CTCs retain many molecular characteristics of the primary tumor and its metastases, and can be used to examine the presence of a target or its loss in tumor cells by for example fluorescent in situ hybridization (FISH), sequencing or by immunofluorescence. Analyses of tumor cell specific changes such as mutations or translocations could be useful, allowing a better understanding of mechanisms of resistance or susceptibility to treatment with novel agents. Limitations to these studies, however, may include RNA degradation and contaminating WBC RNA.
Overall, it is envisioned that CTC biomarkers will play an important future role in drug development.

169 INVITED

Genomics in early clinical trials

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It is common to employ gene expression profiling as a predictive marker discovery tool in Phase II clinical trials. However, there are several reasons why this supervised approach to predictor discovery may not yield reliable predictors. The multiple comparison problem, inherent to microarray analysis, leads to a large number of nominally small p-values, many of which are due to chance. Another confounder is that clinically important phenotypic characteristics (e.g. histologic grade, estrogen receptor status of breast cancer) are often associated with coordinated expression of thousands of genes. A simple comparison of transcriptional profiles of breast cancers that respond to preoperative chemotherapy with those that did not will reveal many differentially expressed genes. However, most of these genes will reflect the gene expression differences that underlie the phenotypic differences between the 2 response groups. Since responses are more frequent in high grade, ER-negative cancers compared to low grade and ER-positive tumors, the resulting pharmacogenomic response predictors often represent a predictor of clinical phenotype and may provide only modest added predictive value. The often small gene expression differences that are specific to responders and non-responders are easily masked by the large-scale differences due to any phenotypic imbalance between the response groups and the often small sample size of these discovery studies precludes meaningful adjustment for these confounders. Therefore, candidate predictive marker testing, as opposed to discovery, may be more efficient in conjunction with Phase II clinical trials. Usually, enough is known about the mechanism of action of most new drugs that one could rationally propose at least one or more response predictors. Conceptually, testing a response predictor in a prospective clinical trial is no different from testing a candidate drug in a therapeutic study and a 2-step, Phase II design can easily be adopted for a parallel, multi-arm, simultaneous marker and drug evaluation program.

References

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170 INVITED

Clinical biomarkers and imaging for radiotherapy-induced cell death

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Radiation, like most anti-cancer treatments, achieves its therapeutic effect by inducing different types of cell death in tumors. To evaluate treatment efficacy a variety of routine anatomical imaging modalities is available. However, changes in tumor function (*e.g.,* metabolism, proliferation, hypoxia) often precede these volumetric alterations and may reflect tumor responses to treatment more accurately. Therefore, reliable biomarkers and imaging modalities that could assess treatment responsiveness in an early phase would be very useful to identify responders and/or avoid ineffective, toxic therapies. A better understanding of cell death mechanisms following irradiation is essential for the development of such tools. This has become even more important with the recent introduction in clinical protocols of targeted biological agents that modify the radiation response at different levels.
The currently available assays to detect the most prominent types of radiation-induced cell death (apoptosis, necrosis, mitotic catastrophe, autophagy and senescence) *in vivo* and, if applicable, *in vivo*, will be presented in short. Two examples of non-invasive imaging techniques that allow visualization and quantification of radiation-induced cell death *in vivo* will be discussed in more detail: ^{99m}Tc-Annexin V scintigtaphy (TAVS) and ^{99m}Tc-methoxyisobutylisonitrile (MIBI) SPECT.
In a series 61 patients (NHL n = 27; HNSCC n = 16; NSCLC n = 16; SCLC n = 1; sarcoma n = 1) treated with low dose (2x2 Gy) involved-field radiotherapy (n = 27), cisplatin-based concurrent chemoradiotherapy (n = 16) or cisplatin-based chemotherapy (n = 18), we found a significant correlation between tumor TAVS uptake within 24−48 hours after start of treatment and outcome. More recently, we established a significant correlation between pre-chemotherapy MIBI uptake and tumor size change after 2 cycles of chemotherapy in 11 patients with advanced NSCLC.
The predictive value of these tests might help to design novel (combined modality) strategies and evaluate treatment effects at an early stage. Clearly, additional and more specific methods are needed for accurate patient selection to ensure optimal treatment and limit side effects.

