Metastatic disease

The ability to metastasis is one of the hallmarks of malignant disease.

Cancer metastasis is the process by which a cancer cell leaves the primary tumour, travels to a distant site by way of the blood and lymphatic circulatory channels, and establishes a second tumor in this new site.

The metastatic process is a complex sequence of events, sometimes referred to as a cascade, involving cell genetics, cell surface, morphologic and growth properties, and immunologic characteristics of the host.

Recognised steps in the metastatic process.

The Metastatic Process
Angiogenesis: the generation of blood vessels around the primary tumour that increases the chance for tumour cells to reach the blood stream and, ultimately, colonise in secondary sites
Attachment or adhesion: tumour cells need to attach themselves to other cells and/or cell matrix proteins
Invasion: tumour cells move across the normal barriers imposed by the extracellular matrix
Tumour cell proliferation: a new colony of tumour cells is stimulated to grow at the secondary site

Bone Metastases

Bone is a common site for metastatic spread from many primary tumours including lung, myeloma, thyroid and kidney but particularly so in patients with **breast and prostate** cancer.

In these patients some 70-75% will develop bone metastases at some stage of their illness and indeed post mortem findings seem to suggest that the figure may actually be higher.

For patients with breast and prostate cancer there is an interesting tendency for metastatic spread to ONLY the skeleton. This phenomenon is known as **osteotropism.**

Bone Metastases (cont)

Bone metastases can cause considerable **morbidity** – pain, pathological fracture, vertebral collapse (and associated spinal cord compression) and hyper-calcaemia. In advanced cases such as these, the role of radiation therapy is in **palliation of symptoms**.

In breast and prostate cancer patients there is a median survival of around 2 years with 10% still alive at 5-10 years following the diagnosis of bone metastases.

The distribution of bone metastases tends to mirror the distribution of red bone marrow – i.e. they are more likely to arise in: spine; ribs; pelvis; proximal appendicular skeleton

Metastases can also occur in the skull but are very uncommon in the distal append-icular skeleton

The most common mechanism by which cancer affects bone is by **haematological spread.**

Haematological spread is a complex cascade of events beginning with the primary tumour invading local thin walled blood vessels. Fragments of tumour may break off and be carried by the circulatory system to become lodged in organs and structures containing extensive capillary networks (i.e. lungs, liver, bone).

Malignant cells enter the bone marrow space and appear to be attracted to the bone forming surfaces by **chemotactic agents** (most likely collagen fibres).

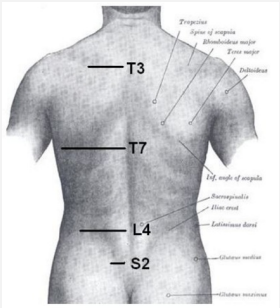
Bone Metastases (cont)

Malignant cells then secrete factors that disturb the balance between osteoclast and osteoblast activity. In some cases tumour cells are also able to reabsorb bone directly through the production of proteolytic enzymes.

The vertebrae are thirty-three in number, and are grouped under the names **cervical, thoracic, lumbar, sacral, and coccygeal**, according to the regions they occupy. There are seven in the cervical region, twelve in the thoracic, five in the lumbar, five in the sacral, and four in the coccygeal. The vertebra are regularly referred to in radiation therapy for land marking, treatment and image recognition.

T3 is at level of medial part of spine of scapula.
T7 is at inferior angle of the scapula. L4 is at highest point of iliac crest.
S2 is at the level of posterior superior iliac spine.
C7 is easily localized as a prominence at the lower part of the neck

Orientation of vertebral column



By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Diagnosis of bone metastases

A range of investigations may be used in the diagnosis of bone metastases: clinical examination; plain radiographic imaging; radionuclide bone scan; CT; MRI; bio-chemical monitoring

In addition it is also essential to determine: pain and mobility; analgesic requirements

Management strategies of bony metastases

External beam radiation therapy may be used for limited painful lesions, but there are also other treatment methods that can be used alone or in combination.

Targeted radiotherapy (radioisotopes)

Radioisotopes that emit ß-particles can be very effective at treating osteoblastic metastases – i.e. sclerotic deposits resulting from prostate cancer.

The radioisotopes are injected intravenously and taken up by areas of increased osteoblast activity.

The ß-particles treat within a very short radius. This type of therapy can be useful for multiple lesions, but its disadvantages are that it damages the bone marrow (making subsequent chemotherapy difficult) and is expensive.

