TUBERCULOUS MENINGITIS IN CHILDREN IN THE DEPARTMENT OF PAEDIATRICS OVER A TEN-YEAR PERIOD

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Childhood tuberculosis is prevalent all over the world and tuberculosis in children is almost a disease entity of its own compared with adult tuberculosis, the common factor being the causative organism. The purpose of this talk is to see the incidence of infection, the clinical picture, the fatality-rate, results of treatment and the sequalae of the disease as we see it in the Paediatric Unit, General Hospital, Singapore, from the year 1955 to 1965. The Paediatric Unit, General Hospital, Singapore, admits children up to ten years of age. It is the only Government children's unit in the whole island, and cares for the great majority of sick children in Singapore.

INCIDENCE & MORTALITY

It is well-known that there is a decline in the incidence and mortality of childhood tuberculosis at all ages in most parts of the world. Miller (1958) stated that in England and Wales the mortality from tuberculosis at all ages had fallen dramatically and in 1956 the number of deaths was less than a twentieth of those in 1947. In 1947, there were 1,955 deaths from childhood tuberculosis while in 1956 there were 89 deaths from childhood tuberculosis in England and Wales. In certain cities like Sheffield and Newcastle, deaths from tuberculosis have almost disappeared (Miller 1958). Lincoln (1962) states that the death rate from tuberculosis in the United States began to accelerate in 1950 and in Denmark for that year there were only 3 deaths, two in Sweden and none in Norway.

In Singapore, there has been a definite downward trend in the incidence and mortality of childhood tuberculosis. It would be difficult to give the exact incidence and death-rate from tuberculosis in childhood on the island, because all the cases of childhood tuberculosis do not reach the Paediatric Unit, General Hospital, Singapore. Nevertheless, when you consider the large number of cases that we receive from all over the island, it would be reasonable to assume that the downward trend in the incidence and fatality from childhood tuberculosis as seen among children admitted to the General Hospital, Singapore, would reflect a similar decline in the incidence of tuberculosis in children outside the Hospital, elsewhere on the island. In 1947, Haridas reviewing the cases of childhood tuberculosis admitted to the Children's Ward, General Hospital, Singapore, stated that from statistics gathered at the Registrar General's report for the municipality of Singapore and from hospital records and case-sheets, that the yearly and monthly sacrifice of children's lives to childhood tuberculosis was very alarming. At that period, the children's ward in General Hospital admitted children under 5 years of age. The greatest killer in children at that time, besides other infections, was tuberculosis. In 1947, Haridas stated that deaths from tuberculosis in children admitted to the Paediatric Unit, General Hospital, Singapore, formed 78·47% of the total number of children admitted. The principal causes of death as stated by Haridas (1947) were primary tuberculosis meningitis, tuberculosis as part of generalised miliary tuberculosis, tuberculous meningitis associated with pulmonary tuberculosis and tuberculosis of the spine. The following figures by Haridas illustrate the type of tuberculosis associated with tuberculous meningitis in children admitted to the children's ward in 1947.

T.B. MENINGITIS CASES IN THE CHILDREN'S WARD, GENERAL HOSPITAL, SINGAPORE, IN 1947

	Admissions	Deaths
Primary Tuberculous Meningitis	40	36
Tuberculous Meningitis as part of generalised miliary T.B.	10	10
Tuberculous Meningitis associated with thoraic tuberculosis.	13	12
Tuberculous Meningitis associated with glandular tuberculosis	3	3
Tuberculous Meningitis with tuberculosis of the spine	1	1
	70	65

The above figures show that less than twenty years ago in Singapore, a child admitted with tuberculous meningitis had, indeed, a fatal outlook.

Three years later, even with the introduction of Streptomycin, Field (1950) reported on the disappointing results of treatment of T.B. Meningitis, and the high mortality of such children in Malaya and Singapore. At that period only intramuscular injections and intrathecal injections of Streptomycin were given. She attributed the high mortality to the delay in treatment as parents were late in bringing the children to hospital. The following figures are her figures which show the high mortality from tuberculous meningitis in Singapore and Malaya in 1950 in children under the age of 15 years.

