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SUMMER 2019 | THE TECHNIGRAM
EDITORIAL

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Cover Photo: CSRT 2018 Spring Seminar at CSU Northridge.
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President’s Message:
By Cheryl Young, MS RT(T)

Sweet summertime has arrived and while most of us are enjoying it, the CSRT Board of Directors are diligently working behind the scenes to ensure progress within our state society. Most recently the Board of Directors met in person to review the past progress of the CSRT, identify strengths and weaknesses of the organization and reviewed opportunities to grow without our professions – to ensure we are on target to meet the goals of our members and the organization. This meeting was a great success, leaving those who were able to attend feeling recharged and refreshed as we continue to work towards the member needs.

The CSRT has successfully hosted two venipuncture courses already this year - one in Northern California and one in Southern California. This course meets the needs required by the California Department of Public Health for Certified Radiologic Technologists. This course provides learners with 10 hours of instruction, reviewing anatomy and physiology of venipuncture sites, use of venipuncture instruments, IV solutions and related equipment, puncture techniques, techniques of intravenous line establishment and complications associated with performing venipuncture procedures. We will be continuously adding courses through the year to meet the needs of our members and technologists who need this course to meet the requirements.

This is a big year for the CSRT annual conference – as we will be celebrating our 80th annual conference. The annual conference has been confirmed and we will be hosting at Cedars Sinai on October 20, 2019. This all-day meeting will provide attendees an opportunity to network with fellow professional in an interactive setting, with presentations from the ASRT and ARRT. In addition, we will have an exhibit hall which will allow attendees an opportunity to meeting with industry leading vendors. The CSRT invites attendees to submit scientific displays which will be evaluated and judged by the Scientific Display Committee and awarded up to $500 to the winners. As well, we will be hosting the annual student bowl, where students will be testing their knowledge regarding radiologic science and win money.

One of the initiatives set forth this year in my presidential goals was to ensure that the CSRT was offering more inclusivity with its members. Considering such, I am happy to announce that this year the CSRT will be offering two educational tracks, one for radiography and one specifically for radiation therapists. It is the hope of the CSRT that through these offerings we can provide radiation therapists with a valuable learning experience and expose new members to the benefits of being a CSRT member. In addition, digital and fluoroscopy presentations will be provided to contribute to the Ca Radiologic Health Branch CE requirements. As you can see, this year’s conference will be packed with learning opportunities for all individuals – regardless of their specialty. With over 15 offerings member will have an opportunity to earn up to 8.5 continuing education units for this one-day event.

I am looking forward to seeing you all at this year’s conference. Be sure to save the date – registration is now OPEN at csrt.org/ac2019.

Cheryl Young, MS RT(T)
2019 President
California Society of Radiologic Technologists
CSRT 2018-2019 Board of Directors

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Elaine Villanueva
Student Committee Chair
This year marks the 80th Annual CSRT Conference! We are very proud of what’s in store for this year’s in-person conference at Cedars-Sinai Medical Center in Los Angeles on Sunday, October 20, 2019. One of the many components we are excited for this year is our new Radiation Therapy Track. Optimized for (but not limited to) radiation therapists, this track will feature CEU talks on Proton Focus, Vision RT, Clinical Expectation for Students and Instructors in Radiation Therapy, as well as more general topics on CBD and Compassion Fatigue in the Workplace.

Our main track will include our usual CEU topics on radiography, fluoroscopy and digital, as well as CEU talks on advanced modalities such as MRI Safety and Cardiac CT. We even have some special speakers to discuss LGBTQ in the Workplace, Imaging in Tanzania, as well as the CQR Update from ARRT. We are proudly providing a diverse selection of topics that almost any technologist and therapist can find useful, applicable, or inspiring and eye-opening.

We highly encourage technologists and therapists interested or involved in any modality to attend and learn something new at this milestone conference. In-person conferences are an excellent networking opportunity for technologists, students, and educators alike. Who knows who you might run into there... your future boss? Future mentor? A well-known physicist?

You won’t know unless you go!

**Students**

Of course, we can’t forget our students. There are many learning and earning opportunities for students at this year’s conference. We will once again be hosting the Student Scientific Display Board Contest, awarding scholarship winners, and running the famous Student Bowl with cash prizes. Similar to prior years, we offer many scholarship opportunities for our students as we encourage them to learn and become leaders and advocates in our field.

*Note to students: If you have class t-shirts or other fundraising merch you want to sell at our conference, email us at info@csrt.org to reserve a table.*

Registration is NOW OPEN online at CSRT.org!

- Early-Bird Registration ends August 16, 2019
  - $149 for Technologist/Therapist Members
  - $59 for Student Members

- Regular Registration ends August 31, 2019
  - $179 for Technologist/Therapist Members
  - $79 for Student Members

- General Registration ends September 20, 2019
  - $209 for Technologist/Therapist Members
  - $99 for Student Members

Register ASAP to get the best price!

Breakfast and Lunch will be included with your registration fee.