Surgery

Where a metastatic lesion presents in a long bone and particularly where there is evidence of cortical destruction, prophylactic orthopaedic surgery can play an important role in pain relief, stabilisation and prevention of pathological fracture.

Management strategies of bony metastases (cont)

If the patient has presented with a pathological fracture then internal fixation is always indicated prior to external beam radiotherapy (assuming that the patient can undergo surgery).

Surgery may also be indicated in cases of spinal cord compression to perform emergency decompressive laminectomy or vertebral fixation, which may then be followed by external beam radiation therapy.

Endocrine therapy (hormonal intervention)

Breast cancer and prostate cancer commonly produce bone metastases that can be effectively palliated using some form of hormonal intervention– either additive or subtractive therapy.

In premenopausal women surgical or radiation induced oophorerctomy or a LHRH-releasing hormone or tamoxifen may be indicated. In postmenopausal women tamoxifen, or aromatase inhibitors are used.

A possible complication of the use of tamoxifen in breast cancer is hypercalcaemia (high calcium (Ca^{2+}) level in the blood serum)

In prostate cancer orchidectomy (one or both testicles are removed) or preferably the use of goserelin acetate (Zoladex) is an option.

Hormone therapy is rarely, if ever, used in isolation for the palliation of bone metastases.

Management strategies of bony metastases Cont.

Cytotoxic chemotherapy

Chemotherapy may be of use in cases of advanced breast cancer and myeloma where bone metastases may be diffuse making radiotherapy impractical.

Management strategies of bony metastases Cont. (cont)

No one chemotherapy regime has been identified as most appropriate.

It should be noted that the tolerance of patients' bone marrow is likely to be significantly reduced, either as a result of destruction by the tumour itself or as a consequence of previous radiotherapy (including radioisotopes).

Therefore, if chemotherapy is used then either nonmyelosuppressive drugs or reduced doses of myelosuppressive drugs should be employed. (Myelosuppression = decreased bone marrow activity)

Biphosphonates (osteoclast inhibition)

Biphosphonates work by inhibiting osteoclast-mediated bone resorption.

Bisphosphonates play an important role in the management of osteolytic metastases (e.g. from breast cancer) and can promote healing and lessen pain thus reducing the incidence of pathological fractures and spinal cord compressions.

Although bisphosphonates have proved to be effective in the treatment of bone metastases it should be noted that they do not improve survival.

These drugs are well tolerated and side effects are minimal. Biphosphonates also play an important associated role in the management of tumour-induced hypercalcaemia.

Analgesia (Pain relief)

Relief of pain is particularly important in the management of bone metastases and analgesic drugs are almost always used in symptomatic patients.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Management strategies of bony metastases Cont. (cont)

It is often essential to treat the pain alongside other active treatments. For example a patient needs to be free enough of pain in order to be able to undergo external beam radiotherapy.

Medical management of metastatic bony disease pain typically begins with paracetamol or nonsteroidal anti-inflammatory drugs or cyclooygenase-2 inhibitors that are aimed at alleviating inflammatory states associated with bone pain.

Emergency cases: Spinal Cord Compression

When a patient presents with bony metastases to the vertebral column, they could have **spinal cord compression.**

This will severely impact on the patient's mobility.

A steroid medication to help reduce any swelling around the spinal cord will already have been administered. It is your job to ensure that the treatment position is appropriate for each patient's mobility and overall condition.

The first decision to make is whether the patient can lie prone or supine.

The patient will have undergone a diagnostic MRI to differentiate between malignant symptoms and musculoskeletal causes. From the MRI the radiation oncologist will instruct you as to which vertebrae are to be treated.

Emergency cases: Spinal Cord Compression (cont)

One thing to remember though regardless of technique is that *the upper level and lower level of the field should cover full vertebrae and should not be part way through a vertebra.*

The region to be treated will determine the technique to be used.

Upper cervical spine

If a direct posterior field were to be used for a C1-C4 vertebral treatment, the field would exit through the oral cavity.

Since the aim of radiation therapy is to deliver a tumorcidial dose and minimise the dose to the surrounding healthy structures, this technique is less than ideal.

The next option is to treat the upper cervical spine with lateral photon beams, this will ensure an even dose to the vertebra, and avoid the oral cavity as much as possible, thereby minimising side effects.