CHILDHOOD TUBERCULOUS MENINGITIS IN SINGAPORE AND MALAYA IN 1950 (FIELD)

Centre	No. of Cases	No. who died
Malacca (1949)	18	10
Negri Sembilan	10	7
Singapore (1948-1950)	18	15
Johore Bahru (1949-1950)	21	17
Perak	8	7
Taiping	7	5
Penang (1950-1951)	31	28

The figures quoted by Field by no means represent the total incidence but only reflect the high mortality in the very few cases that are brought to hospital. Of the few survivors the end result was spasticity and mental retardation. In considering the mortality of tuberculosis as a whole both in children and adults tuberculosis was the most important single cause of death in 1950 accounting for 12% of all deaths in Singapore. Since then the figure has considerably declined accounting for only 6·43% of deaths from all causes in the year 1962. In 1965, the figure stands at 5·1%.

The Paediatric Unit, General Hospital, Singapore, is a 282-bed unit, taking children up to 10 years of age, and it will be seen from the hospital records in that there has been a steady decline in the number of cases of tuberculous meningitis admitted to the unit. The fatality rate of tuberculous meningitis cases admitted to the unit also show a steady decline and during the last two years, there have been only a couple or single deaths in the Department, mainly due to the late arrival of these cases. During the year 1962 the Paediatric Unit was divided into University and Government units each with identical number of beds and the number of admissions from the year 1963 reflect the children admitted to the University side of the Paediatric Unit.

TUBERCULOUS MENINGITIS 1955-1965, PAEDIATRIC UNIT, SINGAPORE

Year	No. of T.B. Meningitis Cases	Fatality of T.B. Meningitis Cases	Total Number of Admissions
1955	112	60·7%	Number not available
1956	106	44·3%	6,473
1957	60	45·0%	7,217
1958	52	30·7%	9,697
1959	45	28·9%	10,517
1960	45	14·4%	10,712
1961	32	15·6%	10,480
1962	15	15·1%	11,928
*1963	3	0·0%	6,731
1964	8	28·0%	6,249
1965	5	33·3%	6,528

(*1963 onwards reflect the children admitted to the University side of the Paediatric Unit.)

We are fortunate in the Department of Paediatrics to be able to get an autopsy on the majority of our children who die. It will be seen from our necropsy records from children who die with T.B. Meningitis from the years 1955 to 1965, that there has been a steady decline in the number of autopsies (Shanmugaratnam, 1965).

AUTOPSY FIGURES OF T.B. MENINGITIS

1955	56 autopsies
1956	21 autopsies
1957	20 autopsies
1958	9 autopsies
1959	None
1960	1 autopsy
1961	2 autopsies
1962	None
1963	None
1964	2 autopsies
1965	1 autopsy

GEOGRAPHICAL DISTRIBUTION AND THE PROBLEM OF OVERCROWDING

Singapore is an island with a total area of 224·5 sq. miles and is situated at latitude 1° N. and longitude 103° 50' B. The city of Singapore has an area of 37·6 sq. miles. The estimated population in 1947 was 938,144. Since then, there has been a double increase by high birth rate and immigration. The estimated population in 1962 was 1,732,800 of which 52·79% were males and 43% were under the age of 14 years and only 2% over the age of 65 years. The population of Singapore consists of Chinese, Malays and Indians. The Chinese comprise 75·2% of the population, the Malays 14·0%, Indians 8·3%, and the other races like Europeans and Eurasians form 2·5% of the population. Of the total population of 1,634,000 in 1960 it was estimated that 1,023,700 or 62·6% live in the city area, and 610,400 or 37·4% live in the rural area. Very severe overcrowding exists in the town centre, popularly known as "Chinatown" extending from Kallang in the East to Outram Road in the West. The General Hospital, Singapore, is opposite Outram Road and, therefore, taps a large number of patients from this area. In Chinatown, the people live in tenement buildings, the ground floors of which are used for trade or small industries, the upper floors for residential purposes. Each floor is divided into cubicles, by wooden partitions and shared by a number of families. The cubicles are so constructed that light and ventilation are grossly deficient, dust and dirt accumulate, and are ideal for the spread of tuberculosis. Because of overcrowding there has been a considerable increase in the number of housing units, in the form of flats built by The Housing and Development Board in Singapore. Children suffering from tuberculosis and living in overcrowded areas are, if recommended by the doctor, entitled to better living conditions in the form of a flat. In 1957, it has been shown that the average number of persons per household was 4·7 in the 1957 census. Even in the rural areas overcrowding exists. The average family live in small houses of wood and attap roofs with only one bedroom where all the members sleep at night. It is common for children to sleep with the parents sharing a common mosquito net. When a person suffering from tuberculosis exists in such a home, the children are subject to a continuous dose of bacilli.

