Epidemiology

Improvements in survival from childhood cancer: results of a population based survey over 30 years

J M BIRCH, H B MARSDEN, P H MORRIS JONES, D PEARSON, V BLAIR

Abstract

Survival from cancer of children whose cancer was diagnosed during the 30 years 1954-83 was analysed. The study was population based with nearly 3000 cases covering about 30 million child years at risk. When survival during the three decades 1954-63, 1964-73, and 1974-83 was compared striking improvements were observed. For all childhood cancer five year survival increased from 21% in the first decade to 49% in the third decade. During the first and third decades five year survival rates for acute lymphocytic leukaemia increased from 2% to 47%, Hodgkin's disease from 44% to 91%, non-Hodgkin's lymphoma from 18% to 45%, Wilms's tumour from 31% to 85%, and germ cell tumours from 10% to 64%. Twenty patients developed second primary tumours, but otherwise there were few late deaths. Less than 1% of children who survived without a relapse for 10 years subsequently died of their initial cancer.

Survival from childhood cancer is no longer rare, and people who have been cured of cancer during childhood should be accepted as normal members of society.

Introduction

Malignant disease is a major cause of morbidity and mortality in childhood and affects about one in 650 children by age 15.[1] With improvements in health care during the past 50 years and the diminishing importance of bacterial and other infections as a cause of death in childhood, malignant disease has assumed a greater importance.

For many years neoplasms ranked second only to accidents as a cause of death in the age range 1 to 14 but recently has dropped to third in rank order after accidents and congenital malformations.[2] Effective treatments for many types of childhood cancer have been developed, and improvements in survival have been reported.[3] Such reports in general, however, are from the results of clinical trials, where some patient selection is inevitable and accrual of patients to the trial takes place over a relatively short time.[4] What impact the developments in treatment have on the prospects for survival of children with cancer can be assessed only by studying a series of patients based on a geographical population.

The Manchester Children's Tumour Registry has detailed clinical and histopathological records of cancer in children from a defined population and can be used for this type of assessment. We report an analysis of survival among children whose cancer was diagnosed over 30 years.

University of Manchester, Manchester M20 9BX

J M BIRCH, MSC, PHD, senior research fellow in oncology, department of epidemiology and social oncology, Christie Hospital and Holt Radium Institute

H B MARSDEN, MB, FRCPATH, professor of paediatric pathology and consultant pathologist, Royal Manchester Children's Hospital and Booth Hall Children's Hospital

P H MORRIS JONES, MB, FRCP, reader in child health (paediatric oncology) and consultant paediatric oncologist, Royal Manchester Children's Hospital and Christie Hospital and Holt Radium Institute

D PEARSON, MB, FRCR, consultant radiotherapist and oncologist, Christie Hospital and Holt Radium Institute

V BLAIR, BA, MSC, research fellow in oncology and statistician, department of epidemiology and social oncology

Correspondence to: Dr Birch.

Patients and methods

All patients with malignant disease or benign intracranial tumours in the Manchester Children's Tumour Registry whose cancer was diagnosed between 1 January 1954 and 31 December 1983 were entered into the study. The register contains information on all patients with malignant and certain benign tumours in children aged under 15 years who were resident within the boundaries of the North Western Regional Health Authority area (Manchester Regional Hospital Board area before 1974) at the time of diagnosis. The average childhood population during the study period was about one million, yielding about 100 new cases each year. Detailed abstracts or photocopies of the clinical records are obtained for the register on each child.

For solid tumours histopathological material is obtained and circulated to a panel of pathologists who are skilled in tumour or paediatric pathology. Material from subsequent biopsies or necropsies is likewise obtained and circulated to the panel. Diagnoses in leukaemias are based on bone marrow specimens. Material is retained by the registry, allowing diagnoses to be reviewed and revised in the light of developments in staining techniques and current ideas on classification. Final diagnoses are assigned to each case, taking into account all the available clinical and pathological information.

Each patient is followed up each year until death by writing to the clinician in charge, the general practitioner, or rarely the parents. It is the policy of the Manchester paediatric oncology team that every child who has received radiotherapy or chemotherapy, or both, is permanently followed up by the hospital. Patients are examined regularly into adulthood in the outpatient clinic. If the family moves out of the Manchester area arrangements for follow up are made with other paediatric oncology centres in the United Kingdom or abroad if necessary. For patients registered early and more recent patients who have not been treated by the paediatric oncologists—for example, some patients with brain tumours treated by surgery alone—follow up information is usually obtained from the general practitioner. When a family moves the name and address of their current general practitioner is obtained with the help of the National Health Service Central Register and family practitioner committees. General practitioners and hospital consultants are asked to provide information on the patient's state of health, including long term effects of treatment, residual disability, and health of parents, siblings, and offspring. Much effort is made to keep track of survivors, and this has been achieved for more than 99% of all surviving patients in the registry. Every patient in the study had been followed up until death or for at least two years at the time of analysis.