It is unlikely that these patients will be prone. Sometimes the patient will be simulated supine in a stabilisation cast/shell for ease of set up and reproducibility.

If the oral cavity could not be completely avoided then there may be some mucositis and oesophagitis experienced by the patient, which can be easily managed with medication.

Lower cervical spine

Lateral fields aren't considered as the patient's shoulders will absorb the beam on its path to the spine.

Emergency cases: Spinal Cord Compression (cont)

For this reason a multi field technique is often employed. Wedged posterior obliques with either a direct posterior, or anterior, field is normally indicated for treating these patients.

Thoracic spine

the spinal column is located posteriorly. Multi field techniques are commonly used in the thoracic region.

Sometimes patients can complain of oesophagitis due to the exiting radiation, but this occurs rarely.

Lumbar spine

From the thoracic to the lumbar region, the vertebral column moves further anteriorly, approaching mid-separation.

Multi field techniques are used in the lumbar region, either opposing anterior and posterior photon fields or a 3 field technique. The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

Just below the last Thoracic (T12) and first Lumbar (L1) vertebra the spinal cord ends at the Conus Medullaris. From this point the spinal nerves, resembling a horse's tail, become known as the Cauda Equina, and extend to the coccyx. These nerves are suspended in spinal fluid.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Emergency cases: Spinal Cord Compression (cont)

Often the referral will be for a nerve-root compression rather than spinal cord compression for this reason.

To include the lumbar and sacral region, the typical radiation field will resemble a spade, larger inferiorly to cover the nerves as they spread out in the sacral region, and then shielding either side of the vertebral column at the level of the lumbar spine region. Once again, current practice would be to use a multi field approach.

Side effect management

Emergency cases: Spinal Cord Compression

When a patient presents with bony metastases to the vertebral column, they could have **spinal cord compression.**

This will severely impact on the patient's mobility.

A steroid medication to help reduce any swelling around the spinal cord will already have been administered. It is your job to ensure that the treatment position is appropriate for each patient's mobility and overall condition.

The first decision to make is whether the patient can lie prone or supine.

The patient will have undergone a diagnostic MRI to differentiate between malignant symptoms and musculoskeletal causes. From the MRI the radiation oncologist will instruct you as to which vertebrae are to be treated.

Emergency cases: Spinal Cord Compression (cont)

One thing to remember though regardless of technique is that *the upper level and lower level of the field should cover full vertebrae and should not be part way through a vertebra.*

The region to be treated will determine the technique to be used.

Upper cervical spine

If a direct posterior field were to be used for a C1-C4 vertebral treatment, the field would exit through the oral cavity.

Since the aim of radiation therapy is to deliver a tumorcidial dose and minimise the dose to the surrounding healthy structures, this technique is less than ideal.

The next option is to treat the upper cervical spine with lateral photon beams, this will ensure an even dose to the vertebra, and avoid the oral cavity as much as possible, thereby minimising side effects.

It is unlikely that these patients will be prone. Sometimes the patient will be simulated supine in a stabilisation cast/shell for ease of set up and reproducibility.

If the oral cavity could not be completely avoided then there may be some mucositis and oesophagitis experienced by the patient, which can be easily managed with medication.

Lower cervical spine

Lateral fields aren't considered as the patient's shoulders will absorb the beam on its path to the spine.

Emergency cases: Spinal Cord Compression (cont)

For this reason a multi field technique is often employed. Wedged posterior obliques with either a direct posterior, or anterior, field is normally indicated for treating these patients.

Thoracic spine

the spinal column is located posteriorly. Multi field techniques are commonly used in the thoracic region.

Sometimes patients can complain of oesophagitis due to the exiting radiation, but this occurs rarely.

Lumbar spine

From the thoracic to the lumbar region, the vertebral column moves further anteriorly, approaching mid-separation.

Multi field techniques are used in the lumbar region, either opposing anterior and posterior photon fields or a 3 field technique. The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

Just below the last Thoracic (T12) and first Lumbar (L1) vertebra the spinal cord ends at the Conus Medullaris. From this point the spinal nerves, resembling a horse's tail, become known as the Cauda Equina, and extend to the coccyx. These nerves are suspended in spinal fluid.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Emergency cases: Spinal Cord Compression (cont)

Often the referral will be for a nerve-root compression rather than spinal cord compression for this reason.

