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THE PLACE OF RADIATION-THERAPY (RT) IN THE MANAGEMENT OF SOFT TISSUE SARCOMAS (STS) IN CHILDREN

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STS represent 5% of malignant tumors (T) in children and adolescents. Embryonal rhabdomyosarcoma (RMS) is the most common form ; it has the reputation of a higher radiosensitivity than STS in adults. This has been shown clinically, especially in orbital RMS that has a 90% curability using RT as single treatment modality and this sensitivity has been confirmed by recent radiobiological investigations. **Indications for RT** : Since 1972, the IRS has based the local treatment on surgical resections (SR) followed by RT. 3 successive studies have explored this approach and showed that RT could be omitted in patients with complete resection (gr I 80% S). In IRS II, patients with microscopically incomplete resection enjoyed an excellent 90% local control with SR + RT, but with gross residual disease, 70% only. The SIOP has developed since 1984, an original approach in which RT is applied only to a subgroup of "high risk" patients, following an initial course of chemotherapy (IVA : Ifosfamide, Vincristine, Actinomycin D) : incomplete response and relapse. Although the relapse rate is definitely high (approx 1/3 patients), this policy doesn't seem to compromise the efficacy of a salvage program (including RT) and so, long term survival (approx 60%). 2 subgroups of patients have drawn a special attention : 1/ parameningeal RMS (ie adjacent, or invading base of the skull) are at high risk of meningeal relapse. Systematic and early RT of T + brain has been followed by a 20% improvement in survival. 2/ GU represent sites of generally excellent prognosis and conservative treatments have been developed that aim to preserv sexual and urinary functions. **Treatment modalities** : T are generally treated with a 3-5 cm safety margin - Total doses range between 40 and 55 Gy, fractionated - Brachytherapy has proven highly successful in small GU sites. Hyperfractionation is under investigation.

With modern approaches, long term survival of 50-80% in non met. can now be achieved.

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ROLE OF RADIOTHERAPY IN NON-HODGKIN'S LYMPHOMA AND HODGKIN'S DISEASE IN CHILDHOOD

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Key words : Radiotherapy, Non-Hodgkin Lymphoma, Hodgkin's Disease

Increasing recognition that Non-Hodgkin lymphoma in childhood is a systemic disease has led to reduction in the use of radiotherapy, even for localised presentations. Radiotherapy may still have a role in the prevention of central nervous system disease through chemotherapy may be more appropriate here too. Total body irradiation may be used as part of the high-dose intensity treatment and results will be compared with those obtainable using chemotherapy alone. The palliative role of radiotherapy will be discussed.

For Hodgkin's disease, radiotherapy may be used - as a single curative modality in early stage disease, - at reduced doses in conjunction with chemotherapy or - for control of residual disease after systemic treatment. Choice of treatment may largely be made on the basis of cosmetic and functional considerations. The results of various international groups using different treatment approaches will be discussed.

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RADIOTHERAPY IN BRAIN TUMORS

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In children brain tumors are the second most common cancer and are now responsible for the greatest number of cancer deaths.
For successful treatment, close co-operation of neurosurgeon, radiation and pediatric oncologist and the pathologist is mandatory.
Radiotherapy is the most effective adjunct to surgery. The aim is to achieve cure with as little radiation as possible in order to minimize the risk for late sequelae.
The following problems will be discussed and elicudated with examples and results:
- whether or not radiation treatment is of benefit in low grade astrocytoma,
- the volume to be treated by radiation: localized versus whole brain or CNA irradiation,
- the dose to the tumor bed,
- planning of radiation treatment,
- fractionation.

Although acute and early delayed reaction to the irradiation of the brain do occur they are relatively easy to control. The more serious late sequelae to radiation have been wi= dely studied recently. Mainly, there are endocrinological, intellectual and psychosocial deficiencies.

