SOLID TUMORS IN CHILDREN
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• BRAIN TUMORS
  ▪ The second most common malignancy in childhood and adolescence.

  ▪ The aetiology of paediatric brain tumours is not well defined. A male predominance is noted in the incidence of medulloblastoma and ependymoma.
CLINICAL FEATURES

- Signs and symptoms are related to obstruction of cerebrospinal fluid (CSF) drainage paths by the tumour, leading to increased intracranial pressure (ICP) or causing focal brain dysfunction.

- Subtle changes in personality, mentation, and speech may precede these classic signs and symptom such changes often occur with supratentorial (cortical) lesions.
- The classic triad of headache, nausea, and vomiting as well as papilledema is associated with midline or infratentorial tumours.

- Disorders of equilibrium, gait, and coordination occur with infratentorial tumours. Torticollis may occur in cases of cerebellar tonsil herniation.

- Blurred vision, diplopia, and nystagmus also are associated with infratentorial tumours.
- Supratentorial tumours are more commonly associated with lateralized deficits, such as focal motor weakness, focal sensory changes, language disorders, focal seizures, and reflex asymmetry.

- Infants with supratentorial tumours may present with premature hand preference.
TYPES AND SITE OF TUMOR

Hemispheric
- Gliomas: 37%
  - Low-grade astrocytomas: 23%
  - High-grade astrocytomas: 11%
  - Other: 3%

Midline:
1. Chiasmal gliomas: 4%
2. Craniopharyngiomas: 8%
3. Pineal region tumors: 2%

Posterior fossa:
1. Brainstem gliomas: 15%
2. Medulloblastomas: 15%
3. Ependymomas: 4%
4. Cerebellar astrocytomas: 15%
DIAGNOSIS

- For primary brain tumours, MRI with and without gadolinium is the neuroimaging standard.

- Tumours in the pituitary/ suprasellar region, optic path, and infratentorium are better delineated with MRI than with CT.

- Patients with tumours of the midline and the pituitary/suprasellar/optic chiasmal region should undergo evaluation for neuroendocrine dysfunction.
Nonenhanced axial T2-weighted MR image of grade III astrocytoma of the right thalamus demonstrating diffuse hyper intensity and area of necrotic cyst formation.
- β-human chorionic gonadotropin and α-fetoprotein can assist in the diagnosis of germ cell tumours.

- Formal ophthalmologic examination is beneficial in patients with optic path region tumours to document the impact of the disease on oculomotor function, visual acuity, and fields of vision.
NEUROBLASTOMA

- Neuroblastomas are embryonal cancers of the peripheral sympathetic nervous system with heterogeneous clinical presentation and course, ranging from tumours that undergo spontaneous regression to very aggressive tumours unresponsive to very intensive multimodal therapy.

- Neuroblastoma is the most common extracranial solid tumor in children and the most commonly diagnosed malignancy in infants.
- Neuroblastoma tumours, which are derived from primordial neural crest cells.

- They can be primarily undifferentiated small round cells (neuroblastoma) to tumours consisting of mature and maturing Schwannian stroma with ganglion cells (ganglioneuroblastoma or ganglioneuroma).
Genetic characteristics of neuroblastoma tumours that are of prognostic importance include amplification of the MYCN (N-myc) proto oncogene and tumor cell DNA content, or ploidy.
The signs and symptoms of neuroblastoma reflect the tumor site and extent of disease, and the symptoms of neuroblastoma can mimic many other disorders, a fact that can result in a delayed diagnosis.

Metastatic disease can cause a variety of signs and symptoms, including fever, irritability, failure to thrive, bone pain, cytopenias, bluish subcutaneous nodules, orbital proptosis, and periorbital ecchymoses.
- Approximately half of neuroblastoma tumours arise in the adrenal glands, and most of the remainder originate in the paraspinal sympathetic ganglia.

- The most common sites of metastasis are the regional or distant lymph nodes, long bones and skull, bone marrow, liver, and skin. Lung and brain metastases are rare, occurring in >3% of cases.
- Neuroblastoma originating in the superior cervical ganglion can result in Horner syndrome.
- Paraspinal neuroblastoma tumours can invade the neural foramina, causing spinal cord and nerve root compression.
- Neuroblastoma can also be associated with a paraneoplastic syndrome of autoimmune origin, termed opsoclonus–myoclonus–ataxia syndrome, with uncontrollable jerking eye and body movements, poor coordination.
Periorbital metastases of neuroblastoma with ecchymoses and proptosis.
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<th>STAGE</th>
<th>DEFINITION</th>
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<tr>
<td>1</td>
<td>Localized tumor with complete gross excision, with or without microscopic residual disease; representative ipsilateral lymph nodes negative for tumor microscopically (nodes attached to and removed with the primary tumor may be positive)</td>
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<tr>
<td>2A</td>
<td>Localized tumor with incomplete gross excision; representative ipsilateral nonadherent lymph nodes negative for tumor microscopically</td>
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<tr>
<td>2B</td>
<td>Localized tumor with or without complete gross excision, with ipsilateral nonadherent lymph nodes positive for tumor; enlarged contralateral lymph nodes must be negative microscopically</td>
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<td>3</td>
<td>Unresectable unilateral tumor infiltrating across the midline, with or without regional lymph node involvement; or localized unilateral tumor with contralateral regional lymph node involvement; or midline tumor with bilateral extension by infiltration (resectable) or by lymph node involvement</td>
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<tr>
<td>4</td>
<td>Any primary tumor with dissemination to distant lymph nodes; bone, bone marrow, liver, skin, and other organs (except as defined for stage 4S)</td>
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<tr>
<td>4S</td>
<td>Localized primary tumor (as defined for stage 1, 2A, or 2B), with dissemination limited to skin, liver, and bone marrow* (limited to infants &lt;1 yr of age)</td>
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Neuroblastoma is usually discovered as a mass or multiple masses on plain radiography, CT, or MRI (that can be appreciated on plain radiography or CT.

- Evaluations for metastatic disease should include CT or MRI of the chest and abdomen, bone scans to detect cortical bone involvement, and at least 2 independent bone marrow aspirations and biopsies to evaluate for marrow disease.
- Iodine-123 meta iodo benzyl guanidine
- (123I-MIBG) studies should be used when available to better define the extent of disease
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CT scan of an abdominal neuroblastoma with central necrosis at diagnosis. B, Coronal fused CT and metaiodobenzylguanidine (MIBG) image of same child with extensive retroperitoneal mass and central necrosis, probably an adrenal primary with extensive lymph node involvement. C, MIBG avid neuroblastoma with increased uptake of radiolabelled tracer can be detected in multiple sites of disease, including bone and soft tissue.
The usual treatment for children with low-risk neuroblastoma is surgery for stages 1 and 2 and observation for stage 4S with cure rates generally >90% without further therapy.

Stage 4S neuroblastomas have a very favourable prognosis, and many regress spontaneously without therapy.
- Treatment of intermediate-risk neuroblastoma includes surgery, chemotherapy, and, in some cases, radiation therapy

- Children with high-risk neuroblastoma have long-term survival rates between 25% and 35% with current treatment that consists of intensive chemotherapy, high-dose chemotherapy with autologous stem cell rescue, surgery, radiation, and 13-cis-retinoic acid
WILMS TUMOR

- Wilms tumor (WT), also known as nephroblastoma, is the most common primary malignant renal tumor of childhood.
CLINICAL FEATURES

- The most common initial clinical presentation for WT is the incidental discovery of an asymptomatic abdominal mass by parents while bathing or clothing an affected child or by a physician during a routine physical examination.
- Hypertension is present in approximately 25% of tumours at presentation and has been attributed to increased renin activity.
- Abdominal pain, gross painless haematuria, and fever are other frequent findings at diagnosis.
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<tr>
<th>Stage I</th>
<th>Tumor <em>confined to the kidney</em> and completely resected. Renal capsule or sinus vessels not involved. Tumor not ruptured or biopsied. Regional lymph nodes examined and negative.</th>
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<td>Stage II</td>
<td>Tumor extends <em>beyond the kidney</em> but is completely resected with negative margins and lymph nodes. At least 1 of the following has occurred: (a) penetration of renal capsule, (b) invasion of renal sinus vessels.</td>
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<td>Stage III</td>
<td><em>Residual tumor</em> present following surgery confined to the abdomen, including gross or microscopic tumor; spillage of tumor preoperatively or intraoperatively; biopsy prior to nephrectomy, regional lymph node metastases; tumor implants on the peritoneal surface; extension of tumor thrombus into the inferior vena cava including thoracic vena cava and heart.</td>
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<td>Stage IV</td>
<td><em>Hematogenous metastases</em> (lung, liver, bone, brain, etc.) or lymph node metastases outside the abdominopelvic region.</td>
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<td>Stage V</td>
<td><em>Bilateral renal involvement</em> by tumor.</td>
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DIAGNOSIS

- An abdominal mass in a child should be considered malignant until diagnostic imaging, laboratory findings, and pathology can define its true nature.
- Abdominal ultrasonography helps differentiate solid from cystic masses. WT might show focal areas of necrosis or haemorrhage and hydronephrosis caused by obstruction of the renal pelvis by the tumor.
• Ultrasonography with Doppler imaging of renal veins and the inferior vena cava is a useful first study that not only can look for WT but also can evaluate the collecting system and demonstrate tumor thrombi in the renal veins and inferior vena cava.

• CT is useful to define the extent of the disease, integrity of the contralateral kidney, and metastasis.

• MRI be helpful in defining an extensive tumor thrombus.
Abdominal CT scan showing a Wilms tumor arising from the left kidney
TREATMENT

- Early surgery provides accurate diagnosis and staging, and can facilitate risk-adapted therapy.
- Preoperative chemotherapy can make surgery easier and reduces the risk of intraoperative tumor rupture and haemorrhage.
- Surgery entails a radical nephrectomy with meticulous dissection to avoid rupture of the tumor capsule and lymph node sampling despite the absence of abnormal nodes on preoperative imaging studies or intraoperative assessment.
PROGNOSIS

- Prognostic factors for risk-adapted therapy include age, stage, tumor weight, and loss of heterozygosity at chromosomes 1p and 16q.

- Histology plays a major role in risk stratification of WT. Absence of anaplasia is considered a favourable histologic finding.
OSTEOSARCOMA

- Osteosarcoma is the most common primary malignant bone tumor in children and adolescents, followed by Ewing sarcoma.

- In children younger than 10 yr. of age, Ewing sarcoma is more common than osteosarcoma. Both tumor types are most likely to occur in the second decade of life.
CLINICAL FEATURES

- Pain, limp, and swelling are the most common presenting manifestations of osteosarcoma.
- Because these tumours occur most often in active adolescents, initial complaints may be attributed to a sports injury or sprain.
- Any bone or joint pain not responding to conservative therapy within a reasonable time should be investigated thoroughly.
• Bone tumor should be suspected in a patient who presents with deep bone pain, often causing nighttime awakening, in whom there is a palpable mass and radiographs that demonstrate a lesion.
• The lesion may be mixed lytic and blastic in appearance, but new bone formation is usually visible.
• The classic radiographic appearance of osteosarcoma is the sunburst pattern
Radiograph of an osteosarcoma of the femur with typical “sunburst” appearance of bone formation.
Before biopsy, MRI of the primary lesion and the entire bone should be performed to evaluate the tumor for its proximity to nerves and blood vessels, soft tissue and joint extension, and skip lesions.

The metastatic work-up, before biopsy, includes CT of the chest and radionuclide bone scanning to evaluate for lung and bone metastases, respectively.
TREATMENT

- With chemotherapy and surgery, the 5-yr disease-free survival rate of patients with non metastatic extremity osteosarcoma is 65-75%.
- Complete surgical resection of the tumor is important for cure.
- Try preoperative chemotherapy in an attempt to facilitate limb salvage operations and to treat micro metastatic disease immediately.
RETINOBLASTOMA

- Retinoblastoma is an embryonal malignancy of the retina and the most common intraocular tumor in children
- Knudson’s “two-hit” model of oncogenesis, In the hereditary form of retinoblastoma, the first mutation in the RB1 gene is inherited through germinal cells and a second mutation occurs subsequently in somatic retinal cells.
- Second mutations that lead to retinoblastoma often result in the loss of the normal allele and concomitant loss of heterozygosity
CLINICAL FEATURES

- Retinoblastoma classically presents with leukocoria, a white pupillary reflex, which often is first noticed when a red reflex is not present at a routine newborn or well-child examination or in a flash photograph of the child.

- Strabismus often is an initial presenting complaint.
A, Leukocoria noted in the left eye of a child presenting with retinoblastoma. B, A large white tumor mass noted within the posterior chamber of the enucleated eye.
DIAGNOSIS

• The diagnosis is established by the characteristic ophthalmologic findings of a chalky, white-grey retinal mass with a soft, friable consistency
• Orbital ultrasonography, CT, or MRI is used to evaluate the extent of intraocular disease and extraocular spread.
  ▪ MRI allows for better evaluation of optic nerve involvement
DIFFERENTIAL DIAGNOSIS

- Persistent hyperplastic primary vitreous
- Coats disease
- Vitreous haemorrhage
- Cataract
- Endophthalmitis from Toxocara canis
- Choroidal coloboma
- Retinopathy of prematurity
- Familial exudative vitreoretinopathy
TREATMENT

- Most unilateral disease presents with a solitary, large tumor. Enucleation is performed if there is no potential for the salvage of useful vision.

- With bilateral disease, chemo reduction in combination with focal therapy (laser photocoagulation or cryotherapy)
GONADAL / GERMA CELL TUMOR

- Most malignant tumours of the gonads in children are GCTs.

- Sacrococcygeal tumours occur predominantly in infant girls.

- Testicular GCTs occur predominantly before age 4 yr. and after puberty
CLINICAL FEATURES

- Ovarian tumours often are quite large by the time they are diagnosed.
- Extra gonadal GCTs occur in the midline, including the suprasellar region, pineal region, neck, mediastinum, and retroperitoneal and sacrococcygeal areas.
- Symptoms relate to mass effect, but the intracranial GCTs often present with anterior and posterior pituitary deficits.
LAB INVESTIGATION

- The serum α-fetoprotein (AFP) level is elevated with endodermal sinus tumours and may be minimally elevated with teratomas.

- Elevation of the β subunit of human chorionic gonadotropin, which is secreted by Syncytiotrophoblasts, is seen with choriocarcinoma and germinomas
TREATMENT

- Complete surgical excision of the tumor usually is indicated, except for patients with intracranial tumours, where the primary therapy consists of radiation therapy and chemotherapy.

- For testicular tumours, an inguinal approach is indicated, and complete resection should include the entire spermatic cord. When complete excision cannot be accomplished, preoperative chemotherapy is indicated, with second-look surgery.
• For teratomas, both mature and immature, and completely resected malignant tumours of the testes, surgery alone is the treatment.

• For ovarian tumours, unless the contralateral ovary is obviously also involved by tumor, a fertility-sparing surgery should be performed
Thank You