*Note to students: If you have class t-shirts or other fundraising merch you want to sell at our conference, email us at info@csrt.org to reserve a table.*
Upcoming Events

80th Annual Conference Schedule

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<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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</thead>
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<tr>
<td>6:45am - 7:45am</td>
<td>Registration Open &amp; Breakfast</td>
<td>Cheryl Young, CSRT President</td>
</tr>
<tr>
<td>7:45am - 8:00am</td>
<td>Opening Remarks &amp; Welcome</td>
<td>Cheryl Young, CSRT President</td>
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<tr>
<td>8:00am - 8:50am</td>
<td>VOLUNTEERING IN TANZANIA - Medicine and Medical Imaging at FameAfrica</td>
<td>Patti Smithson, CRT (R)</td>
</tr>
<tr>
<td>8:00am - 8:50am</td>
<td>Clinical Expectations of Radiation Therapy Instructors and Students</td>
<td>Maureen Sigafoos, CMD, RT(T)</td>
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<tr>
<td>8:50am - 9:40am</td>
<td>LGBTQ in Healthcare</td>
<td>Corey Hidalgo</td>
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<tr>
<td>8:50am - 9:40am</td>
<td>Pediatrics in Radiation Oncology</td>
<td>Kristine Bowlin, BS, RT(T) &amp; Alisha Chlebik, BS, RT(T)</td>
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<tr>
<td>9:40am - 10:00am</td>
<td>Break - Exhibit Hall Open</td>
<td>Jimmy Zhou, PhD, DABR</td>
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<tr>
<td>10:00am - 10:50am</td>
<td>Radiation Safety in Fluoroscopy - Technical Considerations</td>
<td>Damian Holman, BS, RT(T)</td>
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<tr>
<td>10:50am - 11:40am</td>
<td>Pediatrics in Radiation Oncology</td>
<td>Kristine Bowlin, BS, RT(T) &amp; Alisha Chlebik, BS, RT(T)</td>
</tr>
<tr>
<td>11:40am - 12:10pm</td>
<td>Lunch - Exhibit Hall Open</td>
<td>Gina Passmore, Ed. D, RT(T)</td>
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<tr>
<td>12:10pm - 12:40pm</td>
<td>CSRT Members Meeting, Scholarship Announcement &amp; Board Installation</td>
<td>Cheryl Young, CSRT President</td>
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<tr>
<td>12:40pm - 1:30pm</td>
<td>CQR Requirements</td>
<td>Barbara Smith, CRT (R)</td>
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<td>12:40pm - 1:30pm</td>
<td>History of Proton Therapy - Past &amp; Present</td>
<td>Edward Dickey, MHA, BS, RT(T) &amp; Marybeth Sullivan-Dickey, RT (T)</td>
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<tr>
<td>1:30pm - 2:20pm</td>
<td>MRI Safety &amp; Patient Management</td>
<td>Frank Shellock, Ph.D., FACR, FISMRM, FACC, FACS</td>
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<tr>
<td>1:30pm - 2:20pm</td>
<td>Vision RT: Improving Patient Experience and Outcomes</td>
<td>Jotsna Singh, BS, RT (T)</td>
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<tr>
<td>2:20pm - 2:40pm</td>
<td>Break - Exhibit Hall Open</td>
<td>Gina Passmore, Ed. D, RT(T)</td>
</tr>
<tr>
<td>2:40pm - 3:30pm</td>
<td>Digital Imaging - Optimizing Each Exam for Each Patient</td>
<td>Joe Hewes, MBA, R.T. (R)(CT)(ARRT), CIIP</td>
</tr>
<tr>
<td>2:40pm - 3:30pm</td>
<td>DIBH</td>
<td>Kristine Bowlin, BS, RT(T) &amp; Alisha Chlebik, BS, RT (T)</td>
</tr>
<tr>
<td>3:30pm - 5:00pm</td>
<td>Student Bowl Competition</td>
<td>Mark Hyun, CNMT, CRT ARRT (R)(CT) &amp; William Pan, CRT, ARRT (R), (CT)</td>
</tr>
<tr>
<td>3:30pm - 5:00pm</td>
<td>ECG Gating in Cardiac CT</td>
<td>Mark Hyun, CNMT, CRT ARRT (R)(CT) &amp; William Pan, CRT, ARRT (R), (CT)</td>
</tr>
<tr>
<td>5:00pm - 5:15pm</td>
<td>Closing Remarks, Prizes &amp; CE Certificates</td>
<td>Cheryl Young, CSRT President</td>
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Accommodations
Room blocks have been reserved at the following hotels near Cedars Sinai.

- The Elan Hotel - Los Angeles
- Ramada Plaza - West Hollywood
- Sofitel Los Angeles at Beverly Hills

Reservations at the discounted rates below are based on availability for October 19th, 20th and/or 21st.

Visit csrt.org/ac2019 for details and to register.
LEGISLATIVE UPDATE

Legislative Update

By Lorenza Clausen, CRT, RT(R)(CT)(MR), ARRT

There has been a lot of discussions recently on social media, other professional pages, organization newsletters, and websites regarding announcements related to our professional practice.

The AAPM, American Association of Physicists in Medicine released a statement from their April 2-3 Board of Directors meeting regarding the use of gonadal and fetal shielding. “Patient gonadal and fetal shielding during X-ray based diagnostic imaging should be discontinued as a routine practice.” They went on to explain their rationale with “Use of these shields during X-ray based diagnostic imaging may obscure anatomic information or interfere with the automatic exposure control of the imaging system. These effects can compromise the diagnostic efficacy of the exam, or actually result in an increase in the patient’s radiation dose.” They also indicated that studies had shown minimal to no benefit with the use of shielding. You can read the complete statement at the link below:

https://www.aapm.org/org/policies/details.asp?id=468&type=PP&current=true

The ACR followed suit a short time after endorsing the revised recommendation. The ACR posted this announcement on their website in early June 2019.


This sparked a lot of discussion on the ASRT Communities, social media pages, and also at the recent ASRT Governance and House of Delegates Meeting in Orlando. Educators were asking what to do with their educational requirements that students perform proper shielding as part of their competencies. It was reported that some facilities were now adopting the practice and no longer shielding patients per policy. As part of our education for decades, the question is what do we do now?

