Management of oncological emergencies on the acute take

ABSTRACT

In 2008, recommendations from the National Confidential Enquiry into Patient Outcome and Death identified large variations in the quality and safety of delivery of systemic anti-cancer therapy. In 49% of cases it was felt there was room for improvement and in 27% of cases treatment actually caused or hastened death. Every hospital with an emergency department and/or specialist oncology beds should therefore have a fully functioning acute oncology service to align acute oncology with urgent care. Many patients will still present via the acute take and therefore acute physicians need to be aware of the role of the acute oncology teams and management of oncology emergencies. This article discusses the role of the acute oncology team, management of acute oncology emergencies, namely neutropenic sepsis, metastatic spinal cord compression and superior vena cava obstruction, and important points for acute teams to consider.

Every 2 minutes in the UK someone is diagnosed with cancer and the incidence rate is expected to rise by 2% before 2035 (Cancer Research UK, 2018). In 2014, 28% of patients diagnosed with cancer were treatment with chemotherapy (Public Health England, 2018). Arising from this are potentially lethal complications such as neutropenic sepsis which carries a high mortality rate. Treatments and regimens are becoming more complex and have their own unique side effects. Prompt recognition and assessment of patients at risk is vital to optimize outcomes.

While the majority of patients are diagnosed via the 2-week wait referral route, around 21% of cases still present as emergencies. These patients are not previously known to oncology teams and often present with late stage disease and the accompanying poor prognosis (National Cancer Registration and Analysis Service, 2016). These presentations included patients with metastatic spinal cord compression, of which 23% do not have a prior diagnosis of cancer (Levack et al, 2002). The potential for burden on the NHS is therefore significant and the cost of cancer care goes far beyond the initial treatment. Macmillan Cancer Support (2015) estimate that supporting cancer patients following their initial treatment will cost the NHS at least £1.4 billion every year by 2020.

This article discusses the role of the acute oncology team, management of acute oncology emergencies and important points for acute teams to consider.

Dr Romy Ni Chleirigh, Junior Clinical Fellow, Rosemere Cancer Centre, Lancashire Teaching Hospitals NHS Trust, Fulwood, Preston

Dr Simon Gray, Foundation Doctor, Rosemere Cancer Centre, Lancashire Teaching Hospitals NHS Trust, Fulwood, Preston

Dr Catherine C Mitchell, Consultant Oncologist, Rosemere Cancer Centre, Lancashire Teaching Hospitals NHS Trust, Fulwood, Preston PR2 9HT

Correspondence to: Dr CC Mitchell (catherine.mitchell@lthtr.nhs.uk)

Role of the acute oncology team

In 2008 the National Confidential Enquiry into Patient Outcome and Death identified large variations in the quality and safety of services delivering systemic anti-cancer therapy – in 49% of cases it was felt there was room for improvement and in 27% of cases treatment actually caused or hastened death (National Confidential Enquiry into Patient Outcome and Death, 2008). Most patients were presenting to urgent care services rather than oncology and so recommendations focused on service improvement with an urgent need for leadership, governance and monitoring. Acute oncology teams were formed, using expertise from oncology, palliative care, general and emergency medicine. They aim to encompass patients presenting with treatment-related complications, disease-related complications or emergency presentations of suspected malignancy. As well as providing specialist input, acute oncology teams are able to impact on length of stay. The Clatterbridge team demonstrated a reduction in average stay for oncology patients from 12.8 days to 9.7 days (Neville-Webb et al, 2013).

In 2017 the advice for acute oncology service commissioning was updated. Despite measures introduced in response to the 2008 guidance there is still a large variation in acute oncology service (NHS England, 2013). Every hospital with an emergency department and/or specialist oncology beds should have a fully functioning acute oncology service to align acute oncology with urgent care (Young et al, 2016). Three areas were made key priorities:

1. Reducing the number of oncology patients presenting via emergency pathways
2. Reducing variation in practice
3. Achieving best practice.