SOCIAL DISTRIBUTION

Various studies have shown that the lower the socio-economic status of a population group, the higher the tuberculous incidence and mortality rate. In our Paediatric Unit every child with tuberculosis is referred to the Almoner who investigates the home conditions and traces all contact cases. The adult contacts are referred to the Tan Tock Seng Hospital for treatment. It is not surprising that over 90% of our cases come from the poorer, economic classes, living in overcrowded homes.

B.C.G. VACCINATION IN SINGAPORE

In Singapore, the UNICEF/WHO team initiated B.C.G. vaccination in June, 1951. Since its onset the programme was continued by the School Health Department with little or no change until 1957. From January 1957, the Heaf Multiple puncture was substituted as a routine procedure for the Mantoux 1/1000 test because of its simplicity in field work. In December 1957, the whole of the B.C.G. work was taken over by the Tuberculous Control Unit. Up till then, Tuberculous testing and B.C.G. vaccinations were confined to primary school entrants and leavers. B.C.G. vaccination of newborn infants were included in the B.C.G. programme in 1957 when it was offered to babies under one month of age in the rural Maternal and Child Health Centres. In 1957, mass B.C.G. campaign amongst the newborn was started at the Kandang Kerbau Maternity Hospital. About 75% of the babies born on the island are delivered at this Hospital. The table below (Table I) shows the number of cases vaccinated each year with the total number of births from Singapore yearly. The table shows you that in 1965, 86% of the babies born in Singapore were immunised with B.C.G. Because of the rapid delivery rate at the Maternity Hospital, the children are sent home the day after delivery, unless some complication arises. However, in a previous survey in 1957 (Wong) has shown that 97% of B.C.G. vaccinated newborn infants in Singapore had a Mantoux conversion at 3 months of age.

AGE DISTRIBUTION OF T.B. MENINGITIS CASES

It must be stressed that a third of our cases of tuberculous meningitis occurred in children under the age of 2 years. This is very well reflected in the graphs of the distribution of the age groups of the tuberculous meningitis cases.

There has been no change in the age-group prone to tuberculosis even in the last few years. Children under the age of 2 years are the most vulnerable group to tuberculosis.

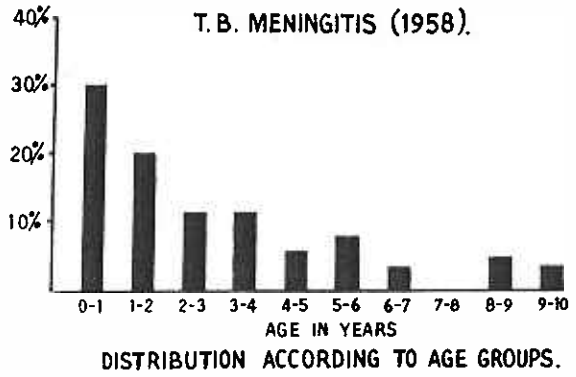

Fig. 1.

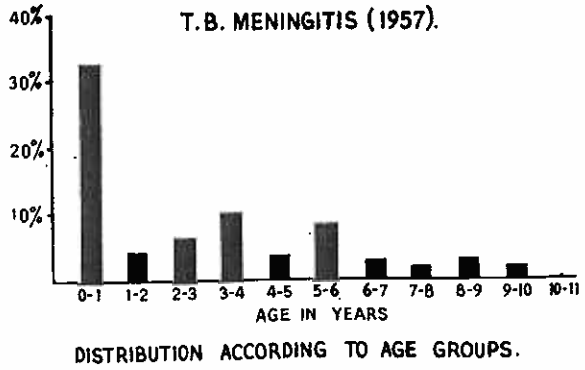

Fig. 2.

RACIAL DISTRIBUTION OF TUBERCULOUS MENINGITIS CASES

There has been no striking distribution among the three ethnic groups in Singapore. The Chinese children form 79% of the cases, but this conforms to the racial distribution of the Chinese population. In adult tuberculosis, the Chinese appear to tolerate tuberculosis rather well. They can continue normal activities for prolonged periods in the face of extensive pathological changes with little apparent disability.

T.B. MENINGITIS
(RACIAL DISTRIBUTION)

Chinese	—	79%
Malay	—	9·0%
Indian	—	7·3%
Eurasian	—	4·7%

AVERAGE LENGTH OF HISTORY AND SYMPTOMATOLOGY

It is well-known that tuberculous meningitis has an insidious onset and this is reflected in the fact that the sick children had been kept at home in 33·3% of our cases for longer than two weeks. The majority of the cases had a history ranging from 7 to 14 days and in only 14·2% of our cases were we able to obtain a history of 4 days, indicating that mothers had brought the children early for treatment.

AVERAGE LENGTH OF HISTORY
OF T.B. MENINGITIS (1958)

	% of cases
Longer than two weeks	33·3%
Between 7 to 14 days	35·6%
Between 5 to 7 days	16·6%
4 days and under	14·5%

SYMPTOMATOLOGY

The order of frequency of symptoms as offered by the parents is shown in the table below. Fever was present in 80% of cases, the temperature niggling between 99°F and 100°F. In 50% of our cases, convulsions were present. The presence of convulsions terrifies the parents and brings the child to hospital. It is gratifying to see that in the year 1960 onwards the history of the cases was shorter, indicating that the children were brought earlier for treatment.

SYMPTOMALOGY OF T.B.
MENINGITIS CASES

Symptoms	% of cases
Fever	80%
Convulsions	50%
Vomiting	38%
Cough	38%
Drowsiness	33%
Constipation	15%
Paresis	14%
Loss of appetite	11%
Irritability	7%
Diarrhoea	4%
Loss of weight	2%

PHYSICAL FINDINGS

The most constant findings in all our cases was that of fever and varying degrees of coma.

The main physical findings in order of their frequency is listed below:-

PHYSICAL FINDINGS IN T.B. MENINGITIS

Fever	64%
Coma	60%
Neck rigidity	52%
Hemiparesis	45%
Enlarged spleen	21%
Kernig's sign	21%
Facial palsy	12%
Ear discharge	8%
Hydrocephalus	7%
Blindness	2%

RADIOLOGICAL CHANGES IN T.B. MENINGITIS

It will be seen that 31% of our cases had miliary tuberculosis of the lung on radiological examination. In such cases there was concomitant enlargement of the liver and spleen. Choroidal tubercles were also commonly seen if a good search was made with the child well sedated.

RADIOLOGICAL CHANGES IN T.B. MENINGITIS

Miliary T.B.	31%
Prominent right hilum	27%
Consolidation—collapse	15%
Increased basal markings	7%
Normal chest X-rays	7%
Paratracheal lymph enlargement	5%
No X-rays	9%

MANTOUX TEST IN T.B. MENINGITIS

A Mantoux test using Old Tuberculin in the dilution of 1/1000 and 1/100 was performed in all cases. It is interesting to note that 78% of our cases gave a positive Mantoux test. The 22% of cases with a negative Mantoux test were cases of fulminating tuberculosis, where one expects the Mantoux reaction to be depressed.