Morphology and topography codes were allocated to each patient using the International Classification of Disease for Oncology,[5] and the patients were classified according to the scheme described by Birch and Marsden.[6] Incidence rates for each main diagnostic group were calculated using the sums of the mid-year estimates of the child population for the Manchester Regional Hospital Board area 1954-73 and the North Western Regional Health Authority area 1974-83. The study covers 29·6 million child years

at risk. Kaplan-Meier survival curves were calculated for each diagnostic group for children diagnosed during the three decades 1954-63, 1964-73, and 1974-83.[7] For each group the three curves were compared by the log rank test.[8] Standard errors (SE) and approximate 95% confidence intervals (CI) were calculated for survival at five years according to the method described by Peto *et al.*[8] Results of clinical trials are often presented in terms of five year survival rates. We have up to 33 years' follow up on patients in our series, and causes of late death—that is, more than five years after diagnosis—details of second malignant neoplasms, and information about children of survivors were abstracted from the case records.

Results

Altogether 2965 patients were eligible for the study. Table I shows the distribution by diagnosis and sex and the incidence rates for each type of cancer. Appreciable increases in yearly incidence rates were seen for acute lymphocytic leukaemia, other and unspecified central nervous system tumours, germ cell tumours, and epithelial tumours during the study period. Increases in yearly rates for non-Hodgkin's lymphoma and medulloblastoma that approached significance were also seen. Rates for all other types were stable. Temporal trends in incidence are discussed in detail elsewhere (Birch *et al*, in preparation).

The diagnosis was histologically confirmed in 96% of patients. The remaining 4% were mainly in patients with unbiopsied brain stem tumours. A few renal and bone tumours where diagnosis was based on clinical and radiological evidence were also included in the register. These were classified with the "other central nervous system" and "other and unspecified neoplasms" respectively. Thus the specified groups include only tumours that were diagnosed histologically. The exception to this is retinoblastoma, where the clinical features are so characteristic that the diagnosis can be made on these grounds alone. Furthermore, with current treatment techniques enucleation is unnecessary in most cases. Therefore recent clinically diagnosed retinoblastomas have been included in the retinoblastoma group rather than with the "unspecified" tumours.

TABLE I—*Manchester Children's Tumour Registry 1954-83: incidence of malignant disease per 10^6 person years*

	No of boys	No of girls	Total No	Rate per 10^6
Acute lymphocytic leukaemia	456	321	777	26·3
Acute non-lymphocytic leukaemia	77	95	172	5·8
Other leukaemia	18	11	29	1·0
Hodgkin's disease	80	29	109	3·7
Non-Hodgkin's lymphoma	93	45	138	4·7
Other lymphoreticular system	43	40	83	2·8
Ependymona	44	46	90	3·0
Adult astrocytoma	54	51	105	3·6
Juvenile astrocytoma	83	84	167	5·6
Medulloblastoma	97	53	150	5·1
Other central nervous system	93	91	184	6·2
Neuroblastoma	108	81	189	6·4
Retinoblastoma	42	42	84	2·8
Wilms's tumour	82	78	160	5·4
Hepatoblastoma	12	4	16	0·5
Osteosarcoma	32	42	74	2·5
Ewing's tumour	26	31	57	1·9
Rhabdomysarcoma	73	45	118	4·0
Other soft tissue sarcoma	24	18	42	1·4
Germ cell tumours	32	47	79	2·7
Epithelial tumours	35	33	68	2·3
Other and unspecified neoplasms	37	37	74	2·5
Total	1641	1324	2965	100·2

