Multiple Myeloma

Introduction

Multiple myeloma is a tumour of the bone marrow cells resulting in the development of osteolytic lesions throughout the bone tissues of the body. This paper will discuss in detail the pathophysiology of multiple myeloma focusing on events taking place in the bone marrow as well as molecular factors involved in its pathogenesis. It will also discuss the role of each medication prescribed to the patient and its specific effects on the manifestations of multiple myeloma using evidence from current literature. Following this, it will describe the medical and nursing management that is required immediately following the procedure so that the patient does not develop adverse events or complications that can result in future injury to the spinal cord.

Pathophysiology of multiple myeloma

Multiple myeloma is a disorder of the plasma cells wherein monoclonal plasma cells undergo malignant proliferation and accumulate in the bone marrow. This results in the occurrence of osteolytic lesions in the bones and an increased risk of fractures, resulting in high morbidity and mortality (Terpos et al., 2018). It begins as an asymptomatic precursor state of monoclonal gammopathy where cell growth occurs without involvement of the bones or other organs. During this stage, patients are highly susceptible to fractures due to damage caused to both auxiliary and appendicular skeletal structures (Fairfield et al., 2016).

If multiple myeloma is not diagnosed and treated at this stage, it progresses to a more severe symptomatic state which is characterized by the formation of plasmacytomas or plasma cell tumours in multiple locations. This further progresses to an aggressive disease stage characterized by plasma cell leukemia (PCL), where the tumour cells enter into circulation and result in tumorous lesions at multiple locations in the body (Fairfield et al., 2016). At the molecular level, several factors are involved in the pathogenesis of multiple myeloma including reactive oxygen species, inflammatory agents, and reactive nitrogen intermediates. Factors that specifically support the growth of malignant cells in the bone marrow include chemokines, cytokines, adipokines, and growth factors produced by macrophages and neutrophils (Kuehl and Bergsagel, 2012).

Pharmacodynamic actions of prescribed medications

Zoledronic acid

Zoledronic acid is a bisphosphonate, which is considered to be the treatment of choice for multiple myeloma in preventing damage to the bones. As osteolytic lesions are visible on x-rays of the skull, ribs, and vertebrae of the patient, and the patient has sustained a spinal fracture, this medicine has been described to prevent further damage to the skeletal structures. It inhibits the action of farnesyl diphosphate synthase, thereby preventing protein prenylation, which is essential for the generation and survival of osteoclasts. When protein prenylation is inhibited, it interferes with the migration and proliferation of tumorous cells, thereby resulting in anti-tumour effects in the body. Therefore, by preventing deterioration of bone tissues, zoledronic acid has been demonstrated to reduce mortality in multiple myeloma patients (Sanfilippo et al., 2015).

Lenalidomide

Lenalidomide is the preferred drug for maintenance therapy following high dose chemotherapy and autologous stem cell transplantation. As this patient has been diagnosed with multiple myeloma, it is highly likely that he will be started on chemotherapy for his condition, and this drug will help maintain the beneficial effects of therapy in the patient. It has been demonstrated to result in high progression-free survival chances in multiple myeloma patients. It binds to the cereblon complex causing the ubiquination of substrates and transcription factors which marks them for proteosomal degradation, eventually leading to a decrease in expression of interferon regulatory factor 4. As a result, it leads to tumouricidal effects in the body through immunomodulatory effects, and activation of T cells and natural killer cells, which plays a role in eliminating disease in the body (Jackson et al., 2019).

Allopurinol

The patient’s case history indicates that his uric acid level is elevated and allopurinol is a drug that lowers the uric acid levels in the blood. Uric acid is a waste product that occurs due to an increase in cancer cells in the body, and high levels of uric acid can damage the kidneys thereby complicating the primary disorder. When the primary tumour is highly proliferative, treatment with cancer chemotherapy can result in tumour lysis syndrome, resulting in hyperuricemia in the body. Therefore, allopurinol can help control the levels of uric acid in the circulation minimizing damage to the kidneys (Eliacik et al., 2016).

