

Radiotherapy in paediatric practice

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Compared with adults, the number of children requiring radiotherapy each year is very small (of 3000 new patients treated annually at the Bristol Radiotherapy and Oncology Centre, 50 are children) but the treatment of a child may make greater demands on time and resources than an adult. There are important differences between adults and children that must be considered by the radiotherapist. The greatest of these lies in the child's potential for growth, development, reproduction, and longevity. Radiation induced tumours rarely occur earlier than 10 years from treatment: therefore children cured of cancer have ahead of them many years of life, carrying a steadily increasing risk of a second tumour as age advances. The late effects of radiotherapy in children have been well described by Shalet and others.¹

Although nearly all childhood cancers are radiosensitive, radiotherapy is used sparingly in children because of these late effects. The dose required for cure is similar to that needed in adult tumours but it is frequently given in smaller fractions over a longer period in the hope of reducing late damage. Other differences relate to the child's size at the time of treatment as this can lead to practical problems of geometrical accuracy due to small field size.

Practical aspects of radiotherapy in children

A necessity of all radiotherapy is that the patient lies absolutely still and alone during treatment (usually 1-2 minutes). This may be hard for an adult but more so for a child. It is usually necessary to give sedation or a short acting general anaesthetic, such as ketamine, in children under 3 years of age. Cooperation without the need for sedation may be obtained from the slightly older child by giving an explanation at a level suitable to its understanding, with full explanation to its parents. A similar detailed explanation should be provided for the more mature child and its parents. In Bristol, a playleader has designed a colouring book for young children and a realistic picture book for those who are older to aid preparation for radiotherapy.

It is frequently necessary to make a Perspex mould for patients receiving localised treatment to the head and neck region. This necessitates a plaster of Paris model of the child's head to be made initially. A doll, complete with its own Perspex mask and a plentiful supply of plaster of Paris for the child to play with, often helps to reduce the stress of the situation. A playleader, experienced in such preparation, will ease the task of the radiographers who give the treatment.

Many adolescents and adults would benefit from similar preparation.

RADIATION INDUCED VOMITING

Radiotherapy only causes vomiting when the abdomen, and particularly the upper abdomen, is in the radiation field. This is the case in total body irradiation, the treatment of Wilms' tumour and when treating the spine, if the radiation beam exits through the stomach. Where the daily fraction size is 200 cGy or less and the field size not large, vomiting is usually easily controlled and much less severe than that induced by chemotherapy.

Prochlorperazine (250 µg/kg every eight hours) is a useful drug which can be given orally or rectally. If this fails, oral metoclopramide or domperidone may prove successful. Where it is necessary to use parenteral drugs a regimen with alternating chlorpromazine (0.5 mg/kg intravenously) and promethazine (0.5 mg/kg intravenously) every four hours is useful, particularly in younger children; those who are older often dislike the sedation produced. As irradiation induced vomiting generally occurs within hours of the treatment, it should be possible to time the treatment and antiemesis so as not to interfere with nutrition and hydration.

Total body irradiation is the treatment most likely to induce vomiting, particularly when given as a single fraction. Fractionated therapy, however, will lead to some vomiting in about 50% of children receiving standard antiemetic drugs. When used in patients receiving fractionated total body irradiation the recently introduced 5HT₃ receptor antagonist, ondansetron, abolished vomiting in 55% and reduced it to mild in a further 27% of cases (RF Stevens. Third International Congress on Neoadjuvant Chemotherapy, Paris 1991).

The changing role of radiotherapy in paediatric malignancy

The improved survival in leukaemia and in childhood solid tumours brought about by the advent of more effective chemotherapy regimens² has made clinicians aware of the need to minimise the late sequelae of treatment.³ This has led to a change in the role of radiotherapy in the management of some paediatric tumours. It remains the mainstay of treatment for brain tumours, after neurosurgery in most instances, and its emergency use in children presenting with superior vena caval obstruction or respiratory embarrassment from mediastinal lymphomas continues to be important.

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The use of radiotherapy in bone tumours has lessened. Completely resectable tumours are treated with surgery and chemotherapy alone. It still has an important part to play, however, in Ewing's sarcoma where the tumour is at a site inaccessible to surgery, where there is residual disease after surgery, and by its preoperative use in large primary tumours to make them resectable.