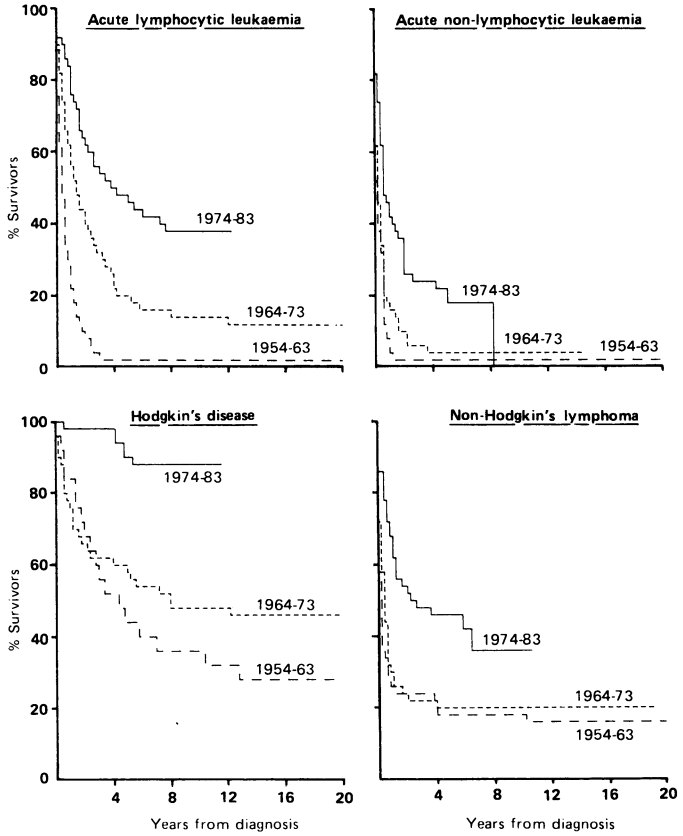

FIG 1—Manchester Children's Tumour Registry 1954-83: survival from childhood cancer by decade of diagnosis: leukaemias and lymphomas.

Leukaemias and lymphomas comprise nearly half of all cases and central nervous system tumours nearly a quarter. The embryonal tumours of childhood (neuroblastoma, retinoblastoma, Wilms's tumour, embryonal rhabdomyosarcoma, and hepatoblastoma) account for a further one fifth of cases. Carcinomas, which are very rare in children and can occur at various sites, together with other "mixed" groups—for example, "other central nervous system," "other soft tissue sarcoma," and "other lymphoreticular"—were not included in the analyses of survival by diagnosis.

Table II summarises the five year survival rates for the main diagnostic groups during each of the three decades covered by the study. There was a highly significant increase in survival rates for all childhood cancers considered together, with the five year survival more than doubling. When individual diagnostic groups are considered all show at least a doubling of five year survival except ependymoma and medulloblastoma. The prognosis

TABLE II—*Manchester Children's Tumour Registry: survival from childhood cancer*

	1954-63				1964-73				1974-83				Log rank test for trend in survival p
	No in group	% Survival at five years	Standard error (%)	95% CI	No in group	% Survival at five years	Standard error (%)	95% CI	No in group	% Survival at five years	Standard error (%)	95% CI	
All childhood cancers	935	21	1	19 to 24	1076	31	1	28 to 34	947	49	2	45 to 53	<0·0001
Acute lymphocytic leukaemia	240	2	1	<1 to 3	286	19	2	15 to 24	251	47	4	39 to 55	<0·0001
Acute non-lymphocytic leukaemia	67	2	2	<1 to 5	60	3	2	<1 to 8	45	21	7	8 to 35	<0·0001
Hodgkin's disease	25	44	10	24 to 64	47	57	7	43 to 72	37	91	5	80 to 100	<0·0001
Non-Hodgkin's lymphoma	38	18	6	6 to 31	49	20	6	9 to 32	51	46	9	29 to 63	0·0003
Ependymoma	30	20	7	5 to 35	30	23	8	8 to 39	30	29	11	7 to 51	0·2
Juvenile astrocytoma	50	66	7	53 to 79	66	74	5	63 to 85	50	83	6	71 to 96	0·2
Adult astrocytoma	34	9	5	<1 to 19	38	13	6	2 to 24	33	24	9	7 to 41	0·2
Medulloblastoma	44	25	7	12 to 38	50	40	7	26 to 54	56	41	8	25 to 57	0·02
Neuroblastoma	64	14	4	5 to 23	71	14	4	6 to 22	54	28	9	11 to 45	0·001
Retinoblastoma	31	84	7	71 to 97	35	86	6	74 to 96	18	72	12	49 to 95	0·6
Wilms's tumour	49	31	6	18 to 43	56	59	7	46 to 72	48	85	6	73 to 98	<0·0001
Rhabdomyosarcoma	41	24	7	11 to 38	45	22	6	10 to 35	31	54	10	35 to 74	0·002
Osteosarcoma	26	15	7	1 to 30	22	9	6	<1 to 21	26	39	12	16 to 62	0·03
Ewing's tumour	22	9	5	<1 to 19	19	16	8	<1 to 33	17	41	14	13 to 69	0·1
Germ cell tumours	20	10	6	<1 to 21	22	41	11	20 to 62	37	64	9	46 to 83	<0·0001

for juvenile astrocytoma and retinoblastoma has always been 60% or better at five years for both diagnoses in all three decades and therefore cannot be doubled with improvements in treatment. For juvenile astrocytoma, however, the mortality has halved from 34% to 17%. In some groups the improvement in survival has been remarkable—notably acute lymphocytic leukaemia, acute non-lymphocytic leukaemia, Wilms's tumour, Ewing's tumour, and germ cell tumours.

Figure 1 shows survival curves for leukaemias and lymphomas. The most dramatic improvement was in acute lymphocytic leukaemia, where survival has increased from 2% in the first decade (our earliest survivor was diagnosed in 1959) to about 40% in the third decade. The outlook for patients with acute non-lymphocytic leukaemia has also considerably improved. Survival from non-Hodgkin's lymphoma has likewise increased appreciably and Hodgkin's disease in children is now usually curable. For all leukaemias and lymphomas the trend towards improved survival has continued. A comparison of three year survival rates for the two more recent quinquennia showed the following: for acute lymphocytic leukaemia diagnosed during 1974-8 the three year survival was 49% (SE 4%, 95% CI 40 to 75), and for 1979-83 60% (SE 5%, 95% CI 51 to 70). Similar rates for acute non-lymphocytic leukaemia were 19% (SE 8%, 95% CI 4 to 34) and 33% (SE 11%, 95% CI 11 to 56); for Hodgkin's disease 96% (SE 4%, 95% CI 87 to 100) and 100% (SE <1%, 95% CI 99 to 100); and for non-Hodgkin's lymphoma 36% (SE 9%, 95% CI 18 to 54) and 65% (SE 11%, 95% CI 43 to 87) respectively.

Late deaths—that is, deaths occurring more than five years after diagnosis—among the patients with leukaemias and lymphomas were usually due to relapse of the primary disease. Among the 29 late deaths in patients with acute lymphocytic leukaemia, however, one patient relapsed with acute myeloid leukaemia, one died of chickenpox, and one died of graft versus host disease after bone marrow transplantation. There were two other patients with acute lymphocytic leukaemia who relapsed with acute myeloid leukaemia within five years of initial diagnosis. Of three late deaths in the group with non-Hodgkin's lymphoma, one patient died of a second primary grade IV astrocytoma. One patient with cured Hodgkin's disease died at age 31 of coronary atherosclerosis. Two other patients died of generalised Hodgkin's disease more than five years after initial diagnosis.

There is less cause for optimism with respect to the prognosis of childhood brain tumours (fig 2). The patients with medulloblastoma are the only group to show a significant improvement over the three decades, but this improvement occurred during the earlier period. A smaller proportion of late deaths among patients with brain tumours was due to recurrence of the primary tumour. Of 16 late deaths in patients with juvenile astrocytoma, nine were due to primary recurrence and six resulted from chronic problems secondary to the tumour or its treatment—epilepsy, chronic hydrocephalus, and various degrees of physical and mental handicap. One further patient who was otherwise well died in a road traffic accident. One patient with adult astrocytoma died from BCNU (1,3-bis (2-chloroethyl)-1-nitrosourea) induced pulmonary fibrosis. Four of five late deaths in patients with ependymoma were due to local recurrence, one also having pulmonary fibrosis induced by BCNU, and the fifth death was due to bronchial pneumonia in a patient who was severely mentally and physically handicapped. There were 13 late deaths in children with medulloblastoma: nine from local recurrence; two from spinal metastases (one of these also had a local recurrence); one from osteosarcoma of the skull which was presumably induced by radiation; and one from pulmonary fibrosis induced by BCNU. In addition to the three cases mentioned above it is noteworthy that there have been three other deaths less than five years from diagnosis from pulmonary fibrosis induced by BCNU. Other survivors who were treated with BCNU now have definite or possible signs and symptoms of pulmonary fibrosis.

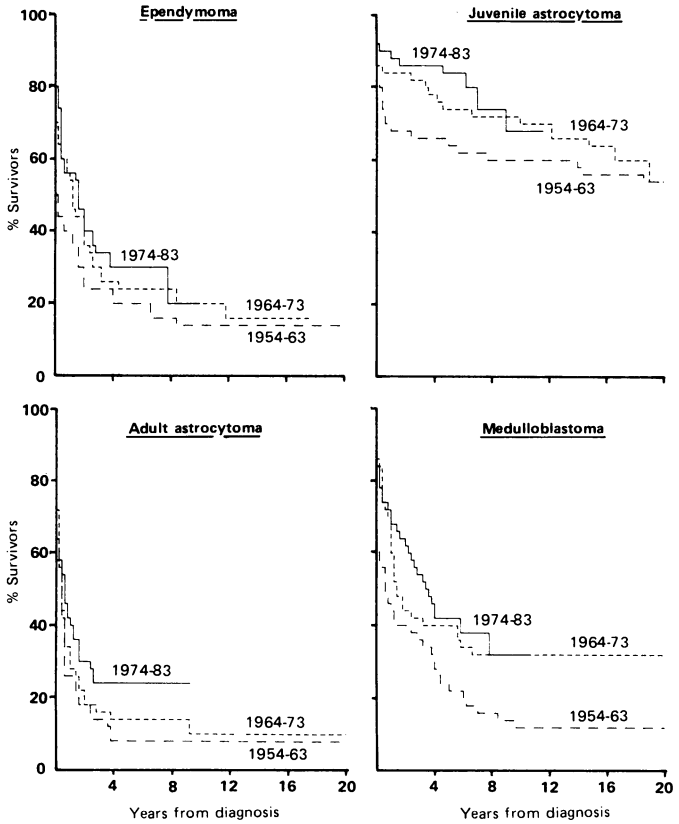

FIG 2—Manchester Children's Tumour Registry 1954-83: survival from childhood cancer by decade of diagnosis: central nervous system tumours.

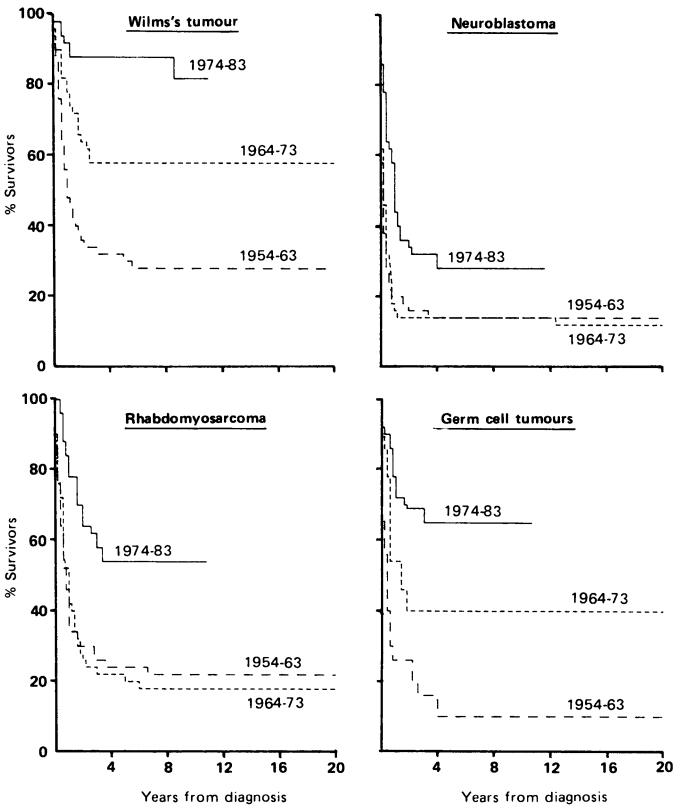

FIG 3—Manchester Children's Tumour Registry 1954-83: survival from childhood cancer by decade of diagnosis: embryonal and germ cell tumours.

Figure 3 shows the remarkable improvements in survival that have been achieved in childhood embryonal and germ cell tumours, perhaps the most striking of which is among patients with Wilms's tumour. For Wilms's tumour, neuroblastoma, and germ cell tumours further improvements are seen when cases diagnosed during 1974-8 are compared with those diagnosed during 1979-83. Thus the three year survival rates during these two quinquennia were 78% (SE 11%, 95% CI 62 to 94) and 95% (SE 5%, 95% CI 85 to 100) for Wilms's tumours; 17% (SE 8%, 95% CI 2 to 32) and 43% (SE 11%, 95% CI 22 to 65) for neuroblastoma; and 63% (SE 11%, 95% CI 41 to 85) and 72% (SE 12%, 95% CI 49 to 95) for germ cell tumours respectively. There was no improvement for rhabdomyosarcoma when the two quinquennia were compared.

Two patients only with neuroblastoma died more than five years after diagnosis: one from local recurrence with distant metastases, and one from a second primary—carcinoma of the liver. Three late deaths in patients with Wilms's tumour were all from distant metastses. There were four late deaths among the rhabdomyosarcoma patients: three with local recurrence and distant metastases, and one from asphyxia during an epileptic attack in a patient who was apparently cured of a middle ear tumour. No patient with a germ cell tumour died more than four years after diagnosis.