Eight key outcome measures were identified which acute oncology teams will be monitoring:

1. Admission avoidance
2. Hospital length of stay
3. 30-day readmission rate
4. Mortality within 30 days of administration of systemic anti-cancer therapy
5. Neutropenic sepsis mortality
6. Metastatic spinal cord compression outcomes

7. Patient experience
8. Emergency admissions and presentation of new cancers.

Neutropenic sepsis

Neutropenic sepsis is a potentially lethal complication of anti-cancer treatment, carrying high mortality rates; as such it should be treated as a medical emergency. Mortality from neutropenic sepsis more than doubled between 2001 and 2010 (National Institute for Health and Care Excellence, 2012), a fact attributed to higher rates of cancer in an ageing population, the increasingly widespread use of chemotherapy, and potentially more accurate death certification.

Neutropenic sepsis is defined as a neutrophil count $<0.5x10^9$/litre combined with either a temperature of >38°C or signs and symptoms of sepsis (National Institute for Health and Care Excellence, 2012). Neutropenia most commonly occurs 5–7 days post-chemotherapy (Clarke et al, 2013), although clinicians should have a low index of suspicion for neutropenic sepsis in any patient who has had anti-cancer treatment in the last 6 weeks (UK Oncology Nursing Society, 2018).

Patients with neutropenic sepsis can often appear well at presentation with few or no signs of infection, as the systemic inflammatory response which produces initial symptoms is compromised in these immunosuppressed patients (Alonso and Corral, 2016). Despite initially appearing well, they may deteriorate rapidly; the following risk factors can help raise suspicion and hasten treatment – increasing age, advanced disease, previous episodes of febrile neutropenia, poor performance status, cardiovascular disease, and multiple comorbidities (Lyman et al, 2014).

Patients should be screened for sepsis with a NEWS (National Early Warning Score) and blood tests including lactate. Patients recognized as having recently had anti-cancer treatment (within 6 weeks) should then be treated for red flag sepsis and the sepsis 6 (The Royal College of Emergency Medicine and The UK Sepsis Trust, 2016) should be initiated within the first hour. A raised lactate level (>2 mmol/litre) indicates increased risk of severe sepsis and septic shock (Heinz et al, 2017) and this knowledge may prompt early discussion with intensive care. The UK Sepsis Trust red flags for sepsis are reflected in National Institute for Health and Care Excellence (2016) guidance as factors indicating a high risk of sepsis. Recent chemotherapy or anti-cancer treatment should be included as a red flag on all sepsis pathways.

In the absence of signs and symptoms of a respiratory infection, abnormalities on a chest X-ray will be found in less than 2% of patients with febrile neutropenia, so chest X-rays are not recommended routinely (Heinz et al, 2017). Other factors indicating later complications are the patient's comorbidities, acute hepatic or renal dysfunction, and prolonged neutropenia (Alonso and Corral, 2016).

Treatment should be started as soon as neutropenic sepsis is suspected, without waiting for confirmation of neutropenia. Antibiotics must be given within the first hour of presentation (National Institute for Health and Care Excellence, 2012), as door-to-needle time of under 1 hour is associated with improved survival for severely septic patients (Rhodes et al, 2017). A beta-lactam antibiotic such as piperacillin with tazobactam should be used first line as monotherapy in the absence of contraindications (National Institute for Health and Care Excellence, 2012). The acute oncology and microbiology teams should also be contacted whenever neutropenic sepsis is suspected to allow early specialist advice and facilitate early specialist review.

If a patient is clinically stable it is not always necessary to remove central venous access devices. Keeping the device in situ maintains access while minimizing further invasive procedures, but removal may be indicated if there is microbiological evidence of a line infection, evidence of septic shock or of clinical deterioration (Hentrich et al, 2014). These potential risks and benefits should be weighed when managing patients with central venous access devices.