To include the lumbar and sacral region, the typical radiation field will resemble a spade, larger inferiorly to cover the nerves as they spread out in the sacral region, and then shielding either side of the vertebral column at the level of the lumbar spine region. Once again, current practice would be to use a multi field approach.

Emergency cases: SVC Obstruction

Superior vena cava (SVC) obstruction is a medical emergency that falls under the 'plan and treat' umbrella.

As the treatment is palliative intent, the daily fraction size is usually large at the start (up to 3-4 Gy) to get the dose in quickly to attempt a quick response. After a few of these larger fractions the radiation oncologist may then prescribe a more normal fractionation of 2-3 Gy per day up to a dose of between 20 and 30 Gy.

Emergency cases: SVC Obstruction

Superior vena cava (SVC) obstruction is a medical emergency that falls under the 'plan and treat' umbrella.

Emergency cases: SVC Obstruction (cont)

As the treatment is palliative intent, the daily fraction size is usually large at the start (up to 3-4 Gy) to get the dose in quickly to attempt a quick response. After a few of these larger fractions the radiation oncologist may then prescribe a more normal fractionation of 2-3 Gy per day up to a dose of between 20 and 30 Gy.

Emergency cases: SVC Obstruction

Superior vena cava (SVC) obstruction is a medical emergency that falls under the 'plan and treat' umbrella.

As the treatment is palliative intent, the daily fraction size is usually large at the start (up to 3-4 Gy) to get the dose in quickly to attempt a quick response. After a few of these larger fractions the radiation oncologist may then prescribe a more normal fractionation of 2-3 Gy per day up to a dose of between 20 and 30 Gy.

Emergency cases: SVC Obstruction

Superior vena cava (SVC) obstruction is a medical emergency that falls under the 'plan and treat' umbrella.

As the treatment is palliative intent, the daily fraction size is usually large at the start (up to 3-4 Gy) to get the dose in quickly to attempt a quick response. After a few of these larger fractions the radiation oncologist may then prescribe a more normal fractionation of 2-3 Gy per day up to a dose of between 20 and 30 Gy.

Emergency cases: Widespread bony metastases

These patients might be appropriately treated with **hemi body** radiotherapy (involving radiation to one half of the body).

The junction of the upper and lower fields is usually at the level of the iliac crests. A single dose of 6 Gy to the upper body and 8 Gy to the lower body is prescribed. The treatment is usually given with the patient as an in-patient due to the expected significant side effects of delivering radiation to such a large volume within the patient.

Emergency cases: Electrons

Electrons are used to treat bony metastases that are **superficially** positioned within the patient, namely the sternum and ribs.

Sternum

Electrons are sensitive to change in patient contour. Therefore, to deliver the correct dose, 'skin-edge' must be achieved.

For a sternum treatment, with the patient flat on their back, the treatment area is usually flat enough. On some occasions you may see the patient is on an incline plane to achieve the flat area.

An energy of 9 MeV with a dose prescribed to the 90 percent isodose line is usually sufficient to relieve the patient's bony pain symptoms. The dose will vary between a single fraction of 8 Gy, up to 20 to 30 Gy in 5 to 10 fractions. An SSD of 100 is usual practice. As skin dose is not usually required, bolus is rarely prescribed, but some erythema is expected as the dose prescribed increases.

Ribs

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Emergency cases: Electrons (cont)

Patient position will be determined by the treatment site, achieving skin-edge for the electron beam.

For lateral ribs, the patient will often have to be lying on their contralateral side. If this happens, the patient will be fairly unstable, so at simulation make sure that you have taken all measures to ensure that the patient is comfortable and stable.

Management Strategies: Chemotherapy

Palliative chemotherapy is defined as treatment in circumstances where the impact of intervention is insufficient to result in major survival advantage, but does affect improvement in terms of tumourrelated symptoms, and where the palliation/toxicity trade-off from treatment clearly favours symptom relief

The role of chemotherapy in circumstances where little or no survival benefit is anticipated remains controversial.

This is despite the mounting body of evidence in favour of its use for symptom palliation. The notion persists that outcomes other than significant survival benefit are not valid, because of firmly held perceptions of toxicity.

Palliative cytotoxic chemotherapy is less widely used than radiation therapy as the toxicities associated with chemotherapy are more common and more difficult to justify according to the criteria for good palliation.

Management Strategies: Chemotherapy (cont)

Palliative hormone chemotherapy is more widely used due to its limited toxicity.