Scientific Symposium (Tue, 22 Sep, 14:45−16:45)
Refining treatment and the cost of the cure − lessons from soft tissue sarcoma in young people

171 INVITED

Stratifying treatment for rhabdomyosarcoma

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All current clinical trials utilise some combination of the best known prognostic factors to stratify treatment intensity for patients with good or poor predicted outcomes. Such an approach is used as much to avoid over treatment of patients with a good chance for cure, as to improve cure rates for patients with less favourable disease.
Experience has confirmed the relevance of a surgical–pathological classification which groups patients according to the extent of the extent of disease remaining after the initial surgical procedure(s) but before beginning chemotherapy.
All groups are currently using the IRSG [Intergroup Rhabdomyosarcoma Study Group] surgical and pathologic grouping system with sometimes light differences.

i. Localized tumour, removed with pathologically clear margins and no regional lymph node involvement
ii. Localized tumour, grossly removed with (a) microscopically involved margins, (b) involved, grossly resected regional lymph nodes, or (c) both
iii. Localized tumour, with gross residual disease after grossly incomplete removal, or biopsy only
iv. Distant metastases present at diagnosis

However, there is a need for a pre-clinical staging system that did not depend on the surgeon's decision or on pathologic assessment of the specimen. Moreover, the great majority of patients (approximately 75%) have macroscopic residual disease (IRS Clinical Group III) at the primary site at the start of chemotherapy.
The TNM system built by the SIOP [International Society of Pediatric Oncology] and UICC [Union Internationale Contre le Cancer] was validated by many studies. It includes the evaluation of site of the local extension of the disease (T1 Confirmed to anatomic site of origin and T2 Extension to surrounding tissue), the size of the tumour (<5 cm or $\geqslant$5 cm), the regional nodal involvement (N0 Regional nodes not clinically involved, N1 Regional nodes clinically involved by neoplasm) and the presence or absence of metastatic disease (M0 No distant metastasis, M1 Metastasis present).
Last but not least additional prognostic influence of site of the disease, histological subtype and patient age adds to the complexities of treatment stratification.
Recently both IRSG and European Paediatric Soft tissue Sarcoma Group (EpSSG) have reevaluated and updated their staging systems. They take into account additional information to the TNM and IRS staging systems: patient age, histology and tumour site. They are the bases of the risk grouping systems currently used to stratify the chemotherapy as well as the indications of radiation therapy. Concordances and differences between these staging systems will be presented.

172 INVITED

Estimating the total burden of therapy in children treated for rhabdomyosarcoma

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Cure rates of over 70% are currently achieved for patients with non metastatic rhabdomyosarcoma (RMS) but young age at diagnosis (median 5 years) and the divergence of clinical presentation at many different

anatomic sites are important factors in determining strategies for treatment and have an influence on outcome. It is agreed that multimodality therapy involving surgery, chemotherapy and radiotherapy is necessary but the optimal use, timing and intensity of these treatment modalities should be planned with regard to known prognostic factors and to the predicted sequelae of treatment.
The concept of the 'total burden of therapy' has become important in assessing the 'cost' of survival. There has been particular debate about the need to use radiotherapy to guarantee local control in patients who appear to have achieved complete remission with chemotherapy and limited surgery. When radiotherapy is systematically implemented as part of primary treatment, the chance of local control is increased (but not guaranteed) and the risk of relapse is less but this can result in important long term problems, particularly in very young children. Recent experience suggests that it may be possible to avoid, or reduce, the intensity of local therapy depending on response to initial surgery and primary chemotherapy, and that it is possible to successfully re-treat many of those who may relapse. However, the late toxicity from chemotherapy (particularly if further agents are added during treatment after relapse) may also be a factor in assessing long term risk to the health of survivors.
The challenge remains to be able to identify, at the outset, the intensity of treatment required to achieve the best possible chance of cure and to prospectively select patients who might be spared local treatment. In adopting this approach, however, it is important to recognise that patients treated initially without systematic use of local therapy may require more intensive initial chemotherapy and that those who relapse experience additional psychological distress and will be exposed to further chemotherapy in addition to delayed radiotherapy. Such a philosophy can therefore be justified only if overall outcome remains satisfactory and if the balance of late effects across the patient population is acceptable.