As of the Orlando meeting, the ASRT had not taken a position on this recommendation. At the ASRT update in Orlando, CEO Sal Martino stated further review and discussion needs to take place before they would make a decision. The board would be meeting following the meeting and the issue is on their agenda.

Our Practice Standards contain language in several locations regarding the shielding of patients during imaging exams. Down the road, this could require some revisions if practice requirements are officially changed. For example, one item included in the Practice Standards for Radiography is listed below.

1. Documents the use of shielding devices and proper radiation safety practices.

The ASRT posted a notice regarding the AAPM Position Statement on Fetal and Gonadal shielding following its first Board of Directors meeting in June. The board will meet again later this year and further discuss and review the documentation before making a decision to endorse or oppose the recommendation.


The JC, Joint Commission, has also recently rescinded its requirement for annual radiation safety education that pertains to fluoroscopy, which had just begun this past January. All persons performing fluoroscopy were required to do annual safety education related to the fluoroscopy environment. Effective immediately, The JC is deleting Standard HR.01.05.03, the element of performance (EP) 15 from the Ambulatory Care, Critical Access Hospital, Hospital, and Office-Based Surgery programs.

https://www.imagewisely.org/News/General/TJC-Deletes-Fluoroscopy-Training-Requirement?fbclid=IwAR0diWgmxULj1T1lzexowoVuFXWPvm4JSPZ4uADFTbeHqHrKkzpYafVSRdh48

With this kind of news making headlines, it does not help to have recent studies released discussing issues with digital imaging. While it has brought many benefits to our daily workflow, archiving and such, it has also created some not so great habits, thanks in part to post-processing features.
Along with “dose creep” issues that we already know about, we now have “collimation creep,” which comes when there is cropping or masking of the image post-exposure. It is disappointing that some technologists have fallen into bad habits that add a dose to the patient, degrade the quality of the image or potentially exclude imaged anatomy that may contain important incidental information in the interpretation. As technologists, we are not in a position to decide what is important to be reviewed by the radiologist. If it has been imaged, it needs to be seen by the radiologist, who is the only one who can legally interpret the acquired images.

Post-processing, while positive in some ways, can lead and has led to basic details being omitted from our previous expected workflow. Cropping, masking, and even annotation of right or left markers all go against the expected performance standards. Below are the standards of pre-exposure collimation and pre-exposure placement of markers. The ASRT has an Advisory Position Statement, as well as, statements within the Radiography Practice Standards that speak to the expected performance standards. Below are the expectations for technologists.

4. Uses appropriate uniquely identifiable pre-exposure radiopaque markers for anatomical and procedural purposes.
5. Selects the best position for the demonstration of anatomy.
6. Injects medication into peripherally inserted central catheter lines or ports.
7. Coordinates and manages the collection and labeling of tissue and fluid specimens.

This new position statement is currently a recommendation from or endorsed by some notable organizations. This does not mean, however, that it is yet a requirement such as a law or regulation would mandate. It will be interesting to see what happens in the next few months or year regarding the expectations moving forward. State regulations and practice standards may need to be revised to keep up with these changes in the future.

Having discussed repeals of shielding and fluoroscopy education, it could not come at a worse time with current legislation working its way through the California legislature. AB 407 was introduced in the state Assembly back in February.

The current amended bill text as of June 24, 2019, is at this link:
http://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201920200AB407

The most current bill analysis is at the following link:

The bill was moved through the Assembly Health, Business, Professions and Economic Development and Appropriations committees, before moving to the Assembly Floor. Passed with little opposition, it moved on to the Senate. The most recent committee hearing was in Business & Professions on June 24th. It was passed and referred on to the Appropriations committee. The following amendments were added during the committee hearing:

(b) Notwithstanding subdivision (a), a physician and surgeon or a doctor of podiatric medicine, who complies with subdivision (c), may provide fluoroscopy and radiography services and may supervise radiologic technologists without a Fluoroscopy X-ray Supervisor and Operator’s permit or certification.
(c) A physician and surgeon or a doctor of podiatric medicine, who has completed the radiation safety training provided by a facility accredited by the Centers for Medicare and Medicaid Services’ Conditions for Coverage relating to radiation safety, shall submit evidence that they have completed the facility’s radiation safety training to the State Department of Public Health within 60 days of completing the training. That training shall serve in lieu of passing the Fluoroscopy X-ray Supervisor and Operator’s permitting or certification test required by the State Department of Public Health. After receiving evidence that the radiation safety training is complete, along with a copy of their valid license and any required and reasonable permit or certification fee, the State Department of Public Health shall issue the physician and surgeon or the doctor of podiatric medicine a Fluoroscopy X-ray Supervisor and Operator’s permit or certification without requiring a permitting or certification examination.

(i) A physician and surgeon or a doctor of podiatric medicine, who works in a setting that is in compliance with the Centers for Medicare and Medicaid Services’ Conditions for Coverage relating to radiation safety, satisfies the requirement for fluoroscopy and radiography continuing education as set forth in subdivision (b) of Section 30403 of Title 17 of the California Code of Regulations.

In summary, there will still be a permit for the supervisor/operator but without the required examination. The radiation safety continuing education...
will be removed in lieu of “initial education documented”. They will be able to supervise CRTs in fluoroscopy or radiography.

The state will continue to generate its revenue from the permits, but without ensuring that the physicians and chiropractors have appropriate education and training. The education deemed necessary to be sufficient for privileges in Fluoroscopy will be left up to the facilities to decide. All of the required education for the JC, CMS and our state licentiates seems to have been deleted because of implied “redundancy” and under the expectation that the “other organizations” are still requiring it. This will lead to a variety of inadequate education and training for those very supervising MDs that technologists work under.

