Pediatric Abdominal Tumors: Advances in Wilms Tumor, Hepatoblastoma and Neuroblastoma

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We do not have any conflicts of interests to disclose.

To discuss Wilms Tumor and the implications for upfront resection versus multimodal treatment.

To discuss neuroblastoma, the importance of complete surgical resection and supportive data

To discuss hepatoblastoma and describe how complete resection leads to increased survival rate
PEDIATRIC ONCOLOGY

- An estimated 15,780 children in the United States under the age of 19 will be diagnosed with cancer in 2015.
- In the past 50 years there have been many advances in childhood cancer treatment. In the 1960s, the overall 5 year survival rate for oncology patients 0-14 years old was estimated at 28%. Overall, survival rates have drastically improved and now more than 80% of children diagnosed with cancer survive 5 years or more.
- Three diagnoses in which surgery is pivotal are Wilms tumor, Hepatoblastoma and Neuroblastoma.

RELATIVE INCIDENCE OF PEDIATRIC SOLID TUMORS

WILMS TUMOR

- Wilms tumor is a tumor of the kidney which are large rapidly growing, vascular abdominal tumors
- It is the second most common intra-abdominal solid tumor of childhood accounting for 6% of all pediatric cancers
- There are ~500 new cases a year in the US
- 1 in 10,000 children per year
- 50% before age 3; 90% before age 6
WILMS TUMOR

History

Dr. Carl H. Wilms, described 1 case of Wilms tumor
1899

Dr. John Hunter, assembled the first known specimen of Wilms tumor
1728-1793

Thomas Jessop, performed the first successful nephrectomy for Wilms tumor at General Infirmary, Leeds
1877

http://en.wikipedia.org/wiki/Max_Wilms

WILMS TUMOR

Associated Syndromes

- Beckwith Syndrome
- Denys-Drash Syndrome
- Soto’s Syndrome
- Perlman Syndrome
- Bloom’s Syndrome
- WAGR (Wilms tumor, Aniridia, Genitourinary Abnormalities and Mental Retardation)
- Simpson-Golabi-Behmel syndrome

WILMS TUMOR

Associated Abnormalities

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>WT Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemihypertrophy</td>
<td>3 - 5%</td>
</tr>
<tr>
<td>Spinal Aniridia</td>
<td>30 - 40%</td>
</tr>
<tr>
<td>Genitourinary Anomalies</td>
<td>Low</td>
</tr>
<tr>
<td>Nephroblastomatosis</td>
<td>Bilateral</td>
</tr>
<tr>
<td>Beckwith-Wiedemann</td>
<td>10 - 20%</td>
</tr>
</tbody>
</table>

SCREENING: ULTRASOUND every 3 months until age 8
**WILMS TUMOR**

**Symptoms**
- Palpable abdominal mass
- Abdominal pain
- Hematuria (associated with tumor invading collecting system/ureter)
- Fever
- Dysuria
- Hypertension
- Malaise
- Nausea/loss of appetite

**Imaging**

**ULTRASOUND**

**CHEST XR**
WILMS TUMOR

Common Metastatic Sites

Lung

Liver

History Cont.

1914 - 1930
Boston Children's experienced 10% operative mortality. 

1931
Improvements made by Dr. William Ladd concentrating on proper anesthesia, removal of the entire tumor without rupture. IVF and blood administration were given to prevent shock.

1932
No more operative deaths.

1940-1947
Dr. Gross and Dr. Neuscheuer instituted a Program for immediate surgery and postoperative radiation to the tumor bed. 
Overall survival increased to 47% for children of all ages and in babies <12months old survival rate was 80%.

Survival rate increased to 25.7%
### WILMS TUMOR

**Upfront Resection**

- To prevent intraoperative tumor spillage, **DO NOT** remove tumor tissue through a flank incision, and do not biopsy.
- Total nephrectomy is performed to accurately diagnose the disease (exception bilateral disease).
- Children with tumor spillage have an increased risk of local recurrence rates and mortality.

### WILMS TUMOR

**Upfront Biopsy / Pre-nephrectomy Chemotherapy**

- Tumor thrombus above the level of hepatic veins.
- Pulmonary compromise from massive tumor or pulmonary metastases.
- Resection requiring removal of nearby organs (other than the adrenal gland).
- Surgeon determines that attempting nephrectomy would result in significant morbidity, tumor spill or residual disease.