Emergency cases: Spinal Cord Compression

When a patient presents with bony metastases to the vertebral column, they could have **spinal cord compression.**

This will severely impact on the patient's mobility.

A steroid medication to help reduce any swelling around the spinal cord will already have been administered. It is your job to ensure that the treatment position is appropriate for each patient's mobility and overall condition.

The first decision to make is whether the patient can lie prone or supine.

The patient will have undergone a diagnostic MRI to differentiate between malignant symptoms and musculoskeletal causes. From the MRI the radiation oncologist will instruct you as to which vertebrae are to be treated.

One thing to remember though regardless of technique is that *the upper level and lower level of the field should cover full vertebrae and should not be part way through a vertebra.*

The region to be treated will determine the technique to be used.

Upper cervical spine

If a direct posterior field were to be used for a C1-C4 vertebral treatment, the field would exit through the oral cavity.

Emergency cases: Spinal Cord Compression (cont)

Since the aim of radiation therapy is to deliver a tumorcidial dose and minimise the dose to the surrounding healthy structures, this technique is less than ideal.

The next option is to treat the upper cervical spine with lateral photon beams, this will ensure an even dose to the vertebra, and avoid the oral cavity as much as possible, thereby minimising side effects.

It is unlikely that these patients will be prone. Sometimes the patient will be simulated supine in a stabilisation cast/shell for ease of set up and reproducibility.

If the oral cavity could not be completely avoided then there may be some mucositis and oesophagitis experienced by the patient, which can be easily managed with medication.

Lower cervical spine

Lateral fields aren't considered as the patient's shoulders will absorb the beam on its path to the spine.

For this reason a multi field technique is often employed. Wedged posterior obliques with either a direct posterior, or anterior, field is normally indicated for treating these patients.

Thoracic spine

the spinal column is located posteriorly. Multi field techniques are commonly used in the thoracic region.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Emergency cases: Spinal Cord Compression (cont)

Sometimes patients can complain of oesophagitis due to the exiting radiation, but this occurs rarely.

Lumbar spine

From the thoracic to the lumbar region, the vertebral column moves further anteriorly, approaching mid-separation.

Multi field techniques are used in the lumbar region, either opposing anterior and posterior photon fields or a 3 field technique. The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

The 3 field technique may use either posterior oblique fields or laterals to achieve the desired dose distribution to the required depth.

Just below the last Thoracic (T12) and first Lumbar (L1) vertebra the spinal cord ends at the Conus Medullaris. From this point the spinal nerves, resembling a horse's tail, become known as the Cauda Equina, and extend to the coccyx. These nerves are suspended in spinal fluid.

Often the referral will be for a nerve-root compression rather than spinal cord compression for this reason.

Emergency cases: Spinal Cord Compression (cont)

To include the lumbar and sacral region, the typical radiation field will resemble a spade, larger inferiorly to cover the nerves as they spread out in the sacral region, and then shielding either side of the vertebral column at the level of the lumbar spine region. Once again, current practice would be to use a multi field approach.

Emergency cases

Emergency patients are often referred to as **'plan and treat'.**

This is because the patients need prompt treatment as they are at risk of permanent, irreversible damage. To minimise risks and discomfort for these patients, they are treated immediately following the planning procedure.

There are two main instances of 'plan and treat' patients.

The first is for spinal cord compression - where the tumour is impinging on the cord itself, or a nerve, with the potential to leave the patient a paraplegic or a quadriplegic if left untreated.

The other is for superior vena cava (SVC) obstruction. This is where disease in the mediastinum is reducing blood flow. The patient will present with shortness of breath, swelling and discolouration of the skin in the head, arms and chest above the site of obstruction.

Extremities: Humerus

The patient will be positioned with the ipsilateral arm **'akimbo'**. This is a position where the arm is abducted away from the chest wall (like putting your hand on your hip) in order to minimise dose to the adjacent chest wall.

A **lymphatic strip** will also be required for drainage, i.e. sparing a strip of skin on the medial edge of the arm.

Opposing anterior and posterior photon fields will be used.

A consideration for these patients, and/or if you are treating their forearm, is missing the side rails of the bed with the posterior field.

References to consider recording in simulation include:
-SN (sternal notch)/tip of shoulder
-Tip of elbow/chest wall
-Chin-chest
-RL = for example, 15 cm to left of ML (mid line) at SN level through to mid elbow
-Tattoos will be at SN level/RL, Isocentre/RL, and possibly Lower Level (LL)/RL

The SN/tip of shoulder measurement is required to reproduce the shoulder position.

