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Molecular imaging for tailoring cancer therapy

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The ultimate goal of cancer therapeutics is to identify the drug regimen that will have the best chance to cure an individual patient while reducing risks and toxicity.

Tumour response to a given therapeutic regimen depends on many factors including the specific molecular signature or gene expression profile of an individual tumour, the characteristics of tumor microenvironment and some host-related factors. A number of traditional biomarkers are currently used to guide physicians in therapeutic decisions and new molecular tests are becoming increasingly available to identify individual tumor aggressiveness, sensitivity or resistance to therapy and risk of tumour relapse and metastases. Angiogenesis and hypoxia are well-known processes occurring in tumour microenvironment that can affect tumour response. Variability of therapy outcome may be also due to host-related factors such as age, sex, performance status, pharmacokinetics and pharmacodynamics.

Molecular imaging provides tools to visualise molecular characteristics of tumours, local microenvironment properties and some host factors affecting tumour response.

There is a growing body of evidence that, on the basis of imaging findings, patients can be selected for a given drug regimen, drug effects can be monitored in real time, sensitivity or resistance can be predicted and identified, relapse or progression can be early detected. In particular, the appropriate selection of patients for molecularly targeted therapies would promote an enrichment of patient population that can potentiate clinical trials. Early monitoring of tumour response to therapy would allow continuing or changing therapy on the basis of individual tumour sensitivity or resistance. Tumour microenvironment and host factors may be evaluated and eventually monitored during subsequent therapy. Here we report prominent examples of non-invasive imaging techniques that may identify potential responders or non-responders before and during specific treatment. The exploitation and wide use of predictive markers and surrogate end points of tumour response based on imaging findings require standardisation of imaging procedures and clinical validation in large prospective trials. In conclusion molecular imaging can significantly contribute to tailor cancer therapy on an individual basis and imaging criteria of patient selection and treatment monitoring are expected to be progressively integrated in the standard evaluation of cancer patients.

References

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