### WILMS TUMOR

**Surgical Resection**

- Transabdominal Approach
- Complete Resection of tumor without Rupture is Key
- Radical nephrectomy involves removing the entire kidney, along with a section of the tube leading to the bladder (ureter), the gland that sits atop the kidney (adrenal gland), and the fatty tissue surrounding the kidney.
- Lymph node sampling.
- Partial nephrectomy involves removed only a portion of the kidney (if bilateral, only one remaining kidney).
25th Annual Scientific Conference | May 12-15, 2016 | San Diego, CA

WILMS TUMOR

Surgical Resection

WILMS TUMOR

History Cont.

Dr. Dana Farber first demonstrated efficacy of actinomycin D in 1955. Vincristine was proven effective in the treatment of Wilms tumor, leading to the development of the National Wilms Tumor Study Group which performed randomized trials. During the course of these studies, cure rates increased to over 90%.

1955
Since the 1960’s focus has been on treatment based on risk stratification including:

- Favorable histology – cells look relatively normal under the microscope and usually consists of blastemal, epithelial and stromal cell types.
- Unfavorable histology - in ~10% of Wilms tumors, abundant mitoses, apoptotic figures, can be focal or diffuse. These cases are more difficult to treat.

<table>
<thead>
<tr>
<th>WILMS TUMOR</th>
<th>Treatment Favorable Histology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RISK/STAGE</strong></td>
<td><strong>DRUG</strong></td>
</tr>
<tr>
<td>Very Low Risk</td>
<td>Surgery alone</td>
</tr>
<tr>
<td>Stage I</td>
<td>Dactinomycin</td>
</tr>
<tr>
<td>Stage I - &lt;2 years of age, &lt;500 gram tumor</td>
<td>Vincristine</td>
</tr>
<tr>
<td>Low Risk</td>
<td>Surgery + Chemotherapy</td>
</tr>
<tr>
<td>Stage I/II</td>
<td>Dactinomycin</td>
</tr>
<tr>
<td>No LOH 1p/16q</td>
<td>Vincristine</td>
</tr>
<tr>
<td>Standard Risk</td>
<td>Surgery + Chemotherapy</td>
</tr>
<tr>
<td>Stage I/II</td>
<td>Dactinomycin</td>
</tr>
<tr>
<td>Positive LOH 1p/16q</td>
<td>Doxorubicin</td>
</tr>
<tr>
<td>Stage III</td>
<td></td>
</tr>
<tr>
<td>No LOH 1p/16q</td>
<td></td>
</tr>
<tr>
<td>Stage IV</td>
<td></td>
</tr>
<tr>
<td>No LOH 1p/16q</td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>Surgery + Chemotherapy + Radiation</td>
</tr>
<tr>
<td>Stage III/IV</td>
<td>Dactinomycin</td>
</tr>
<tr>
<td>Positive LOH 1p/16q</td>
<td>Doxorubicin</td>
</tr>
<tr>
<td>Stage IV</td>
<td></td>
</tr>
<tr>
<td>Any metastatic disease outside lung</td>
<td>Vincristine</td>
</tr>
<tr>
<td>Surgery + Chemotherapy + Radiation</td>
<td></td>
</tr>
<tr>
<td>Focal Anaplastic</td>
<td>Surgery + Chemotherapy + Radiation</td>
</tr>
<tr>
<td>Stage I/III</td>
<td>Dactinomycin</td>
</tr>
<tr>
<td>Vincristine</td>
<td>Vinca Alkaloid</td>
</tr>
<tr>
<td>Doxorubicin</td>
<td>Anthracycline Antineoplastic Antibiotic</td>
</tr>
<tr>
<td>Etoposide</td>
<td>Mitotic Inhibitor</td>
</tr>
<tr>
<td>Diffuse Anaplastic</td>
<td>Surgery + Chemotherapy + Radiation</td>
</tr>
<tr>
<td>Stage I/II - III</td>
<td>Dactinomycin</td>
</tr>
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<td>Vincristine</td>
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<tr>
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<td>Cyclophosphamide</td>
<td>Nitrogen mustard derivative</td>
</tr>
<tr>
<td>Etoposide</td>
<td>Mitotic Inhibitor</td>
</tr>
<tr>
<td>Diffuse Anaplastic</td>
<td>Surgery + Chemotherapy + Radiation</td>
</tr>
<tr>
<td>Stage IV with measurable disease</td>
<td>Vincristine</td>
</tr>
<tr>
<td>Irinotecan</td>
<td>Camptothecin analog, topoisomerase I inhibitor</td>
</tr>
<tr>
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<td>Cyclophosphamide</td>
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<tr>
<td>Carboplatin</td>
<td>Alkylating agent</td>
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<td>Etoposide</td>
<td>Mitotic Inhibitor</td>
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</tbody>
</table>
WILMS TUMOR