Studies are being undertaken to define the precise part radiotherapy plays in the management of a number of other tumours. Attempts to refine its use are well illustrated by considering Wilms' tumour, acute lymphoblastic leukaemia, and rhabdomyosarcoma.

WILMS' TUMOURS

Eighty per cent of UK patients are registered with the United Kingdom Children's Cancer Study Group (UKCCSG) Wilms' tumour studies. The aims of the second such study include continuing refinement of therapy 'in the hope of further reducing side effects without compromising efficacy' (UKCCSG. Second Wilms' tumour study, June 1986). It has been shown that study patients have increased survival with decreased treatment sequelae.⁴ Serial studies have allowed a reduction in the number of patients receiving radiation. Patients in stage I or II (tumour completely excised) in the UKCCSG second Wilms' tumour study receive no abdominal irradiation. Patients in stage III (residual non-haematogenous tumour confined to the abdomen) with operable disease and favourable histology, receive a dose given to the abdomen which is lower than the dose given to those with initially inoperable stage III disease or unfavourable histology. Thus fewer children with Wilms' tumours are receiving irradiation than previously; of those who do, some receive a lower dose.

ACUTE LYMPHOBLASTIC LEUKAEMIA

In the next Medical Research Council trial for acute lymphoblastic leukaemia, cranial irradiation will be omitted in those children whose presenting white cell count is less than $50 \times 10^9/l$; cranial prophylaxis will be achieved by regular intrathecal methotrexate with or without high dose systemic methotrexate. Those whose presenting cell count is greater than $50 \times 10^9/l$ will be randomised to receive cranial irradiation with standard intrathecal methotrexate or both systemic and intrathecal methotrexate. It is hoped these changes will reduce late sequelae such as learning problems and abnormalities of growth and puberty, probably attributable to cranial irradiation.⁵

RHABDOMYOSARCOMA

Refinement in the treatment for rhabdomyosarcoma in childhood is directed towards improving the quality of life of cured children by reducing late sequelae, many of which are due to the effects of irradiation on developing tissues. Based on results of previous rhabdomyosarcoma studies, stage I patients (those with complete

resection of tumour) no longer receive radiotherapy. In current International Society of Paediatric Oncology studies of disease in non-parameningeal sites, radiotherapy is confined to those patients who do not have a complete response to chemotherapy with or without surgery. Using these criteria there will be a greater number of relapses but only those who relapse will receive radiotherapy as part of their salvage management, thus avoiding irradiating many patients.

Palliation

Despite advances in the management of paediatric malignancies, 30–40% of such children diagnosed will die of their disease. For some of these patients palliative radiotherapy plays a part in symptom control. In a recent study from Bristol, of terminal care in children, 40% received palliative radiotherapy during the terminal phase of their illness.⁶ This is many more than in the study reported from the Hospital for Sick Children, Great Ormond Street, where only 9% received radiotherapy.⁷ This may reflect a different spectrum of tumours studied or the ease of access to a radiotherapy department. The children in our study all lived within a 25 mile radius of the hospital where the terminal care team worked, whereas 56% of children in the second study lived greater than 20 miles from the treating hospital.

The aim of palliative treatment is to obtain rapid relief of symptoms using the smallest number of radiotherapy fractions compatible with the desired response and with as few side effects as possible. A team approach to terminal care should include ready access to a consultant radiotherapist with a special interest in paediatrics. The need to travel long distances, combined with referral to a radiotherapist unfamiliar to the family, may contribute to a lower use of radiotherapy than is desirable.

The commonest indication for palliative radiotherapy in children is pain: others include control of primary tumour masses in the presence of untreatable metastatic disease, treatment of lymph node masses causing pain and/or oedema, and control of neurological symptoms. Dose and fractionation depend on site, tumour type, and precise cause of pain.

Limb pain caused by bone marrow infiltration from leukaemia or neuroblastoma, and less frequently by localised bony metastases, can be treated with a single fraction of radiotherapy.⁸ Pain relief usually occurs within hours of treatment and is likely to be achieved within a week. Local or systemic upset from this kind of treatment is extremely uncommon.