Placing the isocentre according to a tattoo/skin mark is irrelevant if the patient shrugs their shoulder.

The tip of elbow to chest wall measurement will control the arm position, ensuring that the treatment area is correct.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Extremities: Forearm

The patients' forearm should be placed in a position that is comfortable and away from the body.

A reference line will be required, possibly from mid-separation elbow through to mid-separation wrist. Other anatomical references are epicondyles on the wrist. A series of tattoos/skin marks will be required to ensure the same RL is obtained on each day of treatment.

Extremities: Femur

A patient may have radiation to the femur either pre- or post- operatively, or with no surgery planned.The size of the field may depend on whether surgery has or has not been performed.

If not, the metastases and a margin around the lesion will be treated: Shielding may be positioned superior-medially to minimise bowel and bladder toxicity. Diarrhoea and cystitis may be experienced if included within the pelvic region of the fields.

If a pin has been surgically inserted (either due to pathological fracture or prophylactically), then it is possible that tumour cells will have been forced down the femoral shaft by the pin. The lower level of the field will therefore need to cover the inferior end of the pin, plus a margin.

Extremities: Femur (cont)

A strip of skin also needs to be spared from the radiation field. If the entire circumference of the leg is treated, the lymphatic drainage will be impaired, resulting in severe swelling of the limb (lymphoedema). This is often called **'ring barking'**. This scenario is unacceptable from a patient's quality of life perspective, and should be avoided at all costs.

The femur and lower pelvis are centrally located (in the anterior- posterior plane), and are therefore treated with opposing anterior and posterior photon fields.

Patients are positioned supine, with a bolster under their knees and some form of foot separation device to maintain the leg position.

Landmarks:

UBP/ML (upper border pubis/midline) and location from anterior commissure (Ant Comm.) or **Base of Penis (BOP)**; and

Reference line (RL) – established to ensure that the leg position is maintained. For example, a reference line could be established of 10 cm to the left of ML at UBP through to midseparation patella.

When a full femur is being treated, the length of the field is often longer than can be achieved with the standard jaw setting (especially when the hemi-pelvis is also encompassed in the field).

Extremities: Femur (cont)

This problem can be overcome by using an extended **SSD technique**. By moving the patient away from the radiation source, the x-rays diverge to give an effectively larger field size.

To achieve this, the SSD is typically set (known as fixed SSD) to 120 or 130 cm. (Compare this to having an isocentric technique with 100 at the isocentre and an SSD of approximately 90 cm.

Management Strategies: Radiation Therapy

Palliative radiation therapy is aimed at relieving local symptoms of advanced disease.

When deciding on the dose to be prescribed to a patient the following points are some to be considered by the radiation oncologist:

prognosis
ECOG status
proximity to services
social circumstances
carers and support services
side effects
patient wishes
Radiation Oncologist preferences

Overlap of the area to be treated with previous areas of irradiation is of concern for any patient.

It is a regular occurrence that patients who have developed bony metastases require ongoing radiation treatment as further metastases arise. The details of previous treatment need to be known and mapped out to determine potential overlap.

This will help to establish if the patient can safely receive further treatment, particularly with metastases to vertebral bodies where the underlying critical structure is the spinal cord.

For most palliative treatments, side effects from the treatment should be minimal.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Management Strategies: Radiation Therapy (cont)

Patients rarely experience erythema due to the lower doses being below skin tolerance. Most patients will experience tiredness. However, it is difficult to distinguish between radiation induced symptoms and those associated with the disease itself.

There will be a range of dose prescriptions, incorporating these considerations:
30 Gy in 10 fractions, 5 fractions per week
20 Gy in 5 fractions, 5 fractions per week
8 Gy in a single fraction

Radiation therapy is a proven effective palliative treatment option for many tumour sites and metastatic disease symptoms.

Treatment and Planning considerations

Radiation Therapy for metastatic disease covers many anatomical sites. However, there are some underlying principles that can be applied to all sites. To meet patient positioning principles it is important that the patient is as comfortable as possible.

Simulation for all treatment sites, information to be recorded is as follows:

-patient position including: vertical baselines (VBL); reference lines (RL)
-stretches (the distance between two anatomical landmarks);
-CT slice at 'zero' location or imaging centre, referenced to an anatomical landmark;
-position of tattoos or skin marks

Management Strategies: Radiation Therapy (cont)

It is important to record the isocentre position relative to bony structures.If there is a query about where the isocentre is when the patient is about to be treated, you can always refer to the anatomical references to avoid discrepancies.