173 INVITED

Synovial sarcoma: adult vs. paediatric approaches and the need for consensus

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Background: Synovial sarcoma (SS) is a typical soft tissue sarcoma subtype that crosses the pediatric and the adult ages. No published data describes a different biology of SS when arising in adults as opposed to children, but – since up to recent times – different therapeutic strategies have been developed for pediatric and adult oncology protocols dealing with SS. Since relatively high response rates to chemotherapy have been well documented in pediatric series, pediatric oncologists approached SS as a chemosensitive tumor ("rhabdomyosarcoma-like" tumor), and designed treatments around this concept, particularly in Europe (all patients receiving systemic treatment, regardless of stage). By contrast, adult SS has usually been treated as the other adult STS, generally regarded as poorly chemosensitive tumor and for which the standard therapeutic approach was focused on local control. Different overall outcomes have been reported by pediatric and adult groups, but it remains unclear whether these results are due to differences in clinical prognostic features, tumor biology, or treatment strategies adopted.
Methods: Few studies have directly investigated this issue and compared adult to pediatric SS patients. The current review focuses in particular on the recent analysis performed on 1268 cases (213 children/adolescents and 1,055 adults) registered on the North-American Surveillance, Epidemiology, and End Results (SEER) database (1983–2005), and on the retrospective analysis on 271 patients of all ages performed at the Istituto Nazionale Tumori (INT) in Milan.
Results: Both the studies did not suggest major differences in stage distribution and clinical features across the age groups, whereas overall survival strongly correlated with age. While it is unclear whether the survival gap observed in the SEER data might be related to the different use of chemotherapy, the INT series reported a correlation between survival and use of chemotherapy.
Conclusions: Recently, on one hand adult oncologists have recognized the differences that make SS be considered different from the other adult STS (i.e. younger age, increased metastatic potential, need to regard it as a chemosensitive histiotype); in contrast with findings emerging from most published clinical trials, in the day-to-day clinical practice the majority of adult oncology clinical guidelines suggest the use of chemotherapy not only in case of advance disease, but also as adjuvant treatment after surgery. On the other hand pediatric protocols have moved from a "rhabdomyosarcoma-like" strategy to a treatment concept closer to that usually adopted in adult setting. The uniqueness of SS, a tumor that encompasses the pediatric and adult age groups, should expedite the development of cooperative trials that would integrate uniform treatment concepts regardless of age and provide adequate numbers to answer relevant questions in a randomized manner.

174 INVITED

New approaches to the use of radiation therapy in young people: efficacy vs. late effects

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Radiation is an important component of multi-modality therapy for many tumour types. In theory, any localised tumour can be eradicated by irradiation provided that a sufficient dose is given. In practice, however, the potential for cure is limited by the tolerance of adjacent normal structures which are inevitably also irradiated. In children, the developing normal tissues are more vulnerable than those of adult patients.
Potential late effects include somatic deformities arising from hypoplastic bone and soft tissue development, neuro-cognitive difficulties and endocrine dysfunction following central nervous system treatment and cardiac, pulmonary, hepatic and renal impairment following irradiation of the thoracic and abdominal viscera.
Anxiety about late effects has sometimes meant that radiotherapy has been systematically withheld, resulting in a lower local control probability and an higher chance of death from the cancer, compared with if radiotherapy had been used.
A number of separate approaches in refining treatment strategy, service organisation and improving treatment delivery have been devised which when combined may realise the aims of using radiotherapy only where necessary and minimizing the late effects it causes. These include:

- Evidence-based risk stratification to select those patients who have the greatest likelihood of benefit from radiotherapy.
- Creation of specialist centres for paediatric radiation oncology with professional networking to ensure quality control.
- Modern cross sectional and functional imaging co-registration to enable more accurate definition of the target volume.
- Inverse-planned intensity-modulated radiation therapy to allow conformal treatment of the target with sparing of adjacent normal structures.
- Interstitial and intracavitary brachytherapy to permit high dose treatment of small clearly defined volumes with sparing of nearby normal tissues.
- Intoduction of therapy facilities using proton beams which have different physical characteristics enabling better dose distributions.
- Altered fractionation schedules which have biologically different effects on tumours and normal tissues.
- Combinations of radiotherapy with chemotherapy and biological treatments which may change the therapeutic ratio.

It is anticipated that by using these advances to optimise radiation treatments for children and young people, the costs of cure in the future will be less than they have been in the past. However many years of follow-up will be required to demonstrate that this is in fact the case.

Advocacy Session (Tue, 22 Sep, 14:45−16:15)
Improving cancer outcomes through healthy lifestyle choices

175 INVITED

Benefits of exercise for cancer patients

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Loss of physical performance and fatigue are frequent problems of cancer patients. Traditionally, they were advised to avoid physical effort and to rest. However, there is a growing body of evidence suggesting that exercise can help improve physical ability and stamina and reduce fatigue in cancer patients. In this presentation we will show data about the effects of exercise in cancer and discuss the possible applications of this intervention in different settings.

176 INVITED

CAM and cancer: the good, the bad and the ugly

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Complementary therapies are used by many cancer patients. This article briefly reviews the scientific evidence. In the prevention of cancer, complementary medicine has little to offer that is not also provided by mainstream medicine. In the treatment of cancer, proponents of complementary medicine frequently mislead cancer patients; an "alternative cancer cure" is a contradiction in terms. The true and beneficial role of complementary medicine is in supportive cancer care and cancer palliation. This is where we should focus on in clinical practice as well as research.