Calcitonin

The patient has also been diagnosed with hypercalcemia, which often occurs in multiple myeloma due to osteoclast activation and increased bone resorption. When lesions occur on renal tubular epithelium, it results in kidney failure eventually leading to necrosis of renal epithelial cells and formation of calcium deposits in the kidney. Calcitonin is prescribed to prevent bone resorption leading to moderate hypocalcemic effects in the body. Its advantage is that it does not cause nephrotoxicity as compared to other better hypocalcemic agents, and so, it is the preferred drug for treating hypercalcemia in multiple myeloma (Mateu et al., 2011).

Ibuprofen

Ibuprofen is a non-steroidal anti-inflammatory agent and an analgesic that is used for pain management in multiple myeloma. The patient’s condition has progressed to a stage where he has fractured his spine; therefore, his condition is extremely severe and painful. Occurrence of osteolytic lesions in the bones are responsible for pain, which can be relieved by ibuprofen. Ibuprofen can cause a disturbance in the osteoblasts leading to the stem cells leaving the bone marrow and entering the blood circulation. Mobilizing hematopoietic stem cells in multiple myeloma patients can help relieve pain thereby improving their quality of life (Cunningham, 2013).

Oxycodone

Oxycodone is an opioid which is also used for pain management given the patient's susceptibility to fractures and detection of osteolytic lesions in patient x-rays. It is also safe as compared to morphine, with increased bioavailability and decreased immunosuppressive effects (Cartoni et al., 2012).

Acute medical management after decompression of spinal fracture

Following decompression of spinal fracture, it is important to medically assess the stability of the patient's spine. If the spine is found to be unstable, the surgeon may perform spinal stabilization surgery combined with spinal fusion. Spinal stabilization may involve implantation of instruments such as plates, screws, rods, and interbody cages, which provide spinal stability and the spinal fusion procedure will act as glue for these implanted instruments. Some of the spinal fusion techniques include autograft and allograft that is performed around the implanted device (Charles and Steib, 2015).

The patient will also have to undergo rehabilitation following his procedure. This may include physical strengthening and conditioning exercises such as muscle exercises and understanding how to perform daily tasks. The patient can be referred to a physical therapist who can help with regaining function, improving mobility, and preventing further complications. Some of the post-operative recommended exercises include cardiovascular exercises, strength training, respiratory conditioning, stretching, and mobility training. Other challenges the patient may face following spinal cord decompression include somatic and neuropathic pain, ventilator dependence, and psychosocial challenges, all of which will have to be medically managed by the physician (Charles and Steib, 2015).

Acute nursing management after decompression of spinal fracture

The patient is already prescribed to be on bed rest and log rolled, and this should be continued even after the procedure. After the decompression procedure, the nurse needs to position the patient such that there is minimal stress on the surgical site. The patient should be turned by log rolling every couple of hours. The patient should be advised not to try to turn by himself by taking support from the side rails as this may cause undue stress to the surgical site. The nurse should continually assess for signs of nerve root compression by checking arm strength, leg strength, motor functions, and sensory functions. The patient should also be monitored for signs of the development of a hematoma at the surgical site which may be manifested as pain and reduction in motor function. The surgical site should also be assessed for signs of leakage of cerebrospinal fluid as this may increase the chance of infection (Guo et al., 2019).

Within 8 hours of the surgery, the patient must void his bladder, otherwise he may suffer from urinary retention. During decompression surgery, sympathetic nerves are stimulated which may put the patient at risk for urinary retention, and therefore, the nurse should closely monitor fluid intake and output for 8 hours post surgery. Pain should be assessed using the pain scale and rated from 0 to 10. Vital signs should be noted every 4 hours and signs of infection should be assessed in the form of inflammation, pain, pus, and drainage. Mobility of the client should depend on the physician’s recommendation as surgery and anesthesia may make it difficult for the patient to move around (Guo et al., 2019).

Conclusion

Multiple myeloma is characterized by plasma cell tumour that primarily occurs in the bone marrow resulting in the formation of osteolytic lesions and making the bones susceptible to fractures. Different medications are prescribed that target different pathways that contribute to the development of multiple myeloma. Apart from those that help control the formation of lesions, pain relievers such as ibuprofen and opioids such as oxycodone are also prescribed for pain management. Medical assessment following the procedure requires the surgeon to look for signs of spinal instability and correct it using implantable devices and spinal fusion. Nursing care is extremely important following this procedure as it requires continual monitoring and assessment of signs of infection, pain, nerve root compression, and other complications that may arise due to this surgery.

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