The baselines and reference lines selected should be perpendicular to each other and any measurements from those lines to CT reference points or isocentre should be perpendicular also.

Lung metastases Management Strategies

The following criteria should be applied to achieve good palliation:

-prompt relief of symptoms
-minimal toxicity from treatment
-simple treatment technique
-minimal number of treatment fractions

Patients with metastatic cancers often have multiple symptoms including; pain, anorexia, vomiting, weight loss, dysphagia, dyspnea, fatigue, depression, anxiety.

Pain is the most important symptom of patients with metastatic cancer, as pain interferes with mobility, sleep and psychological issues.

80-90% of pain can be successfully controlled with oral analgesia or adjuvant medication. 10-20% of patients have pain which is difficult to control and resistant to opioid analgesia.

Lung metastases Management Strategies (cont)

Patients with metastatic disease may experience pain crises, characterised by acute onset of a new pain quality. This may be due to a pathological fracture, spinal cord compression, intestinal obstruction or perforation, vascular complication, other complications or acute breakthrough of pre-existing constant pain.

A thorough history and clinical examination can sufficiently classify the main patho-physiological type of pain. These pain types may be **neuropathic, nociceptive, visceral or somatic** pain.

This differentiation may aid selection of adequate analgesics, comedication, and help assessment of the underlying cause and the most appropriate treatment options.

Some complications such as spinal cord compression require urgent assessment and treatment of neurological function is to be improved or retained. The three factors that can assist in the choice of treatment management for metastatic disease include:

1. The **tumour**: the site, size, spread, operability, radiosensitivity, chemo-sensitivity, and histology all need to be considered.

2. The **patients factors** include; age and general condition (physical and mental), morbidity and mortality, function and cosmesis, reliability of follow up after treatment, patient preference.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Lung metastases Management Strategies (cont)

3. The **resources available**: Most oncological treatments require technical expertise, experience and specialist equipment. The availability of these resource requirements may influence treatment management options when patients are unable to travel, or are living in rural or regional areas where specialist treatment may not be available.

Lung metastases

The lungs are a common site for metastatic disease.

Primary tumours that commonly spread to the lungs include: breast, colorectal, lung, testicular, pancreatic, oesophageal, stomach, ovarian, renal cell and prostate carcinomas, osteogenic and soft tissue sarcomas, and melanoma.

Metastatic cells from both local and distant sites can reach the lungs via **haematogenous pathways**, developing into secondary tumours within the parenchyma, large airways, hilar and mediastinal lymph nodes, lymphatic vessels or pleura.

Pulmonary haematogenous spread occurs most commonly from tumours that have direct venous drainage into the lungs, such as head and neck, kidney, testis, melanoma, and osteosarcoma's.

Lymphatic metastasis occurs as tumour cells travel via lymph nodes and lymphatic vessels.

Tumour emboli may become trapped in an individual lymph node, or may bypass certain nodes and become established in distant nodal sites called **"skip" metastasis**.

Lung metastases (cont)

Metastatic cells from primary lung tumour sites often spread to hilar and then mediastinal nodes, thus resulting in a higher disease stage with fewer therapeutic options and a poorer prognosis.

Diagnostic investigations for metastatic lung cancer may include: chest x-ray; CT; bronchoscopy; sputum cytology (examines a sample of sputum (mucus) under a microscope); CT guided needle biopsy; thoracoscopy; mediastinoscopy

Symptoms of pulmonary metastasis are uncommon and are related to tumour size and location: cough; wheezing; haemoptysis (coughing up blood); dyspnea (shortness of breath); fatigue and; chest pain.

Palliative laser therapy can provide rapid relief for dyspnea and haemoptysis if due to disease in the trachea or main bronchi.

In certain circumstances single or multiple pulmonary metastases can be **surgically removed**, surgery does depend on the tumour size, location, nodal involvement, the patients ECOG performance status and other co-morbities.

Treatment with **chemotherapy and/or biological agents** is used when a patient is not an optimal surgical patient or when surgery would be ineffective in removing all the cancer, such as in instances of mediastinal, lymphangitic, or pleural metastasis.

