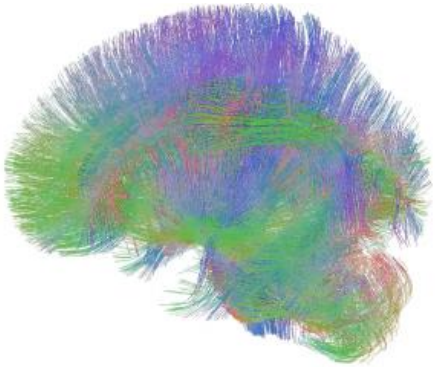
Welcome to the Neuro-Oncology Clinic

Resource Sheet 3



Stereotactic radiosurgery for brain metastases and skull base tumours

This resource sheet discusses two quite different groups of patients who are often treated with the same high precision radiotherapy technique, known as stereotactic radiosurgery.

Radiosurgery is a good name for the treatment. 'Radio' refers to the use of ionising radiation from outside the body, and 'surgery' refers to the intention to ablate a lesion in a single treatment.

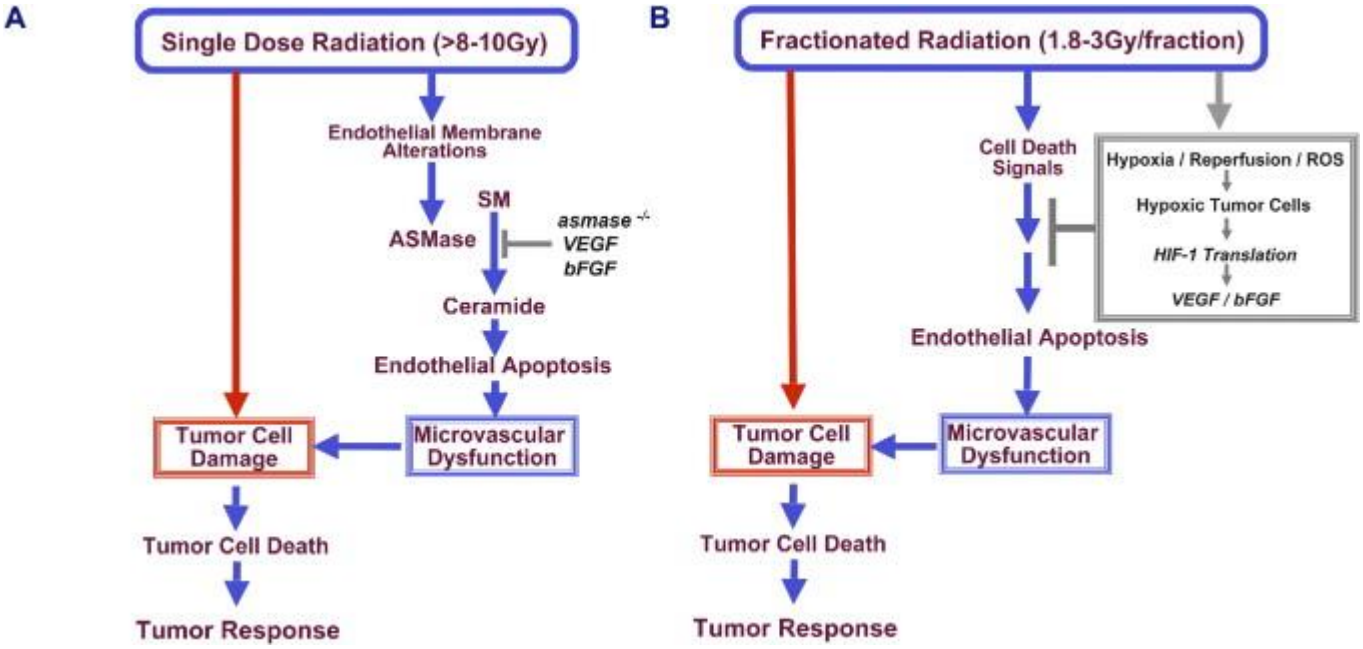
You may recall from the seminar 3 on radiation therapy that we often use fractionation in radiation therapy to enhance the therapeutic index – deliver the same effective dose to the tumour, whilst delivering a biologically safer dose to healthy normal tissues.

Radiosurgery takes the principle and turns it on its head – by delivering a huge dose of radiation in a single treatment, we aim to destroy everything within our target volume. Normal brain tissue is protected by focussing the high dose region as tightly as possible. Because the treatment is delivered in one setting, there is no possibility to undo a mistake. As a result, we have to quality assure every aspect of the treatment plan very carefully before treating the patient.

The biology of radiosurgery is different

Seminar 3 teaches you that radiotherapy works mainly by damaging DNA in tumour cells and normal tissues, and the tumour cells are incapable of repairing the DNA damage.