The Radiologic Health Branch, (RHB) just announced a Proposed Rule Making regarding fluoroscopy. Notices were sent out to facilities, licentiates and registered technologists in the state. The department is asking for comment on its proposed changes to Title 17, 17 CCR based on recommendations from the Radiologic Technology Certification Committee (RTCC). The four items regard the movement of the fluoroscope or patient during procedures, defined scope of practice for CRTs, recording time of exposure during fluoroscopic procedures and experience requirements for individuals with training oversight of radiologic technology students. The proposal hopes to clarify what actions and which persons must hold certain RT Act authorizations.

https://lookaside.fbsbx.com/file/DPH-17-009%2045-Day%20PN.pdf?token=AWyzzl4iqdTYP1wBlqnr1xNViliXZtiFhKz208gBYKpoigil7Z5L-DLhsmuTL4bS9fZ96eMRS1xIKOHc3azuDVKrtpDaiX2p-yApDYBDw7_IW5bprtknK CZZqoIhzhgxEkDykbyeEES5wNgKhvmDuRpuQma5FbRz4QqviFr5wxx0zWim6j89wT.fl

Comments will be accepted until August 5th, 2019. A public hearing is possible if requested by concerned persons or organizations. The CSRT will be requesting a public hearing to address all of the proposed regulation changes. Check back with the CSRT website (www.csrt.org) and Facebook/LinkedIn pages for more information as it arises. The CSRT encourages everyone to submit their comments, concerns, and suggestions to the proposed revisions of the Radiologic Technology Act and Title 17.

The RTCC, Radiologic Technology Certification Committee, will hold its next meeting on Wednesday, October 23, 2019 in Sacramento. More information can be found at the RHB website under Certification and Permitting

https://www.cdph.ca.gov/Programs/CEH/DRSEM/Pages/RHB.aspx

MARCA is the Medicare Access to Radiology Care Act of 2019 and was introduced on March 28, 2019, by U.S. Representatives Mike Doyle of Pennsylvania and Pete Olson of Texas as H.R. 1970. There is a Senate Bill 1544 introduced on May 20, 2019, by Senator John Boozman. Both of these bills would amend the Medicare reimbursement policy for radiologist assistants to be in line with state radiologist assistant licensure laws. The ARRT and the ASRT are working with the ACR and the Society for Radiology Physician Extenders (SRPE) to enact H.R. 1970 and S. 1544.

Links to each bill H.R. 1970 and S. 1544

The State of California introduced its own bill for Radiologist Physician Extenders in February of this year. SB 480 is currently referred to the Senate Business, Professions and Economic Development committee. It has not had much activity since that time. We are continuing to monitor any progress or changes in the bill.

http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB480

Stay up to date on our website and further news. The CSRT encourages everyone to please join and become a member to support the state and local efforts related to our profession. Please see our membership information at www.csrt.org and join today.
Neuroblastoma is the most common extracranial solid tumor found in childhood (Casey et al., 2018; Kang et al., 2017; Mullassery & Losty, 2015; Newman & Nuchtern, 2016; Phelps et al., 2018; Schleiermacher & Philip, 2019) after leukemia (Nabavizadeh et al., 2014). In the United States it represents approximately 7%-10% of all childhood cancers (or about 650 cases per year) (Colon & Chung, 2013; Kang et al., 2017; Mullassery & Losty, 2015; Newman & Nuchtern, 2016). Neuroblastoma accounts for 15% of all childhood cancer deaths (Colon & Chung, 2013; Kang et al., 2017; Mullassery & Losty, 2015; Newman & Nuchtern, 2016). The average age of diagnosis is between 18 and 22 months; neuroblastoma is not often seen in adolescents nor adults (Colon & Chung, 2013; Newman & Nuchtern, 2016; Schleiermacher & Philip, 2019; Schor, 2019, p.207). Furthermore, there is a slight predilection for males (Colon & Chung, 2013; Newman & Nuchtern, 2016; Schleiermacher & Philip, 2019; Mullassery & Losty, 2015, p. 68).

Neuroblastoma is a cancer of the sympathetic nervous system (Arumugam, Manning-Cork, Gains, Boterber, & Gaze, 2018; Mullassery & Losty, 2015; Newman & Nuchtern, 2016; Pastor & Mousa, 2019) and it arises from cells of the neural crest (Pastor & Mousa, 2019). As many as 70% of neuroblastoma patients have reportedly presented with metastases at the time of initial diagnosis (Nabavizadeh et al., 2014, p.329; Casey et al., 2018; Arumugam et al., 2018; Mullassery & Losty, 2015; Schleiermacher & Philip, 2019). Some reports note that neuroblastoma tumors start to metastasize 6-36 months after initial diagnosis (Hu et al., n.d., p.4-5).

Neuroblastoma commonly metastasizes to bone, bone marrow, liver, head, neck, orbit, or base of skull (Nabavizadeh et al., 2014). In rare cases, it will metastasize to the brain (Nabavizadeh et al., 2014). Almost 65% of neuroblastoma presents in the abdomen and half of those are located in the medulla of the adrenal gland (Colon & Chung, 2013; Mullassery & Losty, 2015; Pastor & Mousa, 2019, p.38). With regard to brain metastases, discovery of tumors at this site frequently occur at the time of disease recurrence and not at diagnosis (Nabavizadeh et al., 2014; Hu et al., n.d.). Moreover, neuroblastoma tumors involved in the parenchymal, intraventricular, or leptomeningeal parts of the brain pose serious complications and, thus, translate to poorer prognoses (Nabavizadeh et al., 2014).

There are no known risk factors for neuroblastoma (Newman & Nuchtern, 2016). A family history of neuroblastoma has been reported in 1-2% of cases of familial autosomal dominate cases (Mullassery & Losty, 2015; Newman & Nuchtern, 2016; Schleiermacher & Philip, 2019). Neurofibromatosis type 1 has been reported in neuroblastoma patients (Mullassery & Losty, 2015; Schleiermacher & Philip, 2019).

Presentation & Diagnosis

Neuroblastoma may be discovered incidentally while undergoing medical studies for another (suspected) ailment or through elevated urinary catecholamine metabolite levels such as dopamine (DA), vanillylmandelic acid (VMA), and homovanillic acid (HVA) (Mullassery & Losty, 2015, p.68). Catecholamine metabolites are the most sensitive and specific tumor markers for neuroblastoma (Berthold & Simon, 2005; Mullassery & Losty, 2015). Likewise, other elevated lab results such as ferritin (142+ ng/ml), neuron specific enolase (100+ ng/ml), and lactate dehydrogenase (1,500+ IU/I) have been found at diagnosis for some neuroblastoma positive patients; high levels in these specific serum markers at diagnosis proved to be predictive of poorer outcomes (Mullassery & Losty, 2015, p.68). How neuroblastoma presentation in the clinical setting varies widely, ranging from life-threatening to spontaneous regression (Mullassery & Losty, 2015). Some children will present with general symptoms of malaise, fevers or weight loss (Colon & Chung, 2013; Mullassery & Losty, 2015). Other patients may present with abdominal extension due to a growing mass or pain from metastatic disease to bones (Berthold & Simon, 2005; Colon & Chung, 2013; Mullassery & Losty, 2015; Newman & Nuchtern, 2016; Schleiermacher & Philip, 2019). Still other patients may present with convulsions...
Neuroblastoma found in the thorax may be visible on chest radiographs (Mullassery & Losty, 2015). Thoracic tumors may cause symptoms related to intraspinal extension or spinal cord compression and are associated with Horner's Syndrome [ptosis, miosis, and anhidrosis (Mullassery & Losty, 2015)]. Abdominal neuroblastoma tumors may compress organs and cause swelling, urinary retention, or constipation (Mullassery & Losty, 2015).

Intraorbital masses may cause bilateral periorbital ecchymosis ['raccoon eyes' (Berthold & Simon, 2005; Schielemacher & Philip, 2019; Mullassery & Losty, 2015)]. If the orbits are involved swelling and proptosis may also occur (Colon & Chung, 2013; Mullassery & Losty, 2015).

Metastatic disease in high risk disease includes bone marrow, bones, and lymph nodes (Berthold & Simon, 2005). Patients with low risk disease are often found incidentally (Kushner et al., 2005; Newman & Nuchtern, 2016). The child may be asymptomatic but a mass may be palpable during a physical exam (Kushner et al., 2005; Newman & Nuchtern, 2016).

Infants with stage 4S frequently present with abdominal distension (Berthold & Simon, 2005). This is caused by the liver infiltration and subcutaneous nodules (Berthold & Simon, 2005). The liver enlargement can lead to respiratory distress within hours or days (Berthold & Simon, 2005). Infants with 4S present without bone involvement but the liver, skin and bone marrow commonly show disease (Berthold & Simon, 2005). Patients with skin lesions may develop blue nodules and are referred to as blueberry muffin syndrome (Colon & Chung, 2013).

Accurately assessing the stage of neuroblastoma in a patient is crucial as this will determine the intensity of patient’s treatment plan (Pastor & Mousa, 2019; Schor, 2019). In general, neuroblastoma can be categorized as stages and also in terms of risk intensity.

Neuroblastoma stage 1 signifies that the tumor is confined to the area of origin and has undergone a complete gross resection with negative lymph node involvement (Berthold & Simon, 2005, p.74; Newman & Nuchtern, 2016). Stage 2 is broken down into Stage 2A-with a unilateral incomplete gross resection with negative lymph nodes-and Stage 2B-a complete or incomplete gross resection with an ipsilateral lymph node positive for tumor but the contralateral lymph node negative for tumor (Berthold & Simon, 2005, p.74; Newman & Nuchtern, 2016). Stage 3 is identified by the tumor crossing anatomical midline with or without lymph node involvement. Stage 4 is tumor metastasizing to distant locations. Stage 4S is designated for infants 12 months or less with primary tumor staged as stage 1 or 2 with distant metastatic disease limited only to the skin, liver and bone marrow (Berthold & Simon, 2005, p.74; Newman & Nuchtern, 2016).

Low risk disease includes stage 1, 2 and 3 without MYCN amplification. Intermediate risk disease is determined by the resectability of the primary tumor. It is not straightforward as imaging may be subjective. Some oncologist and surgeons may use chemotherapy prior to surgery to shrink the tumor (Kushner et al., 2005). Stage 3 tumors with non-MYCN amplification are considered intermediate risk (Kushner et al., 2005).

High risk neuroblastoma includes stage 4, stage 3 with MYCN amplification or unfavorable histology, or stage 4S infants with MYCN amplification (Kushner et al., 2005). MYCN amplification is associated with rapid disease progression and a worse outcome (Mullassery & Losty, 2015; Newman & Nuchtern, 2016; Pastor & Mousa, 2019).

Patients presenting with stage 1 or 2 can be treated with surgery alone (Gerald, 2005; Kushner et al., 2005; Colon & Chung, 2013; Newman & Nuchtern, 2016; Phelps et al., 2019). For patients with non-high-risk stage 3 neuroblastoma, chemotherapy followed by surgery can be utilized (Berthold & Simon, 2005; Kushner et al., 2005). A unique category of neuroblastoma is stage 4S and is diagnosed in infants. Many infants with 4S can
be safely observed with no treatment (Kushner et al., 2005). Many tumors spontaneously regress and have an excellent prognosis (Abramson & Shulkin, 2005). It is limited to the primary site with metastatic disease only to the liver, skin and bone marrow (Berthold & Simon, 2005). Chemotherapy may be indicated for infants with stage 4S with MYCN amplification (Kushner et al., 2005). Historically, 4S classification and less aggressive treatment plan were reserved for infants 12 months or younger. Contemporary research suggests re-categorizing ‘high risk’ children ages 12-18 months with stage 4 non-MYCN amplification as ‘intermediate risk’ so that this relatively older group of patients may, too, benefit from the reduction in the treatment intensity that their younger 4S counterparts enjoy (Kushner et al., 2005).

Stage 4 high risk neuroblastoma requires a much more aggressive treatment plan. Treatment principles for stage 4 high risk neuroblastoma include induction chemotherapy, surgical resection, radiation therapy, and treatment to treat minimal residual disease (MRD) such as immunotherapy (Lucas et al., 2018; Casey et al., 2018; Casey et al., 2019; Mullassery & Losty, 2015; Pinto et al., 2015). Despite initially responding to chemotherapy, some neuroblastoma patients will experience tumor recurrence and become resistant to treatment (Gerald, 2005). Undergoing chemotherapy prior to surgery is one option in order to reduce the tumor volume and bone marrow involvement (Kushner et al., 2005). High dose marrow ablative chemotherapy followed by a hematopoietic cell transplant is used to eradicate residual disease that may become resistant to treatment (Kushner et al., 2005). More specifically, chimeric antigen receptor (CAR) T cells are transplanted in order to prevent neuroblastoma relapse (Pastor & Mousa, 2019). Radiation therapy to primary sites and other persistently diseased sites after induction chemotherapy can be an option plan (Casey et al., 2019; Casey et al., 2018; Arumugam et al., 2018). Radiation therapy doses are typically around 21Gy (Casey et al., 2019; Casey et al., 2018; Colon & Chung, 2013). Targeted therapies after treatment has been utilized due to the high relapse rate of neuroblastoma after treatment (Kushner et al., 2005).

Induction chemotherapy uses different combinations of intensive cycles of chemotherapy (Mullassery & Losty, 2015). The goal of induction chemotherapy is to achieve a complete metastatic remission (Schleiermacher & Philip, 2019). The response to the initial chemotherapy protocol is a significant indicator of prognosis (Casey et al., 2018; Schleiermacher & Philip, 2019). Induction chemotherapy may include cisplatin, cyclophosphamide, vincristine, doxorubicin and etoposide (Newman & Nuchtern, 2016; Mullassery & Losty, 2015).

**Surgery**

In general, surgical resection is used to excise macroscopic tumor; great care is given to minimize damage to adjacent structures (Mullassery & Losty, 2015). Because neuroblastoma is a highly infiltrative tumor-frequently adhering or even encasing adjacent structures, achieving negative surgical resection margins is difficult (Mullassery & Losty, 2015). Nonetheless, surgery is standard treatment for all stages of neuroblastoma except 4S. For low risk tumors, complete resection of the tumor may be the only treatment necessary (Kushner et al., 2005; Schleiermacher & Philips, 2019). For intermediate risk patients the goal of surgery is to remove as much of the primary tumor as without harm to the patient. For patients with unresectable intermediate risk chemotherapy following surgery should be use (Kushner et al., 2005). High risk neuroblastoma initially begins with a biopsy and then complete resection of the tumor is completed after induction chemotherapy (Kushner et al., 2005.) All high risk patients should be treated with radiation therapy as the microscopic margin is considered to be positive (Kushner et al., 2005). Surgery is not recommended for metastatic disease (Kushner et al., 2005). Side effects of surgery can include large hemorrhage, vascular injury, intubation after surgery, and permanent post-operative Horner’s syndrome (Kushner et al., 2005).

**Chemotherapy**

Not all neuroblastoma patients will require chemotherapy intervention; for those patients that do require chemotherapy, the role chemotherapy plays may differ. “Low-risk” patients may require only observation or surgical resection to address their treatment needs unless they suffer from life-or organ-threatening symptoms (Mullassery & Losty, 2015). Chemotherapy is more frequently employed when treating intermediate and high risk neuroblastoma cases. Chemotherapy can help to suspend tumor growth, improve viability of surgical resection, or alleviate life-threatening symptoms (Mullassery & Losty, 2015). “High-risk” neuroblastoma patients undergo three distinct chemotherapy phases: 1) induction of remission, 2) consolidation of remission, and 3) maintenance phase (Mullassery & Losty, 2015). The induction phase utilizes “combinations of anthracyclines, platinum-based compounds, etoposide, microtubule inactivating agents and alkylating agents” (Mullassery & Losty, 2015). A successful induction phase of therapy will show total or significant neuroblastoma remission (Schor, 2019). The second chemotherapy phase involves two course of high-dose chemotherapy that is administered 6-12 weeks apart (Schor, 2019, p.206). In the maintenance phase of chemotherapy-when neuroblastoma is in remission, immunotherapeutic agents and other biological response modifiers are employed (Schor, 2019). In addition, “high-risk” patients undergo myeloablative chemotherapy and a bone marrow transplant (Mullassery & Losty, 2015).