<table>
<thead>
<tr>
<th>Stage</th>
<th>Favorable Histology</th>
<th>Unfavorable Histology</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>99%</td>
<td>83%</td>
</tr>
<tr>
<td>II</td>
<td>98%</td>
<td>81%</td>
</tr>
<tr>
<td>III</td>
<td>94%</td>
<td>72%</td>
</tr>
<tr>
<td>IV</td>
<td>86%</td>
<td>38%</td>
</tr>
<tr>
<td>V</td>
<td>87%</td>
<td></td>
</tr>
</tbody>
</table>

Even though overall cure rate is high for Wilms tumor there is still research needed for patients with unfavorable histology or tumors which are resistant to therapeutic treatment.

It is also important for research to be done to find out what causes relapse and therapeutic resistance in these patients.

NEUROBLASTOMA

- Neuroblastoma is a solid malignant tumor derived from neural crest cells.
- Majority arise from adrenal gland, but an also occur in the neck, chest, spinal cord or pelvis along the sympathetic nerve.
- Major sites of metastasis: bone marrow, bone, distant lymph nodes.
- Less common sites of metastasis: liver, brain/CNS, lung, paratesticular, ovary, skin.

**NEUROBLASTOMA**

**History**
- Virchow described an abdominal tumor in a child that he called a "glioma" 1864
- Marchand described common aspects of tumors derived from SNS 1891
- Hutchinson noted pericocular hematomas significant for orbital/skeletal metastases 1907
- Wright provided an early description of multi-organ metastasis in the prenatal period, now what we identify as NB 1910
- Cushing and Wolbach first described the spontaneous maturation of neuroblastoma into ganglioneuroma 1927

**Epidemiology**
- Most common extracranial solid tumor of childhood
- Most common malignancy in infancy
- Accounts for 7.2% of all malignancies in children younger than 15 years old
- Approximately 650 children are diagnosed with NB each year in the US

**Presenting signs**
- Presentation can vary depending on location and extent of disease
- Typically present in infancy or toddler years
- Common signs/symptoms:
  - Abdominal pain
  - Limping due to bony pain
  - Weight loss or failure to thrive
  - Periorbital ecchymosis
  - Subcutaneous nodules
  - Changes in kidney or bowel function
NEUROBLASTOMA
Presenting signs

Work up

CT-CAP
MIBG
Bone scan
HMA/VMA (urine catecholamines)
+/− MRI
Bone marrow biopsy
LDH, ferritin
Surgery plays an essential role in the diagnosis, staging and treatment of neuroblastoma.

INSS staging is accepted by Children's Oncology Group and other major oncology groups in Japan and Europe.

Staging is determined largely by surgical resectability and regional nodal involvement.

**In summary,**

**International Neuroblastoma Staging System (INSS)**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>Localized tumor with no palpable nodes, with no or minimal necrosis, invaded: upper or middle third of the tumor resectable surgically. Tumor is removed surgically.</td>
</tr>
<tr>
<td>IB</td>
<td>Localized tumor with palpable gross nodes, resectable surgically. Operation includes removal of gross nodes and the tumor.</td>
</tr>
<tr>
<td>II</td>
<td>Limited metastatic spread in organs or tissues, with removal of extra-mural nodes and extensive tumor resection.</td>
</tr>
<tr>
<td>III</td>
<td>Chemotherapy-sensitive tumor (vasa vasorum involved), with or without involved regional nodes or lymph nodes. Limited metastatic disease. Limited resection of involved nodes in adenopathy. Limited resection of organ invasion.</td>
</tr>
<tr>
<td>IV</td>
<td>Disease has spread to distant organs, bones, brain, heart, lungs, and/or other organs newly involved since diagnosis.</td>
</tr>
<tr>
<td>IVS</td>
<td>Disease is interpreted to have spread to skin (1), brain (2), bone (3), heart (4), and/or other organs (5).</td>
</tr>
</tbody>
</table>

Robert E. Gross noted that "extensive and radical surgery" could lead to a permanent cure.