External beam radiation therapy (EBRT) is helpful in relieving symptoms from metastatic lung disease. Studies have shown a single fraction of **endobronchial high dose rate (HDR) brachytherapy** to be as effective as EBRT.

Lung metastases (cont)

Generally radiation therapy is used infrequently to treat pulmonary metastasis, except in lung cancer, and is reserved for palliation for cough, haemoptysis, or pain.

Obstructive lesions may shrink with radiation therapy, depending on tumour histology. Shrinking of a lesion may relieve dyspnea or facilitate drainage of a post-obstructive infection.

Management strategies of brain metastasis

Radiation therapy is the treatment of choice includes: Whole brain irradiation; Stereotactic irradiation

Surgery
Chemotherapy – limited use
Corticosteroids

There are several **factors to consider in determining the best treatment** for each individual patient. These factors are: the extent of systematic disease, the patients' general condition or ECOG status, the number and site of the metastases, the patients' age and the patients' neurological status at diagnosis.

If the patient is terminally ill, relief of intracranial pressure by steroids alone (dexamethosone 4mg orally) may be all that is appropriate.

Whole Brain Irradiation Treatment and Planning

Depending on the patient's condition, the radiation oncologist will prescribe either 20 Gy in five fractions or 30 Gy in 10 fractions prescribed to midplane.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com

Management strategies of brain metastasis (cont)

The skull is treated with opposing lateral photon fields to deliver an even dose throughout the brain.

The **intent of the treatment** is **palliative** to relieve the patient of their neurological symptoms. Their prognosis remains poor.

Median survival post-whole brain radiotherapy ranges from three to six months for patients with multiple metastases.

An oncologist may prescribe a boost when the patient has demonstrated a good response and there is a solitary metastasis. This boost may be treated with external beam, or the other option is stereotactic radiation therapy.

An anatomical baseline of **SOM (superior orbital margin)** to **ITN (inferior tragal notch)** will ensure that the base of skull is vertical.

If this baseline is not achievable the jaws can be rotated so the inferior beam edge remains the same, or an alternate baseline can be chosen and MLC collimation employed to shield the eyes and oral cavity.

ATN (anterior tragal notch) levels are equivalent. A non-divergent inferior field edge is desirable to ensure the lens dose is kept to a minimum.

These patients have a limited prognosis, but if they live long enough to develop cataracts, their quality of life will usually be poor.

The radiation field will include the entire brain, so the anterior, posterior and superior field edges will overshoot the patient's profile.

Management strategies of brain metastasis (cont)

If the isocentre is on the vertical baseline (VBL), ATN and ML, asymmetric collimation can be used to achieve this. Two opposing lateral fields ensure that an even dose is delivered throughout the skull. If the patient has metastases in the cerebellum, the lower level of the field needs to be increased by a few centimetres, which would then irradiate the eyes and some of the nasal cavity. If this is the case, the eyes will need to be shielded.

Verification images will be taken on the first day, or daily pre-treatment (centre dependent) to ensure adequate treatment of the brain. The patient may experience some headaches during treatment due to swelling of the brain. The patient may be already experiencing these, in which case the oncologist would have prescribed a steroid drug such as Dexamethosone. Other side effects are tiredness, slight erythema and alopecia (hair loss).

Brain metastases

A number of cancers develop metastases that migrate to the brain. (i.e lung, breast, melanoma and sometimes renal)

Brain metastases may be detected at the same time the primary tumour is diagnosed (**synchronous presentation**) or as is the case for over 80% of cases, the brain metastases develop after the primary is diagnosed (**metachronous presentation**).

Most tumours reach the brain by **haematogenous spread**, usually through arterial circulation.

Brain metastases (cont)

Intracranial metastases may occur in the meninges, brain or the skull. 80% of brain metastases occur in the cerebral hemispheres and 16% in the cerebellum. Rarely deposits may occur in the basal ganglia, brainstem, pituitary gland and the choroid plexus.

Diagnosis: The patient will normally present with symptoms such as headaches, raised intracranial pressure, physical weakness/-paralysis, vision and speech difficulties.

physical examination testing reflexes; a neurological examination; CT; Contrast enhanced MRI; Arteriography (radiography of an artery); Biopsy

The treatment of brain metastases is virtually always palliative.

By **Molly**
cheatography.com/molly/

Not published yet.
Last updated 24th October, 2016.

Sponsored by **ApolloPad.com**
Everyone has a novel in them. Finish Yours!
https://apollopad.com