Figure 4 shows the survival from bone tumours diagnosed during

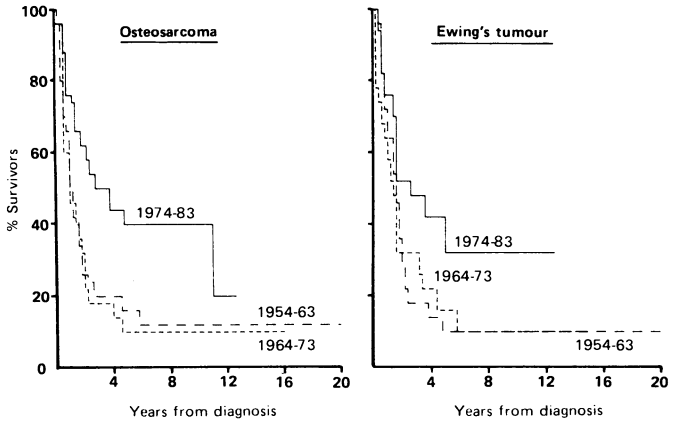

FIG 4—Manchester Children's Tumour Registry 1954-83: survival from childhood cancer by decade of diagnosis: bone tumours.

childhood. The outlook for these children, which was at one time bleak, is now brighter. Three year survival from osteosarcoma during 1974-8 was 36% (SE 13%, 95% CI 10 to 61) compared with 66% (SE 15%, 95% CI 37 to 95) during 1979-83. No improvement in survival was seen among patients with Ewing's tumour when these two most recent quinquennia were compared, but the numbers of patients are very small (six during 1974-8 and 11 during 1979-83). Two late deaths among the osteosarcoma patients are accounted for by one patient with local recurrence plus pulmonary metastases and one with a second primary osteosarcoma with pulmonary metastases. Both patients with Ewing's tumour who died more than five years after diagnosis had multiple bone lesions and lung metastases.

In addition to the seven patients with double primary cancers described above 13 further patients developed second primary malignancies. In five of these 20 patients there was a known underlying condition, neurofibromatosis (two patients), Gorlin's syndrome (two patients), and retinoblastoma (one patient). There was a strong family history of cancer in two patients. In a further three patients the second primaries were within fields of previous irradiation. In the remaining patients the aetiology was not clear, but in at least one patient the second primary was probably associated with previous chemotherapy.

Although no detailed study of fertility has been carried out, details of offspring have been noted. One hundred and sixty five children have been born to survivors in our series. No tumours have occurred among these children except in patients with known genetic disease (retinoblastoma, neurofibromatosis, and von Hippel-Lindau syndrome). Two children had congenital deafness, four children were mentally retarded, one child each had phenylketonuria and congenital cataract, and there was one cot death. All others in the series are apparently healthy.

Discussion

The Manchester Children's Tumour Registry is a unique body of data because it is accurate, complete, and covers a long period of time. The data are not subject to changes in diagnostic fashion. Because the registry retains the histopathological material diagnoses can be reviewed and updated in line with current ideas on classification and utilising modern staining techniques. Data on trends in survival from childhood cancer have seldom been presented, and no other report has covered such an extended period.[1 9 10] This report, therefore, provides an unparalleled opportunity to consider the achievements and otherwise in paediatric oncology.

Appreciable improvements in survival from most childhood cancers occurred during the 30 years studied. In some types of cancers the increase in the survival rate has been dramatic. These improvements have been most noticeable during the most recent 10 years compared with the previous 20 years. The better outlook for children with cancer is reflected in the national mortality data, the death rates from neoplasms in children aged 1-14 years being 84·4, 62·5, and 43·3 per million in 1965, 1975, and 1985 respectively.[2 11 12] A similar decline in mortality from childhood cancer has recently been reported in the United States.[13] Data on mortality therefore no longer adequately reflect the extent of the problem of cancer in childhood, and high quality data on incidence are required for planning health services.

Our results may not seem to compare favourably with recent results of clinical trials, but the figures encompass all cases from an entire population, including those who died before treatment could be initiated, those whose cancers were diagnosed at necropsy, and children who were not treated with trial protocols. The data therefore more accurately reflect the current state with respect to survival for children with cancer in general.