The use of granulocyte-colony stimulating factor in neutropenic sepsis is controversial and not routinely recommended at present. Although administration of granulocyte-colony stimulating factor can reduce the period of neutropenia and therefore potentially shorten a hospital admission, it does not significantly affect mortality from neutropenic sepsis (Mhaskar et al, 2014). Its side-effect profile is also considerable and includes bone pain, nausea, headache and fatigue.

As neutropenic sepsis is an increasing issue, hospitals across the UK are evaluating and auditing their practice. The introduction of acute oncology teams as well as the use of integrated sepsis guidelines has helped improve management of neutropenic sepsis with significant improvement in door-to-needle times (Forde and Scullin, 2017; Wild, 2017) and reduction in mortality rates from neutropenic sepsis (Wells et al, 2015).

Metastatic spinal cord compression

Metastatic spinal cord compression is an oncological emergency which occurs when the dural sac and its contents are compressed by an extradural, or rarely an intradural, mass. Neurological damage follows, which may progress to irreversible paraplegia or tetraplegia depending on the location of the causative lesion. Incidence of metastatic spinal cord compression is estimated at approximately 4000 cases each year in England and Wales, and this is expected to rise together with cancer survival times (National Institute for Health and Care Excellence, 2008). A GP serving an average-sized patient population will therefore see a case of metastatic spinal cord compression approximately every 2 years (Baird et al, 2016). Audit data from the USA suggest that 23% of patients with metastatic spinal cord compression do not have a prior diagnosis of cancer (Levack et al, 2002), and while cancers of prostate, lung and breast are each responsible for 15–20% of cases of metastatic spinal cord compression, almost any systemic cancer may metastasise to the spine (Savage et al, 2014).

Distinguishing clinically between simple back pain, pain from non-compressive spinal metastasis and metastatic

spinal cord compression can be challenging. Features which raise suspicion of spinal metastasis include known cancer diagnosis, persistent severe back pain, pain in the cervical or thoracic regions, and pain aggravated by raised intra-abdominal pressure. Metastatic spinal cord compression is suggested by superadded neurological symptoms including any limb weakness or difficulty walking, any sensory deficit or radicular pain, and any dysfunction of the bowel or bladder. All cancer patients with back pain should be reviewed frequently to discern whether any of the above features have developed, or progressed. There is a focus on educating patients with worrying symptoms to present at the earliest opportunity, which is facilitated by use of patient information leaflets and direct counselling. *Table 1* highlights the impact of presenting early on patients' later functional status.

Where metastatic spinal cord compression is suspected, a designated metastatic spinal cord compression coordinator should be contacted immediately and imaging performed within 24 hours. If non-compressive spinal metastasis is suspected, the coordinator should be contacted within 24 hours and imaging is recommended within 7 days. Magnetic resonance imaging of the whole spine is the modality of choice as 30–50% of patients have multi-level metastatic involvement and the metastatic spinal cord compression coordinator should offer guidance where magnetic resonance imaging is contraindicated; plain radiographs have no role in diagnosing metastatic spinal cord compression or spinal metastasis. Situations where it may be desirable to palliate rather than to investigate and treat include patients with an overall prognosis of days to weeks from known disease and poor baseline performance status, providing the situation has been fully discussed with the patient; in these cases empirical corticosteroids may be the favoured management option (National Institute for Health and Care Excellence, 2008; Al-Qurainy and Collis, 2016).

Table 1. Functional status of patients with metastatic spinal cord compression at presentation to Lancashire Teaching Hospitals Foundation Trust and 3 months post presentation after therapy between 2013 and 2016

Functional grade at presentation	Number of patients	Functional grade at 3 months	Number of patients
Walking unaided	57	Walking unaided	52
		Walking aided	3
		Wheelchair bound	1
		Paraplegic	1
Walking aided	32	Walking unaided	7
		Walking aided	21
		Wheelchair bound	4
Wheelchair bound	15	Walking unaided	6
		Walking aided	4
		Wheelchair bound	4
		Paraplegic	1
Paraplegic	12	Walking unaided	1
		Walking aided	3
		Wheelchair bound	1
		Paraplegic	7

Patients with signs of either metastatic spinal cord compression or spinal instability should be nursed flat with neutral spine alignment, including 'log rolling' where necessary, until stability of the spinal column and cord is ensured. Such patients should wear anti-embolism stockings and if judged to be high risk for venous thromboembolism and safe for anticoagulation they should also receive low molecular weight heparin.

Both neuropathic and bony pain feature in metastatic spinal cord compression; analgesia should follow the World Health Organization pain relief ladder, with non-steroidal anti-inflammatory drugs, non-opiate and opiate agents prescribed in ascending doses as needed. Neuropathic analgesia represents a further useful adjuvant, and bony pain often responds well to corticosteroids (covered below). Consider specialist pain team review if severe pain persists despite giving appropriate analgesia (National Institute for Health and Care Excellence, 2008; Al-Qurainy and Collis, 2016).

Dexamethasone is widely used in patients with metastatic spinal cord compression as it confers short-term improvement of neurological function in addition to any analgesic effect (Skeoch et al, 2017). An initial dose of 16 mg should be offered to all patients with metastatic spinal cord compression unless contraindicated (suspicion of lymphoma is a contraindication), and continued daily during treatment planning and while awaiting definitive treatment; if definitive treatment is not considered appropriate after planning, dexamethasone should be gradually reduced and stopped.

Surgical procedures have a role in the management of spinal metastasis without metastatic spinal cord compression; consider patients with spinal instability for urgent surgery to prevent metastatic spinal cord compression. Spinal surgery may benefit patients without spinal instability but who have analgesia-resistant pain or vertebral body collapse; metastatic spinal cord compression patients with complete paraplegia or tetraplegia for over 24 hours may still benefit from surgery as a means of improving poorly-controlled pain. Various scoring systems exist for the preoperative prognostic assessment of patients with spinal metastasis, of which the Tokuhashi system is a useful example (Tokuhashi et al, 2014); spinal stability scoring systems such as the Spinal Stability Neoplastic Score have been developed and shown to be reliable (Fox et al, 2017).

Definitive treatment of metastatic spinal cord compression is with surgery or radiotherapy – the former aims to achieve cord decompression and durable spinal

column stability, and the latter is chosen if patients are unsuitable for surgery. Once the diagnosis of metastatic spinal cord compression is confirmed, definitive treatment of patients should ideally begin within 24 hours to prevent further neurological deterioration. Selection for type of definitive treatment focuses on patient variables (functional status, general health, overall prognosis and fitness for anaesthetic) and disease variables (tumour histology and stage). Exceptions to the rule of urgent definitive treatment are patients with complete paraplegia or tetraplegia for over 24 hours whose pain is well controlled, and patients with very poor overall prognosis (National Institute for Health and Care Excellence, 2008).

Superior vena cava obstruction

Superior vena cava obstruction is the clinical manifestation of compression or obstruction of the thin-walled, compliant superior vena cava; while superior vena cava obstruction can significantly impact patients' prognosis, it is considered an emergency only when it causes tracheal compression and airway compromise. Principal causes of superior vena cava obstruction are lung cancer, lymphoma and metastatic disease, with smaller contributions from primary mediastinal cancers and from non-malignant causes such as tuberculosis, thyroid goitre and central line thrombosis.

Clinical features of superior vena cava obstruction can be graded, with severe or life-threatening cases indicated by signs of cerebral oedema (headache and dizziness progressing to confusion and obtundation) and laryngeal oedema which causes stridor when severe. Another worrying feature is haemodynamic compromise, expressed as hypotension or syncope which may be unprovoked or provoked by the patient bending over.

A chest X-ray can identify masses within, or widening of, the mediastinum but computed tomography is the preferred imaging modality to identify the level and the degree of any obstruction, and will also reveal any superior vena cava thrombus and collateral vessel formation (Foy and Kurup, 2016).

Initial management of superior vena cava obstruction should be with supplementary oxygen, head elevation and analgesia, with particular attention to avoiding over-sedation. Dexamethasone 16 mg daily is commonly used to provide a degree of symptomatic relief. In life-threatening malignant superior vena cava obstruction, urgent percutaneous superior vena cava stenting is indicated.

Patients presenting without airway compromise should have tumour biopsy and staging with formation of a definitive treatment plan which may feature a combination of chemotherapy, radiotherapy and adjunctive stenting (Foy and Kurup, 2016).

Specific chemotherapy side effects

During the consent process patients are educated as to the specific side effects of their systemic anti-cancer therapy and information leaflets should be given. Patients should be aware of the common side effects but also of rare but serious adverse outcomes (General Medical Council, 2018). The Macmillan Cancer Support website lists 122 different chemotherapy regimens (Macmillan Cancer Support, 2018) and there are many different protocols for use. Having a clear understanding of all potential side effects is therefore difficult for medical physicians on a busy acute take. The acute oncology service should be able to provide support 24-hour-a-day, 7-days-a-week to advise on specific management. If there are concerns that systemic anti-cancer therapy may be contributing to a particular presentation then this systemic anti-cancer therapy should be withheld until further advice is available. Be aware that patients may be very reluctant to miss a chemotherapy dose, and may not disclose its use when asked for their medication history. Oral chemotherapy agents will not be included in medication lists and patients may not view this as something they need to mention to the medical teams. Equally, examining for intravenous access lines may reveal a chemotherapy pump which the patient did not initially acknowledge.

Conclusions

The acute oncology service aims to reduce the number of oncology patients presenting via emergency pathways, reduce variation in practice and provide advice. Going forward the acute oncology service will hope to reduce admissions, reduce length of stay and 30-day mortality.

Mortality from neutropenic sepsis more than doubled between 2001 and 2010 (National Institute for Health and Care Excellence, 2012). Neutropenic sepsis should therefore be treated as red flag sepsis with rapid initiation of the sepsis-6, including antibiotics, within 1 hour.

Around a quarter of patients with metastatic spinal cord compression will not have a prior cancer diagnosis and therefore present via the acute take. Metastatic spinal cord compression needs to be managed with magnetic resonance imaging of the whole spine within 24 hours as 30–50% of patients have multi-level disease. Rapid initiation of definitive treatment is required to preserve functional outcome.

The severity of superior vena cava obstruction should be assessed to see if there is time for the formation of a definitive treatment plan. These cases should have tumour biopsy, staging and a treatment plan which may feature a combination of chemotherapy, radiotherapy and adjunctive stenting.

Patients on any form of chemotherapy who present as unwell should have their chemotherapy stopped and discussed with the acute oncology team.

Acute oncology service support should available 24/7 in every hospital with an emergency department and/or specialist oncology beds. **BJHM**

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Al-Qurainy R, Collis E. Metastatic spinal cord compression: diagnosis and management. BMJ. 2016 May 19;353:i2539. https://doi.org/10.1136/bmj.i2539

Alonso M, Corral J. 2016. Febrile Neutropenia in Cancer Patients. ESMO handbook of Oncological Emergencies. Viganello-Lugano,

KEY POINTS

- Every trust with an emergency department should have a readily contactable acute oncology service who should offer advice or review patients within 24 hours
- Treat neutropenic sepsis as red flag sepsis with rapid initiation of the sepsis-6, including antibiotics, within 1 hour.
- Metastatic spinal cord compression needs to be treated as an oncological emergency with magnetic resonance imaging of the whole spine within 24 hours and rapid initiation of definitive treatment.
- The severity of superior vena cava obstruction should be assessed in order to determine if there is time for the formation of a definitive treatment plan.
- Patients on any form of chemotherapy who present as unwell should have their chemotherapy stopped and be discussed with the acute oncology team.