MANTOUX TEST RESULTS IN T.B. MENINGITIS

Number positive	78%
Number negative	22%

AVERAGE LENGTH OF STAY IN HOSPITAL

The average length of stay in hospital for our cases of tuberculous meningitis is 3 months, which is considered a relatively long period as our turnover of cases is very rapid. At the end of 3 months the cases were sent to Convalescent Home beside the sea for a further 3 months after which they were followed up as outpatients in the Department of Paediatrics. Our follow-up of our cases of tuberculosis in the Outpatient has been good and every case is known to the social worker who calls up the patient should they fail to attend regularly.

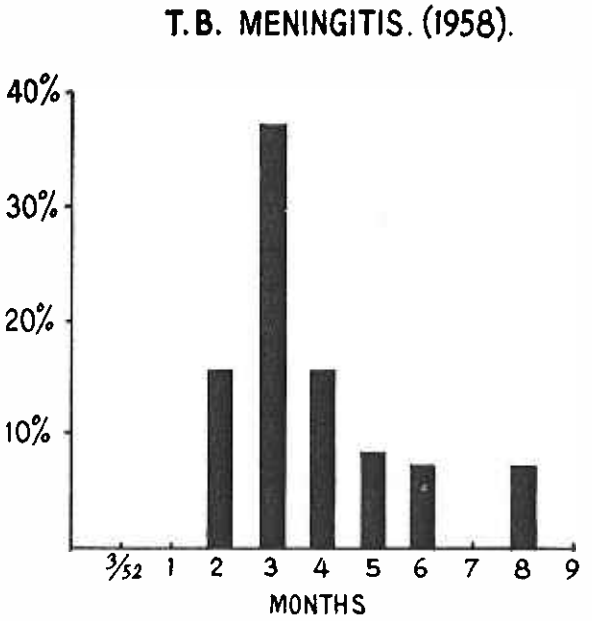

Fig. 3.

TUBERCULOSIS ALLOWANCE

The home conditions of every case of tuberculous meningitis is investigated by the Almoner and where the family is in financial difficulty, the child is eligible for a tuberculosis allowance, if recommended by the doctor. The tuberculosis allowance varies from $30 to $40 per month, and this is of tremendous help to the average family in Singapore in utilising the money for good food for the child.

TUBERCULOUS MENINGITIS IN B.C.G. VACCINATED CHILDREN

Of particular interest in the series of cases in the years 1959 and 1960 were a study of 14 children who had developed tuberculous meningitis in spite of having had BCG at birth (Paul, 1961). In all these 14 cases the BCG used was the Glaxo variety and was given at birth at the Kan-

TABLE I

NUMBER OF INFANTS WHO RECEIVED BCG VACCINATION COMPARED WITH NUMBER OF LIVE-BIRTHS IN SINGAPORE (1956 to 1965 ½ year)

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965 (½ year)
Number of BCG Vaccinations at K.K.M. Hospital	-	22,168	23,889	28,283	30,623	33,109	33,163	34,865	34,252	15,535
Number of BCG Vaccinations at Infant Welfare Clinic										
a) Urban (commenced July 1958)	-	-	2,904	5,930	6,192	6,420	6,584	7,505	7,745	3,938
b) Rural (commenced July 1956)	221	517	2,866	4,766	5,401	4,938	5,502	6,832	7,128	3,687
Pulau Bukom & Tekong	-	-	-	268	290	368	405	-	-	-
Totals	221	22,685	29,659	38,595	42,506	44,835	45,654	49,225	49,125	23,160
Number of births in Singapore	60,892	61,757	62,464	62,464	61,775	59,930	59,084	59,518	58,456	26,768
Percentage Vaccinated	0·36%	36.73%	47·48%	61.78%	68.81%	74·81%	77·3%	82·6%	84·4%	86·15%