As we treat tumours with large single doses of radiation, the biology of tumour response changes. We believe that in addition to causing tumour DNA damage, radiation causes injury to friable tumour vasculature, through induction of endothelial apoptosis:



High doses of radiation therapy also seem to be particularly good at activating the immune system, whether due to the release of inflammatory cytokines or the creation of tumour neo-antigens – exposing bits of the tumour to the

immune system that have previously been hidden from the antigen presenting cells. As you will see below this immune response can be a double-edged sword.

Patients with cerebral oligometastatic disease

We can offer radiosurgery to fit patients with oligometastatic disease, subject to strict criteria:

- The patients must be fit (Karnofsky performance status 70 or higher)
- They must have controlled extracranial disease, or the possibility to control extracranial disease with further treatment, and a life expectancy of at least 6 months if the brain metastases are controlled.
- They must have less than 20cc of active cerebral metastases. There is no restriction on the number of lesions we can treat, though in practice we tend not to treat patients with more than 4 mets.

You will here us going through these criteria with patients who are referred for consideration of radiosurgery treatment. We always aim to deliver treatment within a 2 week window from decision to treat. You will also see that we have to be careful to schedule treatment around their systemic therapy. Some chemotherapy agents act as radiation sensitisers and we have to allow time for the drug to wash out before delivering radiosurgery.

The cytokine release as a tissue response to radiosurgery needs careful management. We give patients a huge dose of steroids to take on the day of radiosurgery and the day after, which covers the acute swelling, but sub-acute swelling can go on for 6-8 weeks post treatment!

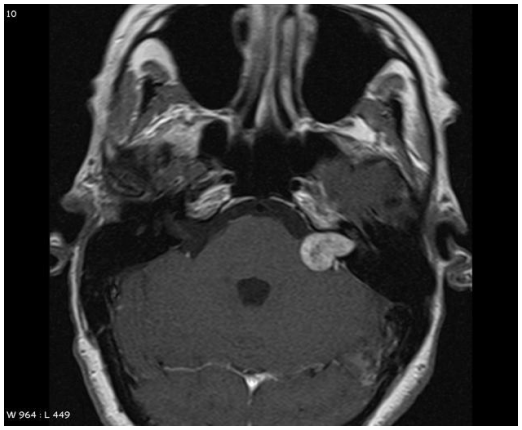
Patients with skull base tumours

We can offer radiosurgery to patients with benign skull base tumours, mainly vestibular schwannoma. This is a benign tumour that occurs on the 8th nerve and presents typically with tinnitus, unilateral sensorineural deafness. Large tumours can cause balance problems and issues with facial function.

Patients typically get diagnosed at an early stage with an MRI scan, and it is customary to obtain at least one repeat MRI scan after 6 months to assess the growth rate of the tumour. Patients may have radiological surveillance, surgery or stereotactic radiosurgery. Control rates are excellent for both options – each has its pros and cons and it is worth listening to Dr Jefferies or Kate Burton as they advise patients about treatment options in the skull base clinic

The closer you are to equipoise between treatments, the harder it is to advise patients, and the harder it is for patients to make a choice. When one treatment option is significantly better than another, it is easy to make the choice!

Patients receiving radiosurgery can have treatment related symptoms for up to two years after treatment, as the tumour swells, turns cystic, and eventually shrinks down in response to treatment.



Here is an example of a fairly bulky vestibular schwannoma sitting in the left cerebello-pontine angle. The tumour is growing inwards along the path of the nerve and has expanded the internal auditory canal. It is also bulging outwards and starting to compress the ipsilateral pons. Remember your skull base anayomt and think about the other cranial nerves that sit close to this region. What other symptoms might you expect as the tumour gets bigger?

Our radiosurgery platform

Don’t let Dr Jena bore you to tears telling you about the kit – he’s just a complete tech nerd and loves this kind of stuff. Our system is called Novalis and it is a robotic radiosurgery system. It has and end-to-end accuracy of 0.8mm and we can use it to treat lesions as small as 4mm across. The machine uses computer vision and orthogonal x-rays to track the internal and external location of the patient during treatment, so that if the patient moves, it can interrupt the treatment until the patient is returned to the correct position. It is this tracking that gives us the confidence to treat these small lesions that sit adjacent to critical regions of the brain.

If you are reading this electronically you can click the Novalis picture and watch a short YouTube animation that shows how the Brainlab Novalis system works. Dr Jena may show you this on the radiotherapy tour in week 2 – it really is an awesome piece of kit!

Find more teaching resources

To find an electronic copy of this resource sheet, and other materials, go to www.camradiotherapy.org.uk/neuroclinic or just scan this QR code with your phone: