Meningioma

Definition
Meningiomas are believed to originate from arachnoid cap cells because of the cytological and functional similarities between these two groups of cells. Therefore, Cushing and Eisenhardt named these types of tumors as meningiomas in 1938.

Epidemiology
Meningiomas are common tumors of the central nervous system. In the United States, the incidence rate of meningiomas is 6.84 per 100,000 people per year. Incidences of meningiomas gradually increase with age. Women have a higher incidence of developing meningiomas compared to men with a 2:1 ratio.

Pathophysiology
Arachnoid cap cells normally form a single cell layer that is close to the dura mater. With advanced age, the arachnoid cap cells cluster together and form whorls and psammoma bodies; these structures are also found in the meningiomas.

Meningiomas accounts for 20% of primary brain tumors. Most meningiomas arise in places where arachnoid villi penetrate the dura. The most common sites for meningiomas are in the olfactory groove, tuberculum sellae, parasagittal region, sylvian fissure, and cerebellopontine angle. Occasionally, meningiomas may be found in some unusual sites such as the ventricles, choroid plexus, or within the cerebral parenchyma. They are believed to arise from the perivascular arachnoidal cells. Eighty percent of the spinal meningiomas are located in the thoracic spine.

Invasion of meningiomas to the surrounding structures such as the dura, dural sinuses, skull, scalp, or orbital contents are common. Invasion makes complete excision of the tumor difficult.

The World Health Organization has identified 15 subtypes of meningiomas and classified them into three grades based on histopathological variables. Most meningiomas belongs to Grade I (approximately 80%), they are encapsulated, rounded or elongated, slow growing and benign. Grade II meningiomas (5% - 15%) are atypical meningiomas and have a higher rate of recurrence (30% - 40%) after surgical removal. Grade III meningiomas (1% - 3%) are anaplastic or malignant meningiomas and require more aggressive interventions. The recurrence rate of grade III meningiomas after surgery is around 50% - 80%.

The etiology of meningiomas is unknown, inherit factors of meningioma is suggested. The most common familial occurrence of meningiomas is linked to neurofibromatosis type 2. Ionized radiation has been identified as the most common risk factor for meningiomas. Patients exposed to full mouth dental radiographs and patients receiving radiotherapy to the head and neck region for other medical illness are at higher risk of developing meningiomas.

The argument that females have a higher incidence of developing meningiomas is believed to be related to the tumorigenic role of sex hormones. Researchers have identified that adult women who are pregnant or receiving sex hormone replacement are at higher risk of developing meningiomas.

Manifestations
Meningiomas are slow growing tumors and have a long latency period of more than 20 years. Meningiomas can grow to a very large size before patients start to have signs or symptoms, especially if they are in the non-eloquent areas. Therefore, most meningiomas are asymptomatic. The most common manifestations of meningiomas include headaches, seizures, and focal neurological signs. Headaches are due to dural irritation and are related to the size or location of the tumor.

The specific presentation of meningiomas is related to the size, rate of growth, site of origin, involvement of cranial nerves, and extent of edema or vascular obstruction. Manifestations of meningiomas are mostly related to the mass effect of the tumor. The mass effect of meningiomas could cause serious complications such as obstruction of the cerebral sinuses, narrowing of the arterial structures, and cranial nerve dysfunction.

Diagnostic Tests
The most commonly used imaging modalities to diagnose meningiomas include MRI and CT scans. CT scans are more widely used because of availability, speed, and affordability. CT scans can be used in emergency settings and can be used for patients who are not suitable for MRI, such as patients with pacemakers or metal implants in the body. CT scans provide evidence of effects of the tumor on adjacent bones such as osseous destruction or hyperostosis, and detecting psammomatous calcification of the tumor.
MRI is the preferred diagnostic test. It provides a superior outline of the tumor and tumor extensions. In MRI, meningiomas are usually shown as well as demarcated masses with smooth and multilobular contours. MRI also provides detail of the surrounding anatomy, particularly blood vessels and bony architecture that could be helpful for surgical planning.

Treatment Options
The goals of therapy for meningiomas are to relieve the compression on the surrounding critical anatomical structures, and to prevent tumor spread and recurrence. Treatment for patients with meningiomas depends on the patient’s clinical presentation, age, heath status, tumor size, progression, location, and involvement of adjacent neurovascular structures. Patients with small, slow growing meningiomas, which have not produced any signs or symptoms, may not require treatment. However, regular follow up to monitor the growth of the tumor is necessary.

Surgical excision is the primary treatment of choice for accessible intracranial meningiomas. Complete surgical resection of the tumor achieves the best long-term outcome. Meningiomas that are close to the eloquent tissues or located at the base of the skull may be difficult to access and often only partial excision of the tumor is allowed. The remaining un-resected tumor has a high tendency to regrow. Stereotactic radiosurgery (SRS) or fractionated stereotactic radiotherapy (FSRT) is effective in controlling regrowth of the remaining tumor for incomplete excision of benign skull base meningiomas. The precise irradiation of the stereotactic technique is able to minimize damage to the surrounding healthy tissues. The adverse effects of SRS and FSRT include radionecrosis of the brain and cranial nerve deficits (CN II, V and VI). SRS delivers a high dose of radiation in a single session. SRS is used for tumors <3cm and located 3-5mm away from the optic chiasm. For patients with larger tumors that are close to the brain stem, acoustic nerve, or optic chiasm, FSRT is recommended. FSRT delivers a lower dose of radiation over several treatments, therefore, damage to the surrounding healthy tissue is decreased.

Research has been conducted on various medical treatments for meningiomas such as chemotherapy, interferons, and hormonal therapy, with no medical treatment proven to be effective in treating meningiomas. Different regimes of chemotherapy have been trialed but failed to show significant effects in controlling the progression of tumor growth. However, chemotherapy has been combined with surgery when the meningiomas are only partially surgically removed.

Nursing Implication
Meningiomas can occur in various locations with different presentations and treatments. Nursing care for patients with meningiomas is focused on providing both psychological and physiological care. Any type of tumor is devastating to patients and their families. Psychological support includes providing information about the disease, treatment options, and diagnostic procedures. Listen to the patient and their family to identify their feelings and needs, and arrange support such as a social worker if required. Physiological support includes providing comfort measures, preparation of the patient for diagnostic tests, pre-operative care, post-operative management, and/or pre and post radiotherapy care. Monitor patient’s neurological and vital signs closely for any signs of complications before and after surgery.

Reference

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