dang Kerbau Maternity Hospital, and the presence of a scar was noted in all cases. Six of these children were in the 2-year age group, 4 were in the 1-year old group, and 4 were under the age of one year. The concentration of the disease under the age of 2 years shows the poor resistance of these children in this young age group in spite of immunisation with BCG. However, as mentioned earlier, isolation of these cases until Mantoux conversion is not possible. With the aid of the Almoner and by interview with the parents, it was found that six of the children had been in contact with adults suffering from pulmonary tuberculosis. Thirteen of the fourteen cases had a positive Mantoux test when tested in the ward. The most striking feature in this group of tuberculous meningitis children who had received BCG at birth, and the group who did not receive BCG was the short history of the symptoms and the quick return of the C.S.F. to normal in the BCG vaccinated group, as compared with the group that did not receive BCG (Paul, 1961). There were three deaths among the 14 children who developed tuberculous meningitis in spite of BCG and one of them on autopsy showed an indurated mass at the apical portion of the right lower lobe with miliary tubercles scattered throughout both lungs (Paul, 1961). In 1963, out of the five cases of tuberculous meningitis, only one had received BCG and in 1965 all the cases of tuberculous meningitis cases had received BCG at birth. However, when you consider the large number of children who are vaccinated with BCG in Singapore (Table 1) and the very small number of children who develop tuberculous meningitis in spite of BCG, it can be concluded that BCG vaccination will provide considerable, if not absolute, immunity.

CEREBROSPINAL FLUID CHANGES

The average time taken for the cerebrospinal fluid to return to normal is 2½ months, and this is with treatment with Streptomycin, isoniazid, and para-amino salicyclic acid. During the first phase of treatment up to 1950, Streptomycin was the only antibiotic available and was used in prolonged intramuscular and intrathecal causes. As seen in the figures reported by Field (1950) the mortality rate was high in Singapore and Malaya. The next phase was the introduction of isoniazid and since 1954, all the cases of tuberculous meningitis are given Streptomycin sulphate in the dose of 20 mgms per lb. body weight per day and isoniazid is given in the dose of 8 to 10 mgms per lb. body weight per day. A most valuable drug as an adjunct in the treatment of childhood tuberculosis has been Prednisolone. Ever since 1956, all cases of tuberculous meningitis are started on Prednisolone when the cerebrospinal fluid approaches 100 mgm%. The child is kept on oral Prednisolone until the cerebrospinal fluid shows changes to normal, and this may vary from one month to

RETURN OF C.S.F. TO NORMAL IN A T.B. MENINGITIS WITH A BLOCK

LUMBAR ROUTE

Date	C.C.	T.P.	Globulin	Sugar	Chloride	Org.	Lymph.	Polymorphs
27.11.58	280	4000	+++	35	500	-	+	-
20.2.59	120	600	+++	33	700	-	+	-
8.11.59	30	100	+	36	700	-	+	-
6.2.59	8	100	+	28	740	-	few	-
8.3.59	3	50	+	60	720	-	-	-

CISTERNAL PUNCTURE

Date	C.C.	T.P.	Globulin	Sugar	Chloride	Org.	Lymph.	Polymorphs
18.1.59	30	100	+	36	690	-	++	-
26.2.59	5	50	+	50	700	-	++	-
8.3.59	1	40	+	40	680	-	-	+

three months. Since 1959, we are using intrathecal Prednisolone (Deltacortil) in the dose of 2·5 mgms or 5 mgms in all cases with a C.S.F. protein approaching 100 mgms%. The interval of intrathecal treatment varies from ten days to two weeks and in some cases the intrathecal treatment is repeated again.

The above show the cerebrospinal fluid changes in a case of tuberculous meningitis with a block where three ten-day periods of intrathecal Deltacortil were necessary to bring the cerebrospinal fluid to normal. A positive culture for tubercle bacilli were obtained in 10% of our cases on culture of the cerebrospinal fluid.