Switzerland: ESMO Press. 21: 208–218

Baird B, Charles A, Honeyman M et al. 2016. Understanding pressures in general practice. London: King's Fund

Cancer Research UK. 2018. Cancer Incidence Statistics. (accessed 12 February 2018) http://www.cancerresearchuk.org/health-professional/cancer-statistics/incidence#heading-Zero

Clarke R, Jenyon T, van Hamel Parsons V, King AJ. Neutropenic sepsis: management and complications. Clin Med (Lond). 2013 Apr;13(2):185–187. https://doi.org/10.7861/clinmedicine.13-2-185

Forde C, Scullin P. Chasing the Golden Hour – Lessons learned from improving initial neutropenic sepsis management. BMJ Qual Improv Rep. 2017 Mar 31;6(1). pii: u204420.w6531. https://doi.org/10.1136/bmjquality.u204420.w6531

Fox S, Spiess M, Hnenny L, Fourney DR. Spinal Instability Neoplastic Score (SINS): reliability among spine fellows and resident physicians in orthopedic surgery and neurosurgery. Global Spine J. 2017 Dec;7(8):744–748. https://doi.org/10.1177/2192568217697691

Foy V, Kurup R. 2016. Superior Vena Cava Syndrome. In: Pulla MP, ed. ESMO Handbook of Oncological Emergencies. Viganello-Lugano, Switzerland: ESMO Press. 3:30–38

General Medical Council. 2018. Discussing side effects, complications and other risks. (accessed 26 February 2018) https://www.gmc-uk.org/ethical-guidance/ethical-guidance-for-doctors/consent/part-2-making-decisions-about-investigations-and-treatment#paragraph-28

Heinz WJ, Buchheit D, Christopeit M et al. Diagnosis and empirical treatment of fever of unknown origin in adult neutropenic patients: guidelines of the Infectious Diseases Working Party of the German Society of Haematology and Medical Oncology. Ann Hematol. 2017 Nov;96(11):1775-1792. doi: 10.1007/s00277-017-3098-3

Hentrich M, Schalk E, Schmidt-Hieber M et al; Infectious Diseases Working Party of the German Society of Hematology and Medical Oncology. Central venous catheter-related infections in hematology and oncology: 2012 updated guidelines on diagnosis, management and prevention by the Infectious Diseases Working Party of the German Society of Hematology and Medical Oncology. Ann Oncol. 2014 May 01;25(5):936–947. https://doi.org/10.1093/annonc/mdt545

Levack P, Graham J, Collie D et al; Scottish Cord Compression Study Group. Don't wait for a sensory level--listen to the symptoms: a prospective audit of the delays in diagnosis of malignant cord compression. Clin Oncol. 2002 Dec;14(6):472–480. https://doi.org/10.1053/clon.2002.0098

Lyman GH, Abella E, Pettengell R. Risk factors for febrile neutropenia among patients with cancer receiving chemotherapy: A systematic review. Crit Rev Oncol Hematol. 2014 Jun;90(3):190–199. https://doi.org/10.1016/j.critrevonc.2013.12.006

Macmillan Cancer Support. 2015. Cancer Cash Crisis. (accessed 12 February 2018) https://www.macmillan.org.uk/documents/campaigns/cancercashcrisisreport-macmillandecember2015.pdf

Macmillan Cancer Support. 2018. Chemotherapy Drugs and Combination Regimens. (accessed 26 February 2018) https://www.macmillan.org.uk/information-and-support/treating/chemotherapy/drugs-and-combination-regimens

Mhaskar R, Clark OA, Lyman G, Engel Ayer Botrel T, Morganti Paladini L, Djulbegovic B. Colony-stimulating factors for chemotherapy-induced febrile neutropenia. Cochrane Database Syst Rev. 2014 Oct 30;(10):CD003039. doi: 10.1002/14651858.CD003039.pub2

National Cancer Registration and Analysis Service. 2016. Routes to diagnosis. (accessed 14 February 2018) http://www.ncin.org.uk/publications/routes_to_diagnosis