High dose chemotherapy with stem cell rescue (HDC/SCR) also referred to as an autologous transplant may be used in the treatment of neuroblastoma. It uses high doses of chemotherapy followed by the patient’s own stem cell to help recover. Without the patient’s own stem cells, the patient would not be able to recover as the treatment is myeloablative (Kushner et al., 2005).
Radiation Therapy

Radiation therapy is not standard for patients with stage 1 or stage 2 disease (Kushner et al., 2005; Mullassy & Losty, 2015). Radiation therapy is only used for cases with progressive disease or emergent cases requiring intervention. These include spinal cord compression or respiratory distress (Kushner et al., 2005; Mullassy & Losty, 2015). Radiation therapy treatment of neuroblastoma may require as little as 15 Gy and as many as 36 Gy for local irradiation (Schleiermacher & Philip, 2019). Radiation therapy to doses of 21 Gy is recommended for stage 1 and 2 only if surgery and chemotherapy cannot adequately control the disease (Kushner et al., 2005). For patients with intermediate risk, radiation therapy is only employed to address emergent circumstances as well as persistent tumor after chemotherapy and a second look surgery (Kushner et al., 2005). Infants with 4S only require radiation therapy if the tumor is causing respiratory distress or if liver involvement causes compression (Kushner et al., 2005). In these emergent cases, low doses of radiation may be appropriate, on the order of 1.5 Gy per fraction for three fractions (Kushner et al., 2005).

High risk neuroblastoma typically receives radiation therapy doses of 21.6 Gy in 12 fractions to the primary tumor volume prior to surgical resection (Lucas et al., 2018; Casey et al., 2019). However, due to the low incidence of local failure, lower radiation therapy doses have been considered (Lucas et al., 2018; Casey et al., 2019). CT planning should be used to define the target volume as well as other critical structures. Intensity modulated radiation therapy (IMRT)-a type of radiation therapy approach-is helpful to provide maximum sparing of critical organs (Kushner et al., 2005). Radiation therapy can be useful for palliation of progressive neuroblastoma. It can be extremely effective for bone pain and neurologic deficits (Kushner et al., 2005). Patients with even a solitary brain metastasis may benefit from craniospinal radiation therapy due to the high propensity for leptomeningeal dissemination (Kushner et al., 2005). Patients with persistent metastatic disease after induction chemotherapy may benefit from radiation therapy to provide local control (Casey et al., 2018; Mullassy & Losty, 2015). Side effects from radiation therapy will depend on the size of the tumor as well as the doses given. Certain chemotherapies given prior to radiation therapy may increase the toxicity of the radiation (Kushner et al., 2005). These drugs include doxorubicin and dactinomycin and are commonly contraindicated during radiation therapy (Kushner et al., 2005). For patients receiving radiation therapy to the abdomen, the side effects may include nausea and diarrhea. Long term growth may be minimally impacted but can be more pronounced with treating multiple vertebral bodies or long bones (Kushner et al., 2005).

Most treatment failures are attributed to the minimal residual disease (MRD) that was not eliminated after high dose chemotherapy (Colon & Chung, 2013). Over half of patients with neuroblastoma who achieve clinical remission after induction and consolidation therapy will relapse due to the presence of therapy resistant MRD (Pinto et al., 2015). Targeted biologic agents are given with the goal of eliminating any MRD. These may include immunotherapy, I-MIBG, and other approaches (Pinto et al., 2015).

Immunotherapy

Neuroblastoma is the sole pediatric solid tumor for which the US Federal Drug Administration (FDA) and the European Medicines Agency (EMA) has established immunotherapy as an effective therapeutic modality through the approval of the anti-GD2 antibody dinutuzimab for high-risk neuroblastoma (Kudva & Modak, 2019).

Prognosis

As with most diseases, a patient’s prognosis is highly correlated with the extent of their disease. Stage 1 and low risk patients have the best prognosis. More specifically, low risk neuroblastoma patients treated with surgery alone have a reported survival rate of over 90% (Kushner et al., 2005). Likewise, patients with stage 1 have a reported overall 5 year survival rate of 99% (Pinto et al., 2015; Schleiermacher & Philip, 2019). Infants with stage 45, too, have a 5 year survival rate of 90% (Pinto et al., 2015; Schleiermacher & Philip, 2019).

Patients with intermediate risk stage 3 neuroblastoma have survival of over 90% (Kushner et al., 2005; Pinto et al., 2015). The current goal for intermediate disease to minimize treatment related side effects while preserving the high overall survival (Kushner et al., 2005; Pinto et al., 2015).

The survival rate for high risk neuroblastoma is around 50% (Basta et al., 2016; Newman & Nuchtern, 2016; Pinto et al., 2015). Response to induction chemotherapy is an important prognostic factor for disease control (Casey et al., 2019). According to some experts, distant failure is the most common form of relapse in patients with neuroblastoma (Casey et al., 2019). For children with high risk neuroblastoma the chance of relapse is around 50% (Casey et al., 2018). If a child relapses, their survival rate after relapse in less than 10% (Basta et al., 2016).