SEQUALAE OF TUBERCULOUS MENINGITIS

Intracranial Calcification

Lorber (1958) reviewed ten published reports concerning intracranial calcification in patients treated for tuberculous meningitis and also recorded personal observations on 100 patients. He found significant calcification in 29% of his patients who were examined up to five years after the onset of the illness. In Todd and Nevelle (1964) series of cases from the Liverpool Children's Hospital, calcification was present in 32% of his patients. In all these patients calcification was most commonly found at the base of the brain, where the meningeal exudate usually accumulates in tuberculous meningitis. Todd and Nevelle state that in many patients the development of calcification reflected the severity of the illness, the most advanced patients having the most marked calcification, but this is by no means variable.

In 50 cases of tuberculous meningitis whose skulls were X-rayed here at various periods of 3 to 5 years after the onset of the disease in the Department of Paediatrics, calcification of the skull was found only in one case, and this was a child who developed diabetes insipidus following tuberculous meningitis.

Endocrine Changes:

Endocrine changes have been reported from time to time in patients who have survived tuberculous meningitis. One such abnormality is diabetes insipidus but it is of great rarity. So far 13 such cases have been reported in the literature. Paul (1960) reported one case of diabetes insipidus following tuberculous meningitis in a three-year old Chinese girl. Radiographs of this child three years after the onset of tuberculous meningitis showed extensive calcification in the region of the pituitary. These lesions are in close proximity to the pituitary gland the hypothalamic nuclei and this may lead to vascular thrombosis, and consequent softening of the adjacent brain substance. This child has been maintained on Pitressin Tannate since the onset of the diabetes insipidus. Lorber (1951) reported a girl who developed tuberculous meningitis at the age of 5½ years and who was fully developed sexually at the age of 7½ years. Radiographs of the skull showed a calcified tuberculoma in the wall of the third ventricle.

Neurological lesions:

Hemiplegia, generalised spasticity, sixth nerve palsy and seventh nerve palsy were very common, but in our series of cases many children who had gross neurological lesions during the active phase of the disease made a complete recovery with early physiotherapy.

Hydrocephalus:

In 7% of our cases during the years 1957 and 1958 a hydrocephalus was observed, due to fibrosis at the base of the brain. This complication is very rarely seen now with the introduction of intrathecal Prednisolone. The following radiograph depicts an airencephalogram done on an 11-month old child with gross hydrocephalus due to tuberculous meningitis.

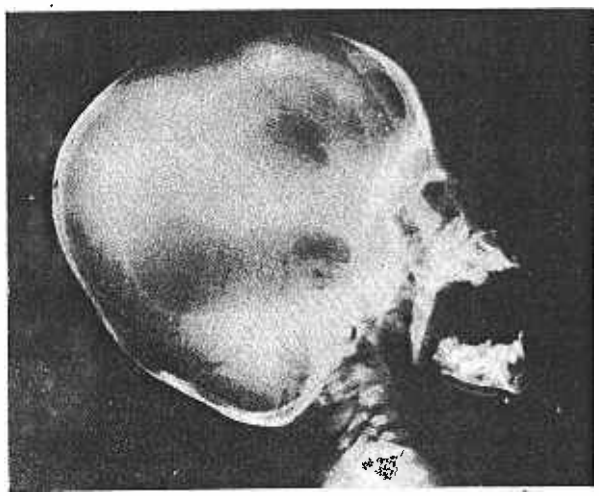

Fig. 4.