National Confidential Enquiry into Patient Outcome and Death. 2008. For better, for worse? A review of the care of patients who died within 30 days of receiving systemic anti-cancer therapy. London: National Confidential Enquiry into Patient Outcome and Death

National Institute for Health and Care Excellence. 2008. Metastatic spinal cord compression in adults: risk assessment, diagnosis and management. Clinical guideline [CG75]. (accessed 14 February 2018) https://www.nice.org.uk/guidance/cg75

National Institute for Health and Care Excellence. 2012. Neutropenic sepsis: prevention and management of neutropenic sepsis in cancer patients. Clinical guideline [CG151]. (accessed 14 February 2018) https://www.nice.org.uk/guidance/cg151

National Institute for Health and Care Excellence. 2016. Sepsis: recognition, diagnosis and early management. Clinical guideline [NG51]. (accessed 14 February 2018) https://www.nice.org.uk/guidance/ng51

Neville-Webbe H, Carser J, Wong H, Andrews J, Poulter T, Smith R, Marshall E. The impact of a new acute oncology service in acute hospitals: experience from the Clatterbridge Cancer Centre and Merseyside and Cheshire Cancer Network. Clin Med (Northfield Ill). 2013 Dec 01;13(6):565–569. https://doi.org/10.7861/clinmedicine.13-6-565

NHS England. 2013. National Peer Review Report: Acute Oncology Cancer Services Report 2012/2013. (accessed 23 May 2018) https://www.cquins.nhs.uk/documents/resources/reports/2013/Acute Oncology NCPR Report September 2013.pdf

Public Health England. 2018. National Cancer Registration and Analysis Service Short Report: Chemotherapy, Radiotherapy and Surgical Tumour Resections in England: 2013-2014 (V2). (accessed 14 February 2018) http://www.ncin.org.uk/view?rid=3459

Rhodes A, Evans L, Alhazzani W et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. Intensive Care Med. 2017 Mar;43(3):304-377. https://doi.org/10.1007/s00134-017-4683-6

Savage P, Sharkey R, Kua T et al. Malignant spinal cord compression: NICE guidance, improvements and challenges. QJM. 2014 Apr;107(4):277–282. https://doi.org/10.1093/qjmed/hct244

Skeoch GD, Tobin MK, Khan S, Linninger AA, Mehta AI. Corticosteroid treatment for metastatic spinal cord compression: a review. Global Spine J. 2017 May;7(3):272–279. https://doi.org/10.1177/2192568217699189

The Royal College of Emergency Medicine, The UK Sepsis Trust. 2016. Toolkit: Emergency Department management of Sepsis in adults and young people over 12 years- 2016. (accessed 23 May 2018) https://sepsistrust.org/wp-content/uploads/2017/08/ED-toolkit-2016-Final-1.pdf

Tokuhashi Y, Uei H, Oshima M et al. Scoring system for prediction of metastatic spine tumour prognosis. World J Orthop. 2014. 5(3): 262–271. https://doi.org/10.5312/wjo.v5.i3.262

UK Oncology Nursing Society. 2018. Acute Oncology Initial Management Guidelines. https://az659834.vo.msecnd.net/eventsairwesteuprod/production-succinct-public/e80a54a0570a470bb0cf1ab07a7644e7

Wells T, Thomas C, Watt D, Fountain V, Tomlinson M, Hilman S. Improvements in the management of neutropenic sepsis: lessons learned from a district general hospital. Clin Med (Lond). 2015 Dec;15(6):526–530. https://doi.org/10.7861/clinmedicine.15-6-526

Wild T. Improving door-to-needle times for patients with suspected neutropenic sepsis. Emerg Nurse. 2017 Nov 10;25(7):24–30. https://doi.org/10.7748/en.2017.e1755

Young A, Marshall E, Krzyzanowska M. Responding to acute care needs of patients with cancer: Recent trends across continents. Oncologist 2016; 21:301–307.