It is not our intention to discuss treatment in detail, but some general comments are in order. The greatest impact on survival has been due to the development of effective multiagent chemotherapy protocols. The introduction of megavoltage radiation and improved tumour localisation techniques have led to the minimisation of side effects of radiotherapy, while achieving maximal tumour resolution. Other important developments include the introduction of various supportive measures to overcome toxicity and the immunosuppressive effects of the primary treatment. The disappointing results for tumours of the central nervous system may be due to the lack of effective chemotherapeutic agents which cross the blood-brain barrier. Furthermore, brain tumours often produce symptoms that could be attributed to other causes, resulting in delay in diagnosis and growth of tumours. (For a more detailed discussion of treatment see Morris Jones[3] and Barrett.[14])

In addition to the new methods of treatment centralisation of care and treatment by a multidisciplinary team are now available. Cancer in childhood is rare and requires highly specialised treatment. Skill in caring for these children and advances in treatment can be gained only in a specialist centre. The trend towards centralisation of treatment of childhood cancer in north western England reflects the improvements in survival. For example, the percentages of children receiving all their treatment in the specialist centre during the three successive decades under study (1954-63, 1964-73, 1974-83) were 31%, 65%, and 90% for acute lymphocytic leukaemia; 47%, 64%, and 100% for Wilms's tumour, and 34%, 62%, and 82% for neuroblastoma, respectively. It is more than coincidence that increased centralisation of care parallels improvements in survival. In several studies benefits from treatment in a specialist centre or clinical trial, or both, have been reported.[15-17] Significantly higher survival rates were reported recently for children who were treated at paediatric oncology centres than for those treated in other hospitals.[18] It seems important therefore that children with cancer should be referred to specialist centres to optimise their chances of survival.

A pessimistic view is sometimes expressed about whether patients have really been "cured" of cancer. In our series 534 patients survived at least 10 years. Thirty of them subsequently died from cancer; 21 of these had relapsed before 10 years, a further seven died from second primary tumours, and only three (less than 1%) died from a recurrence of their primary tumour more than 10 years after diagnosis. One of the late recurrences was a soft tissue sarcoma in a patient who had been treated with radiotherapy, and this may have been a second, radiation induced sarcoma, though histologically the tumour was not sufficiently different from the original biopsy material to exclude late recurrence of the primary. The remaining two late recurrences were in patients with brain tumours of histologically low grade malignancy. It seems therefore that survival without relapse for 10 years may be regarded as synonymous with cure.

Survival from cancer in childhood was at one time rare. This is no longer the case, and it is important that children who have been cured of cancer should be accepted as "normal" by their peers. A few second malignancies have developed among survivors in our series, and results of a multicentre study of long term survivors show an increased incidence of second primary cancers compared with population rates, being about 4% within 25 years of three year survival.[19] This risk, however, is still relatively small, and adults who were cured of cancer during childhood should not have their career opportunities limited or be excluded from obtaining life assurance policies as is the practice in some instances. Although the numbers of children born to survivors in this study are too small to analyse, it is clear that most are perfectly healthy. Fertility among

survivors and the health of their children are part of the multicentre study referred to above.

The prospects for survival for most children with cancer have greatly improved. This has been achieved as a result of a cooperative multidisciplinary approach to treatment. Survivors of childhood cancer are no longer unusual and should be accepted as normal members of society.

We thank Dr M Harris, Dr H Reid, and Dr O G Dodge for help in reviewing the diagnoses; the many general practitioners and clinicians throughout the country who provide follow up information; and the staff of the National Health Service Central Register, Southport, and of family practitioner committees for help in tracing patients.

The Manchester Children's Tumour Registry is supported by the Cancer Research Campaign.