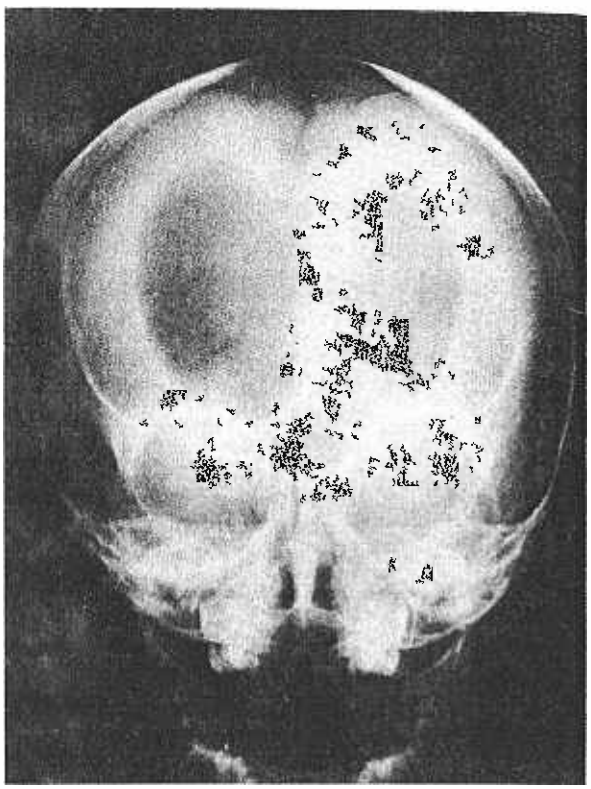

Fig. 5.

Figs. 4 & 5. Note bilateral enlargement of lateral ventricles due to tuberculous meningitis at the base of the brain.

Intelligence:

In Lorber's series of 100 cases, 67 had an I.Q. of 81 to 100, 7 had an I.Q. of 120, 6 had an I.Q. of less than 50. Those who were severely retarded were those who were 2 years of age or under at the time of acquiring the meningitis. It was not possible to do an I.Q. test on all our cases of tuberculous meningitis, but those children who returned to school after their illness, were a failure at their lessons and were asked to leave school, and were referred to a training centre for retarded children. In addition several of the children showed hyperkinetic behaviour and temper tantrums and the children were really uncontrollable at home.

E.E.G. Changes:

The electroencephalogram changes have not been done in many of our children who have recovered from tuberculous meningitis, but abnormal E.E.G. findings have been reported in many series of cases in the form of slow theta excess, dysrrhythmia, rapid beta, excessive delta and paroxysmal spikes. Although the meningeal exudate at the base of the brain is one of the characteristic features of tuberculous meningitis, the brain itself may become involved either because of the development of increased intracranial pressure resulting from obstruction to the flow of cerebrospinal fluid or because of the onset of endarteritis and thrombosis around a tuberculoma or because of encephalitis. Todd and Neville (1964) reported a normal E.E.G. in only 15% of his cases, and Lorber (1961) in 57% of his patients.

CONCLUSIONS

Tuberculous meningitis, the prime killer of children in Singapore, twenty years ago has shown a considerable reduction in the incidence and fatality rate over the last 10 years in the Department of Paediatrics, General Hospital, Singapore. Factors which have been responsible for the marked reduction in the lowering of tuberculous meningitis are the introduction of BCG vaccination in newborn children, mass X-ray campaign of children and adults all over the island, thus detecting early adult tuberculosis, and the introduction of potent antituberculous drugs, like Streptomycin, isoniazid and para-amino salicyclic acid. A valuable adjunct in the treatment of tuberculous meningitis has been the introduction of corticosteroids, namely Prednisolone which is given orally as well as intrathecally. The main sequalae that results from the disease is mental deficiency. As there is a definite downward trend in the incidence of tuberculous meningitis, it is hoped that the disease would be completely eradicated in the next 10 years in Singapore.

SUMMARY

1. A review of the incidence, clinical features, signs, C.S.F. findings, and cause of tuberculous meningitis in the Department of Paediatrics over a ten-year period is reviewed.
2. The most vulnerable age group in children to this dreaded disease is below two years of age.
3. Factors responsible for this marked reduction in the incidence of tuberculous meningitis a re the introduction of BCG, mass X-ray campaign all over the island and the introduction of potent antituberculous drugs.
4. In spite of receiving BCG at birth a very small number developed tuberculous meningitis. It was shown that this group showed a much shorter history and a quick return of the C.S.F. to normal.
5. The main sequalae to tuberculous meningitis in children is mental deficiency.

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