Mason et al. reported the use of catecholamine metabolites as tumor markers.

Koop analyzed surgical interventions on differing degrees of difficulty of resection, providing an rudimentary type of risk status.

C. Everett Koop described the positive effect of tumor debulking on outcome.

1953

1955

1965

1970s

1957

1968

1965: Introduction of neoadjuvant chemotherapy (Vincristine & Cyclophosphamide)

1970s: Major advances in imaging, anesthesia, surgery, blood banking, and critical care as well as founding of national collaborative oncology groups.
NEUROBLASTOMA

History Cont.

- Evans et al. created a staging system that was the first accepted international system\(^1\) in 1971.
- Schwab discovered the role of MYCN amplification in 1983.
- Specific guidelines published on pathology and biopsy studies (Ambros and Ambros) in 2001.
- 1983, 1985: Retrospective studies from Children’s Cancer Study Group on the role of surgery in both localized and metastatic neuroblastomas were published\(^2\).
- 1990s: International agreement on diagnostic criteria and staging were developed.

NEUROBLASTOMA

Risk Stratification

Pre-treatment Risk stratification takes into account:
- Age
- Stage
- INSS International Neuroblastoma Pathology Classification
- Biological Variables
  - MYCN amplification
  - Ploidy (DNA index)
  - 11q del and 17 gain

The above is combined to determine International Risk Grouping (INRG).

The INRG Survival Tree

Risk group: Very low, Low, Intermediate, High
**NEUROBLASTOMA**

**Gross Total Resection**

- Removal of all visible and palpable tumor from the primary site/region
- No attempt to obtain margins
- Microscopic margin is almost invariably positive

**NEUROBLASTOMA**

**Stage 4S**

- Bulky, widespread disease in infants
- Spontaneous regression
- Observation only (ultrasound)
- Rarely require treatment (extensive liver involvement)

**NEUROBLASTOMA**

**Low risk tumors**

- Often incidentally found
- Treated with surgery alone
- Regional lymph nodes should also be biopsied during resection

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NEUROBLASTOMA

**Low risk tumors**

- If GTR is not achievable, chemotherapy may be used to decrease the size of the tumor and allow for eventual GTR.
- Partially resected tumors can be either followed by chemotherapy and observation or observation alone.
- Due to location of some tumors, there may be a high risk of morbidity associated with surgery.
  
  Example: tumor invading epidural space.

**Intermediate risk**

- Until 1990s, stage 2 and 3 tumors were treated with chemotherapy and radiation.
- Multiple studies showed long term survival in patients with surgery alone without systemic cytotoxic treatment.
- Intermediate risk, stage 3 tumors cross midline and tend to encase major vessels.

**Intermediate risk**

- If Gross Total Resection (GTR) achieved, can be “down-staged” and eliminate or reduce cytotoxic therapy.
- Infants → surgery alone.
- Children >1 year → surgery and moderate dose chemotherapy.
- Both groups have event free survival rates >90-95%.
NEUROBLASTOMA

High risk

- Combination of chemotherapy, surgery, radiation, and targeted monoclonal antibody therapy
- Typically, 3-5 cycles of neoadjuvant chemotherapy
- Surgical resection
- Additional chemotherapy
- Radiation
- Monoclonal antibody (3F8 or 14.18)

NEUROBLASTOMA

Chemotherapy Agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Drug class</th>
<th>Major side effects</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carboplatin</td>
<td>Alkylating agent</td>
<td>Myelosuppression, renal insufficiency, electrolyte wasting</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Etoposide</td>
<td>Mitotic inhibitor</td>
<td>Hypotension, liver toxicity, peripheral neuropathy</td>
<td>Intermediate, High</td>
</tr>
<tr>
<td>Cyclophosphamide</td>
<td>Nitrogen mustard derivativealkylating agent</td>
<td>Hemorrhagic cystitis, cardiomyopathy, SIADH, sterility</td>
<td>Intermediate, High</td>
</tr>
<tr>
<td>Doxorubicin</td>
<td>Anthracycline</td>
<td>Pericarditis, cardiomyopathy, amythia, liver toxicity</td>
<td>Intermediate, High</td>
</tr>
<tr>
<td>Topotecan</td>
<td>Topoisomerase inhibitor</td>
<td>Dyspnea, myelosuppression</td>
<td>High</td>
</tr>
<tr>
<td>Cisplatin</td>
<td>Heavy metal alkylating agent</td>
<td>Severe N/V, hearing loss, liver toxicity, electrolyte wasting</td>
<td>High</td>
</tr>
<tr>
<td>Vincristine</td>
<td>Vinca alkaloid</td>
<td>Constipation, peripheral neuropathy</td>
<td>High</td>
</tr>
</tbody>
</table>

NEUROBLASTOMA

Rationale for GTR

- Gross total resection in high risk (stage 4, >1yr) neuroblastoma is still controversial
- Lack of control of the primary site is leading cause of progression of disease
- Conducting a prospective randomized trial is not feasible: overall survival of high risk patients is still poor
Retrospective study done at MSKCC involving 143 high risk patients:
- Left adrenal primary (68 pts)
- Right adrenal primary (36 pts)
- Central abdominal (19 pts)
- Posterior mediastinal (10 pts)
- Thoracoabdominal (6 pts), Pelvic (2 pts), Cervical (1 pt)

Median age at diagnosis: 3.3 years
Children received variations of cytotoxic systemic therapy as protocols advanced over the years.

As chemo protocols progressed in efficacy, more GTRs were performed.
Multivariate analysis performed: both GTR and advanced treatment protocol were associated with improved outcome.
Data indicated that local control and overall survival were correlated with gross total resection.

Thoracoabdominal Incision
Provides excellent exposure for upper abdominal retroperitoneal tumors in childhood.
Allows for controlled dissection of major visceral arteries resulting in improved renal salvage, no cases of mesenteric compromise.
Improves rate of gross total resection.
HEPATOBLASTOMA

- Most common form of liver cancer in children
- Usually occur before 3yo old
- Conditions associated with hepatoblastoma:
  - Beckwith-Wiedemann syndrome and hemihyperplasia
  - Familial adenomatous polyposis
HEPATOBLASTOMA

History

1898
First case of hepatoblastoma was described by Dr. Orel Misick.

1962
Term hepatoblastoma was introduced by Dr. Rupert Willis who defined “an embryonic tumor that contains hepatic epithelial parenchyma. Prior to this hepatoblastoma was not distinguishable from hepatocellular carcinoma.”

1960’s-1970’s
Sporadic reports of survival in hepatoblastoma following surgery.

HEPATOBLASTOMA

Symptoms

- Palpable abdominal mass
- Pallor
- Weight loss
- Pain

HEPATOBLASTOMA

Work Up

- CBC – may show anemia
- Liver enzymes may be elevated
- AFP level - usually elevated
HEPATOBLASTOMA Imaging

ULTRASOUND

CT SCAN

MRI LIVER
HEPATOBLASTOMA

Common Sites of Metastasis

Lungs

1898

1952

Study showed patients who had a complete excision were surviving for a rate 60% which indicated that complete surgical resection is the most effective treatment. However overall survival is 35%.

1962

Term hepatoblastoma was introduced by Dr. Rupurt Willis who defined "an embryonic tumor that contains hepatic epithelial parenchyma."

Prior to this hepatoblastoma was not distinguishable from hepatocellular carcinoma.

1975

Sporadic reports of survival in hepatoblastoma following surgery.

Study showed patients who had a complete excision were surviving for a rate 60% which indicated that complete surgical resection is the most effective treatment. However overall survival is 35%.

HEPATOBLASTOMA

Hepatic Resection

right hepatectomy

extended right hepatectomy

left hepatectomy

extended left hepatectomy

Radiology Assistant
HEPATOBLASTOMA Surgery

- Exploratory laparotomy with incision curvilinear incision starting at the xiphoid process extending inferiorly to the flank
- Vascular control is important intraoperatively to minimize blood loss
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-1985</td>
<td>Studies reported dramatic tumor necrosis with unresectable and metastatic hepatoblastoma using Adriamycin and Cisplatinum.</td>
</tr>
<tr>
<td>1992</td>
<td>Children's Cancer Study Group (CCSG) and Southwest Oncology Group reported significant improvement in survival with the use of combined chemotherapy (vincristine, doxorubicin, 5-Fluorouracil, and cyclophosphamide) and surgery. Prior to this chemotherapy was considered anecdotal.</td>
</tr>
<tr>
<td>1991</td>
<td>Trials also went on to confirm these results and nine patients with unresectable hepatoblastoma can now achieve long-term survival of 60%-70%.</td>
</tr>
<tr>
<td>2005</td>
<td>Revised staging system for primary malignant liver tumors of childhood developed by the SIOPEL group with PRETEXT/POSTTEXT.</td>
</tr>
</tbody>
</table>