References

1 Draper GJ, Birch JM, Bithell JF, *et al. Childhood cancer in Britain: incidence, survival and mortality.* London: HMSO, 1982. (Studies on Medical and Population Subjects No 37.)
2 Office of Population Censuses and Surveys. *OPCS monitor. Deaths by cause, 1985.* DH2 86/2. London: Government Statistical Service, 16 September 1986.
3 Jones PM. Advances in managing childhood cancer. *Br Med J* 1987;**295**:4-6.
4 Medical Research Council. The working party on leukaemia in children. Improvement in treatment for children with acute lymphoblastic leukaemia. *Lancet* 1986;i:408-11.
5 World Health Organisation. *ICD-O: International classification of diseases for oncology.* Geneva: WHO, 1976.
6 Birch JM, Marsden HB. A classification scheme for childhood cancer. *Int J Cancer* 1987;**40**:620-4.
7 Kaplan EL, Meier P. Non-parametric estimation from incomplete observations. *Journal of the American Statistical Association* 1958;**58**:457-81.
8 Peto R, Pike MC, Armitage P, *et al.* Design and analysis of randomized clinical trials requiring prolonged observation of each patient. II analysis and examples. *Br J Cancer* 1977;**35**:1-39.
9 Myers MH, Heise HW, Li FP, Miller RW. Trends in cancer survival among US white children, 1955-1971. *J Pediatr* 1975;**87**:815-8.
10 McWhirter WR, Siskind V. Childhood cancer survival trends in Queensland 1956-80. *Br J Cancer* 1984;**49**:513-9.
11 Office of Population Censuses and Surveys. *Mortality statistics, childhood. Review of the Registrar General on deaths in England and Wales, 1975.* Series DH3 No 2. London: HMSO, 1977.
12 *Registrar General's statistical review of England and Wales for the year 1965.* Part I. Tables, medical. London: HMSO, 1967.
13 Miller RW, McKay FW. Decline in US childhood cancer mortality. 1950 through 1980. *JAMA* 1984;**251**:1567-70.
14 Barrett A. The changing role of radiotherapy in paediatric oncology. *Cancer Surveys* 1984;**3**: 633-48.
15 Meadows AT, Kramer S, Hopson R, Lustbader E, Jarrett P, Evans AE. Survival in childhood acute lymphocytic leukaemia: effect of protocol and place of treatment. *Cancer Invest* 1983;**1**: 49-55.
16 Kramer S, Meadows AT, Pastore G, Jarrett P, Bruce D. Influence of place of treatment on diagnosis, treatment and survival in three pediatric solid tumors. *J Clin Oncol* 1984;**2**:917-23.
17 Lennox EL, Stiller CA, Morris Jones PH, Kinnier LMW. Nephroblastoma: treatment during 1970-3 and the effect on survival of inclusion in the first MRC trial. *Br Med J* 1979;ii:567-9.
18 Stiller CA. Centralisation of treatment and survival rates for cancer. *Arch Dis Child* 1988;**63**:23-30.
19 Hawkins MM, Draper GJ, Kingston JE. Incidence of second primary tumours among childhood cancer survivors. *Br J Cancer* 1987;**56**:339-47.

(Accepted 23 December 1987)

Medical Ethics

Euthanasia

Conclusions of a BMA working party set up to review the association's guidance on euthanasia

The council of the BMA has approved *The Euthanasia Report*, prepared by a working party, which was chaired by Sir Henry Yellowlees.[1] The debate in the council meeting on 4 May is at p 1408 and there is a leading article on the subject at p 1348. The conclusions in the report are reproduced here.

Some patients see death as the fitting conclusion to the events of their life. These people may wish neither to hasten their death nor to delay it. For them, death is a mystery which they approach with tranquillity. There are limits to medical science and it is inappropriate for doctors to insist on intruding in these circumstances.

There is a distinction between an active intervention by a doctor to terminate life and a decision not to prolong life (a non-treatment decision). In both of these categories there are occasions on which a patient will ask for one of these courses of action to be taken and times when the patient could say but does not. There are also occasions where the patient is incompetent to decide.

An active intervention by anybody to terminate another person's life should remain illegal. Neither doctors nor any other occupational group should be placed in a category which lessens their responsibility for their actions.

In clinical practice there are many cases where it is right that a doctor should accede to a request not to prolong the life of a patient. Appropriate medical skills and techniques should be offered to patients when there is a good chance of providing an extension of life that will have the quality that the patient seeks.

Patient autonomy is a crucial aspect of informed patient care. This is achieved most successfully where a trusting and open relationship between the doctor and the patient allows participation in decisions about illness and its treatment. Doctors should regard patients as authorising treatment, and should respect those authorisations and any decision to withdraw consent. But autonomy works both ways. Patients have the right to decline treatment but do not have the right to demand treatment which the doctor cannot, in conscience, provide. An active intervention by a doctor to terminate a patient's life is just such a "treatment." Patients cannot and should not be able to *require* their doctors to collaborate in their death. If a patient does make such a request there should be a presumption that the doctor will not agree.

More important than debate about the limits of autonomy is the need for doctors and everyone else who is involved in the care of the terminally ill to communicate with their dying patients. Doctors need to be able to elicit the fears of dying patients and to discuss and answer those fears. They need to be able to discuss terminal care openly so that patients can see that they will not be abandoned and left helpless in the face of a terminal disease. Only if such communication and good treatment becomes the norm can society expect to dissipate the pressure to force doctors to do things that the medical profession should not accept.

The killing of an individual who is certain to suffer severe pain, and to be isolated from human warmth and compassion as they die, is held by some to be very similar to the situation of a terminally ill