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WILMS' TUMOUR

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Radiotherapy in children with cancer is feared because of its negative long-term effects. In the past and today radiotherapy for children with Wilms'tumour was and is applied to the tumour bed (flank irradiation), whole abdomen and to the lungs in case of pulmonary metastases. This treatment for example can cause sequelae as skeletal growth retardation, vertebral column, scoliosis, alteration of soft tissues, primary ovarian and testicular failure, toxicity of contralateral kidney, liver, heart, lungs and hypertension. Fortunately several SIOP Wilms' tumour trials have convincingly shown that with the use of preoperative and postoperative chemotherapy consisting of vincristine (VCR) and actinomycin (AD) sometimes in combination with adriamycin (ADR) radiation can be limited. Only postoperative stage II patients with unfavourable histology, stage II patients with positive lymph nodes (LN +) and postoperative stage III patients still need radiotherapy for local control. The use of a three drugs regimen consisting of vincristine, actinomycin and adriamycin has also limited the need for total lung irradiation. In some stage V patients where partial nephrectomies have been performed intraoperative radiation therapy in situ or ex vivo can be used to treat positive resection margins and to preserve the remnants of the kidney. It is of utmost importance to develop radiotherapy techniques to diminish the radiotherapy sequelae. The results of brachytherapy together with surgery and the possibility to use free vascularized muscle-bone transplants for reconstruction, have shown the advantage of this treatment method. This method is perhaps also possible in children with Wilms' tumours. Although brachytherapy together with surgery is of increasing importance in children, especially when reconstructions take place with free vascularized bone-muscle transplants its role in children with Wilms' tumours is nihil.

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QUALITY ASSURANCE (QA) IN PEDIATRIC RADIOTHERAPY (PR)

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The medical part of QA in PR includes the multimodality treatment planning and performance within and without protocols, studies, and trials, with low and high dose radiotherapy. Due to the rare occurence of pediatric malignancies (2-3 new cases in 100.000 inhabitants per year) there is little such experience except in some large centres. On the other hand the adequate determination of the target e.g. is a crucial point in many pediatric malignancies like e.g. RMS, Ewingsarcoma, brain tumors. Furthermore as to the technico-physical part of QA (e.g. dose distribution in the treated and irradiated volume) deviations which appear to be small may lead to significant clinical consequences with regard to frequency of relapse (e.g. medulloblastoma) and morbidity (e.g. scoliosis).

Within European studies and trials and from European centres hardly any data are reported with regard to QA in PR. In North America a Quality Assurance Review Centre (QUARC) has been introduced more than a decade ago successfully supporting institutions taking part in multicenter clinical trials with integrated PR and reporting on this experience.

There seems to be a significant need for studying the conditions for the implementation of QA programs within national and international pediatric European studies and trials and to support QA evaluation in centres with different levels of experience in the treatment of pediatric malignancies.

Some aspects of QA in PR reflecting the experience of some multicenter studies and of 2 large centres (Vienna, Münster/Germany) will be reported.

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RADIOTHERAPY IN RETINOBLASTOMA: INDICATIONS, TECHNIQUES, RESULTS AND FUTURE CONSIDERATIONS

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Retinoblastoma (RB), a tumor of the embryonic neural retina, has a reported incidence of about 1 in $2 \cdot 10^5$ live births. With current treatments, overall prognosis is excellent. Thus, the mostly used staging system predicts both preservation of sight and cure. Therapeutic options include surgery, laser photocoagulation, cryotherapy, radio-active plaques and external beam radiotherapy (RT), depending on the potential of visual preservation, tumor(s) size, number, location and on the experience of a reference center. RT can be used in bilateral RB for the eye with the least advanced disease, as an alternative for bilateral enucleation, for multifocal tumors, large tumors, for lesions close to the macula or the optic nerve, and when there is a high risk of recurrence after enucleation. In choosing among the various available RT techniques, a homogenous dose distribution to the retinal target and the best sparing of surrounding structures need first to be considered. Total doses of 45-50 Gy at 1.8-2 Gy/fx are currently recommended. Recent literature review and our own data indicate a high (>90%) overall survival and a good (60-80%) visual preservation. Tumor control and vision depend on stage and RT dose. Median-term complications include cataract and retinopathy : in our experience we calculated an α/β value of < 1.7 for retina, reflecting a high sensitivity to high dose/fraction. Long-term complications consist of bone-growth retardation and radiation-induced sarcomas, up to 20-30%. Research in radiation physics and radiation biology should aim at decreasing these risks. The use of high-precision proton beam therapy and/or hyperfractionation are 2 promising research avenues which deserve to be explored.

Key words : Retinoblastoma, Radiation Therapy.