**PRETEXT/POSTTEXT**

**PRETEXT** - Pre-Treatment Extent of Disease
- Based on segmental liver anatomy
- Assigned by number of contiguous liver sections free of tumor

**POST-TEXT** - Post-Treatment Extent of Disease
- Used to monitor degree of response to neoadjuvant chemotherapy

LIMITATIONS: TENDENCY TO OVERSTAGE
HEPATOBLASTOMA

PRETEXT/POSTEXT

PRETEXT I
One section involved; three adjoining sections are tumor free.

PRETEXT II
One or two sections involved; two adjoining sections are tumor free.

PRETEXT III
Two or three sections involved; one adjoining section is tumor free.

PRETEXT IV
Four sections involved.

Risk Groups

<table>
<thead>
<tr>
<th>RISK GROUP</th>
<th>PRETEXT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low Risk</td>
<td>I or II</td>
<td>Pure fetal histology; primary resection at diagnosis</td>
</tr>
<tr>
<td>Low Risk</td>
<td>I or II</td>
<td>Any histology with primary resection at diagnosis</td>
</tr>
<tr>
<td>Intermediate Risk</td>
<td>II, III, or IV</td>
<td>Unresectable at diagnosis, or Venous involvement, Portal involvement, Extrahepatic involvement, small cell undifferentiated histology</td>
</tr>
<tr>
<td>High Risk</td>
<td>Any PRETEXT</td>
<td>With Metastasis; AFP level &lt;100 ng/mL</td>
</tr>
</tbody>
</table>

**HEPATOBLASTOMA**

### Treatment

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Drug</th>
<th>Drug Class</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very Low Risk</strong></td>
<td>Surgery Alone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>Cisplatin</td>
<td>Heavy metal bifunctional alkylating agent</td>
<td>Hearing loss</td>
</tr>
<tr>
<td>Surgery + Chemotherapy</td>
<td>5-Fluorouracil</td>
<td>Antimetabolite</td>
<td></td>
</tr>
<tr>
<td>Intermediate Risk</td>
<td>Vincristine</td>
<td>Vinca Alkaloid</td>
<td>Peripheral neuropathy, constipation</td>
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<tr>
<td>Surgery + Chemotherapy</td>
<td>Irinotecan</td>
<td>Camptothecin analog, topoisomerase I inhibitor</td>
<td>Diarrhea</td>
</tr>
<tr>
<td>High Risk</td>
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<tr>
<td>Surgery + Chemotherapy</td>
<td>Doxorubicin</td>
<td>Anthracycline antineoplastic Antibiotic</td>
<td>Cardiac toxicity</td>
</tr>
</tbody>
</table>

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**HEPATOBLASTOMA**

### History Cont.

In 2011, Dr. LaQuaglia reported that hepatoblastomas involving 3 or 4 hepatic sectors used to require total hepatectomy and liver transplantation. However, with the development of advanced surgical techniques for reconstruction of the hepatic and portal veins and new techniques, extended left hepatectomy, central hepatectomy, or other variations have given surgeons the option to perform “extreme resections” instead of performing total hepatectomy and liver transplantation. 2014

> In a study by Lautz et al., they reported an 88% overall survival and 75% event-free survival in patients with post-TEXT 3 and 4 tumors. Now, state of the art for hepatoblastomas is consideration of the “extreme resections” of the liver when feasible after chemotherapy.

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**HEPATOBLASTOMA**

### The Effect of Complete Resection

![Graph showing the effect of complete resection on hepatoblastoma](image)

- Complete Resection
- Incomplete Resection

- Time from diagnosis (yr)
- Hepatoblastoma
FUTURE IN PEDIATRIC ONCOLOGY

- Finding out the mechanism that causes relapse and therapeutic resistance
- Personalized medicine with targeted therapies
- Event free survival improving in high risk neuroblastoma, event free survival rates increased from <30% to over 60% with advances in therapy

THANK YOU!

We would like to thank the following colleagues for all of their help and contributions to our presentation:

Michael LaQuaglia, MD, FACS, FAAP, FRCS (ED HOK)
Anita Price, MD, FACR
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REFERENCES

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