Metastatic lymph node masses may cause pain and oedema; treatment of these can be completed in 10 days using three to four fractions. Improvement will occur within a week of starting treatment and will be maximal at two to three weeks. Local side effects should not be severe but mucositis may be troublesome if it is not possible to exclude the mucous membranes from the irradiation field. Erythema may occur after radiation, particu-

larly in skin folds such as the groin, but is unusual in palliation.

Greater systemic upset is expected when treating the trunk. Symptoms due to mediastinal lymph nodes can be relieved by radiotherapy, and the progress of lung metastases from some tumours, such as osteosarcoma, may be controlled for many months by whole lung irradiation. When treating large volumes of the trunk, it is usually necessary to fractionate treatment over at least five treatments to the mediastinum and 10 to the whole lung. Dysphagia occurs in most patients where the oesophagus is in the field. It is temporary and can be relieved by preparations such as oxethazaine. Short term general malaise and tiredness often follows the treatment of large volumes by radiotherapy and it may be difficult to distinguish these from the disease process. If radiation pneumonitis occurs, it will cause shortness of breath three weeks to three months after radiation. Symptomatic relief is obtained with a short course of steroids, typically prednisolone 40 mg/m² per day.

One of the commonest reasons for palliative irradiation of the abdomen is painful recurrent abdominal neuroblastoma. The principles of treatment and side effects are similar to those for chest irradiation, though vomiting maybe more severe. Diarrhoea is common but is likely to be mild and responds to symptomatic treatment. The pain relief achieved is often prompt and justifies the temporary side effects of the radiation. Upper or lower half body irradiation is a very useful way of palliating children with very widespread painful metastases.

Cranial irradiation for recurrent brain tumours or brain metastases is well tolerated and frequently allows a reduction in dexamethasone dosage. However, it causes alopecia and, as life expectancy is often short, it is particularly poignant that parents may comment that worthwhile regrowth of hair is only obvious at about the time of dying. Emergency irradiation may be given for spinal cord compression: a fractionated course of 5–10 treatments will usually

be necessary. Benefit, with good pain relief and improved function, can be achieved but established neurological deficit is unlikely to be reversed.

Conclusion

Radiotherapy has an important part to play in the management of some paediatric tumours. A team approach, with paediatric oncologist working in close association with radiotherapist, paediatric surgeon, paediatric pathologist, and radiologist is necessary for optimal care of children with cancer.

Treatment should ideally be carried out in centres where at least one radiotherapist, familiar with national and international protocols, takes special responsibility for children in order that sufficient experience may be obtained in managing these rare conditions. In the event of treatment failure, close liaison allows quick and effective palliation to be carried out. Adolescents and young adults requiring multimodal therapy would also benefit from such an approach as cancer management becomes more complex.

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- 1 Shalet SM. Endocrine consequences of treatment of malignant diseases. *Arch Dis Child* 1989;64:1635–41.
- 2 Morris Jones PH. Advances in managing childhood cancer. *BMJ* 1987;295:4–6.
- 3 Morris Jones PH, Craft AW. Childhood cancer: cure at what cost? *Arch Dis Child* 1990;65:638–40.
- 4 Pritchard J, Stiller CA, Lennox EL. Overtreatment of children with Wilms' tumour outside paediatric oncology centres. *BMJ* 1989;299:835–6.
- 5 Meadows AT, Massari DJ, Fergusson J, Gordon J, Littman P, Moss K. Decline in IQ scores and cognitive dysfunctions in children with acute lymphoblastic leukaemia with cranial irradiation. *Lancet* 1981;ii:1015–8.
- 6 Chambers EJ, Oakhill A, Cornish JM, Curnick S. Terminal care at home for children with cancer. *BMJ* 1989;298:937–40.
- 7 Goldman A, Beardmore S, Hunt J. Palliative care for children with cancer—home, hospital or hospice? *Arch Dis Child* 1990;65:641–3.
- 8 Price P, Hoskin PJ, Easton D, Austin D, Palmer SG, Yarnold JR. Prospective randomised trial of single and multifraction radiotherapy schedules in the treatment of painful bony metastases. *Radiother Oncol* 1986;6:247–55.