1988; i: 1167.
14. Gilbert RJ, Miller KL, Roberts D. *Listeria monocytogenes* and chilled food. Lancet 1989; i: 383–4.
15. Seeliger HPR. Listeriosis, 2nd ed. Basel: Karger, 1961.
16. Seeliger HPR. New outlook on the epidemiology and epizoology of listeriosis. Acta Microbiol Acad Sci Hung 1972; **19**: 273–86.
17. Owen CR, Meis A, Jackson JW, Stoenner HG. A case of primary cutaneous listeriosis. N Engl J Med 1960; **262**: 1026–8.
18. Cain DB, McCann VL. An unusual case of cutaneous listeriosis. J Clin Microbiol 1986; **23**: 976–7.

19. Lavetter A, Leedom JM, Mathies AW, Ivler D, Wehrle PF. Meningitis due to *Listeria monocytogenes*: a review of 25 cases. N Engl J Med 1971; **285**: 598–603.
20. Larsson S. Epidemiology of listeriosis in Sweden 1958–1974. Scan J Infect Dis 1979; **11**: 47–54.
21. Stamm AM, Dismukes WE, Simmons BP, et al. Listeriosis in renal transplant recipients: report of an outbreak and review of 102 cases. Rev Infect Dis 1982; **4**: 665–82.
22. Schlech WF, Lavigne PM, Bortolussi RA, et al. Epidemic listeriosis: Evidence for transmission by food. N Engl J Med 1983; **308**: 203–6.
23. Fleming DW, Cochi SL, MacDonald KL, et al. Pasteurized milk as a vehicle of infection in an outbreak of listeriosis. N Engl J Med 1985; **312**: 404–7.
24. Linnan MJ, Mascola L, Lou XD, et al. Epidemic listeriosis associated with Mexican-style cheese. N Engl J Med 1988; **319**: 823–8.
25. Welti CV, Roldan EO, Fojaco RM. Listeriosis as a cause of maternal death: an obstetric complication of the acquired immunodeficiency syndrome (AIDS). Am J Obstet Gynecol 1983; **147**: 7–9.
26. Real FX, Gold JWM, Krown SE, Armstrong D. *Listeria monocytogenes* bacteremia in the acquired immunodeficiency syndrome. Ann Intern Med 1984; **101**: 883–4.
27. Read EJ, Orenstein JM, Chorba TL, et al. *Listeria monocytogenes* sepsis and small cell carcinoma of the rectum: an unusual presentation of the acquired immunodeficiency syndrome. Am J Clin Pathol 1985; **83**: 385–9.
28. Eeftinck Schattenkerk JKM, Klopping C, Speelman JD, van Ketel RJ, Danner SA. Complications of the acquired immunodeficiency syndrome. Ann Intern Med 1986; **104**: 726.
29. Gould IA, Belok LC, Handwerger S. *Listeria monocytogenes*: A rare cause of opportunistic infection in the acquired immunodeficiency syndrome (AIDS) and a new cause of meningitis in AIDS. A case report. AIDS Research 1986; **2**: 231–4.
30. Koziol K, Rielly KS, Bonin RA, Salcedo JR. *Listeria monocytogenes* meningitis in AIDS. Can Med Assoc J 1986; **135**: 43–4.
31. Thiel M, Kindt R, Schmidt H, Schassan H, Schmidt-Kiniken H, Potel J. Listeriensepsis bei AIDS. Dtsch Med Wochenschr 1986; **111**: 316–17.
32. Mascola L, Lieb L, Chiu J, Fannin SL, Linnan MJ. Listeriosis: An uncommon opportunistic infection in patients with acquired immunodeficiency syndrome. Am J Med 1988; **84**: 162–4.
33. Harvey RL, Chandrasekar PH. Chronic meningitis caused by *Listeria* in a patient infected with human immunodeficiency virus. J Infect Dis 1988; **157**: 1091–2.
34. Rianco JA, Echevarria S, Napal J, Duran RM, Marcias JG. Endocarditis due to *Listeria monocytogenes* and human immunodeficiency virus infection. Am J Med 1988; **85**: 737.
35. Beninger PR, Savoia MC, Davis CE. *Listeria monocytogenes* meningitis in a patient with AIDS-related complex. J Infect Dis 1988; **158**: 1396–7.
36. Bizet C, Mechali D, Rocourt J, Fraisse F. *Listeria monocytogenes* bacteraemia in AIDS. Lancet 1989; i: 501.
37. Gellin BG, Broome CV. Listeriosis. JAMA 1989; **261**: 1313–20.
38. Anonymous. Communicable disease quarterly. Public Health Laboratory Service Microbiology Digest 1986; **3**: 35–7.
39. Anonymous. Communicable Disease report January to March 1988. Community Med 1988; **10**: 250–4.
40. McLauchlin J, Saunders NA, Ridley AM, Taylor AG. Listeriosis and food-borne transmission. Lancet 1988; i: 177–8.
41. Hall SM, Crofts N, Gilbert RJ, Pini PN, Taylor AG, McLauchlin J. Epidemiology of listeriosis, England and Wales. Lancet 1988; ii: 502–3.
42. Seeliger HPR, Emmerling P, Emmerling H. Listeriosis in Germany. German Medical Monthly 1969; **14**: 157–63.
43. Schmidt-Wolf G, Seeliger HPR, Schrettenbrunner A. Menschliche listeriose-erkrankungen in der Bundesrepublik Deutschland, 1969–1985. Zentralbl Bakteriol Mikrobiol Hyg (A) 1987; **265**: 472–86.
44. Busch LA. Human Listeriosis in the United States 1967–1969. J Infect Dis 1971; **123**: 328–32.
45. Parker MT. Infections with group-B streptococci. J Antimicrob Chemother 1979; **5** (suppl A): 27–37.

46. Stewart AL, Reynolds EOR, Lipscomb AP. Outcome for infants of very low birthweight: survey of world literature. Lancet 1981; i: 1038–40.
47. Hurley R. Neonatal septicaemia and meningitis. J Hosp Infect 1982; **3**: 323–8.
48. Nyfeldt A. Etiologie de la mononucleose infectieuse. Comptes Rendus des Seances de la Société de Biologie (Paris) 1929; **101**: 590–2.
49. Bojsen-Moller J. Human listeriosis: diagnostic, epidemiological and clinical studies. Acta Pathol Microbiol Immunol Scand 1972; Section B (suppl 229): 1–157.
50. Adelstein A, White G. Leukaemia 1911–1973: cohort analysis. Population Trends No. 3, pp. 9–13. Office of Population Census and Surveys. London: Her Majesty's Stationery Office, 1976.
51. Anonymous. Cancer Statistics 43: Incidence, survival and mortality in England and Wales. Office of Population Census and Surveys. London: Her Majesty's Stationery Office, 1981.
52. Ciesielski CA, Hightower AW, Parsons SK, Broome CV. Listeriosis in the United States: 1980–1982. Arch Intern Med 1988; **148**: 1416–9.
53. Bille J, Glauser MP. Zur listeriose-situation in der Schweiz. Bull Bundesamtes Gesundheitswesen 1988; **3**: 28–9.