Long Term Side Effects

Long term side effects from neuroblastoma are dependent on the treatment modalities utilized. Children diagnosed with low and intermediate risk tumors may experience neurological deficits from the disease burden itself and/or from surgery (Laverdiere et al., 2005). These include paraplegia, neurogenic bladder and parasthesias (Laverdiere et al., 2005). High risk neuroblastoma patients often experience more severe long term complications from treatment (Lim et al., 2016). Commonly used platinum-based chemotherapy agents like cisplatin can cause high frequency hearing loss (Lim et al., 2016). Also, chemotherapy agents compromise the function of kidneys; preservation of the remaining kidney in patients who have undergone nephrectomy is particularly concerning (Lim et al., 2016). Hypothyroidism may be caused by both...
MIBG and radiation therapy to thoracic or cervical tumors (Laverdiere et al., 2005; Schor, 2019). Ovarian and testicular dysfunction can be caused by both chemotherapy and radiation therapy (Laverdiere et al., 2005; Schor, 2019). Dental abnormalities from chemotherapy and radiation therapy to the head and neck areas are more common in patients ages five and under (Laverdiere et al., 2005; Schor, 2019). Lungs and the heart may also be affected in the long term (Laverdiere et al., 2005; Schor, 2019). Secondary cancers from both chemotherapy and radiation therapy may also result (Laverdiere et al., 2005; Schor, 2019). The cumulative incidence of a secondary cancer is 3.5% at 25 years (Mullassy & Losty, 2015; Schor, 2019). The most common secondary tumors include thyroid, renal cell, soft tissue sarcoma, acute myeloid leukemia, and breast cancer (Mullassy & Losty, 2015; Schor, 2019).

Neuroblastoma and Medical Imaging Modalities

Medical imaging plays a significant role in the identification, planning, treatment, and monitoring of neuroblastoma patients before, during, and after cancer treatment. Below is a select and brief summary of these roles.

Ultrasound (aka sonography) is the most common screening tool for abdominal and pelvic difficulties in the pediatric population. This modality utilizes non-ionizing radiation which renders sedation unnecessary. Ultrasound can often detect the primary tumor and any metastatic disease in the liver (Abramson & Shulkin, 2005; Colon & Chung, 2013; Mullassy & Losty, 2015; Schleiermacher & Philip, 2019). The use of fetal ultrasonography has proven to be effective in diagnosing neuroblastoma prenatally (Davis et al., 2017). Prenatal sonographic images of neuroblastoma may appear lobulated (Davis et al., 2017, p.193).

Computerized Tomography (CT) scans serve a variety of purposes in the planning, treatment, and management of neuroblastoma. Scans can display vascular anatomy, which plays a vital role in determining the viability and extent of surgical tumor resection (Mullassy & Losty, 2015). CT images enable visualization of tumor calcifications, if present. CT scans may also be used to determine if there are sites of bony disease; this would translate diagnostically to stage 4 disease (Abramson & Shulkin, 2005). However, despite its general usefulness, care should be exercised to avoid using CT to evaluate the response to treatment in bony disease any changes resulting from treatment may not appear on CT scans for months or years (Abramson & Shulkin, 2005).

Magnetic Resonance Imaging (MRI) is frequently utilized in medically imaging neuroblastoma for several reasons, including that it avoids the employment of ionizing radiation, can detect bone marrow disease (unlike CT), and can be used to more precisely define the amount of bony involvement (Abramson & Shulkin, 2005; Schleiermacher & Philip, 2019). Whole body bone scans are used to detect metastatic disease in an afflicted patient. However, similar to CT scans, bone scans may falsely continue to show abnormalities for months or years after treatments (Abramson & Shulkin, 2005). MRI can also be helpful in assessing the spinal cord involvement (Mullassy & Losty, 2015). Contrast-enhanced MRI scans are especially valuable for visualizing neuroblastoma brain metastases (Nabavizadeh et al., 2014). Technically speaking, cystic or necrotic components of neuroblastoma tumors are easily recognizable as high signal on T2WI (Davis et al., 2017, p.193). Calcifications are best displayed in T2 weighted images because diffusion-weighted images appear bright due to the small, dense cells of neuroblastoma tumors (Davis et al., 2017, p.193). Of note, although MRI scans are widely accepted as a safe modality for all gestational ages, some facilities delay the use of 3T MRI scanners until after 28 weeks gestation (Davis et al., 2017, p.195).

Nuclear medicine can be employed in the staging and treatment of neuroblastoma. Meta-iodobenzylguanidine (MIBG) scintigraphy is both a sensitive and specific tracer for neuroblastoma and, thus, is used to accurately stage disease (Mullassy & Losty, 2015). More specifically, MIBG enables visualization of bone, bone marrow, and soft tissue metastases (Mullassy & Losty, 2015). Furthermore, neuroblastoma can be treated with nuclear medicine when MIBG is paired with either 121I, 123I, or Tc-99m (Mullassy & Losty, 2015). It is important to emphasize that healing bone will not absorb MIBG (Abramson & Shulkin, 2005). Because it takes months or years after a patient completes treatment for positive treatment results to appear in bone on medical images, many neuroblastoma patients with recently treated and healed bone may experience false-positive medical imaging results for neuroblastoma (Abramson & Shulkin, 2005). MIBG is also able to identify the amount and distribution of bone marrow involvement (Abramson & Shulkin, 2005). MIBG imaging uses the expression of norepinephrine transporters which will cause the scan to become MIBG avid (Schleiermacher et al., 2019). Nearly 90% of neuroblastomas express the neurotransmitter and therefore will be MIBG avid (Schleiermacher & Philip, 2019). For these patients, other medical imaging modalities may be more helpful. Of note, some experts found MIBG to be unreliable in detecting brain metastasis, particularly small lesions. In these cases, employing MRI in an appropriate and timely fashion is a superior monitoring plan for afflicted patients (Nabavizadeh et al., 2014).

Positron Emission Tomography (PET) is effective in monitoring neuroblastoma tumors that fail to concentrate MIBG at diagnosis or following treatment; more specifically, fluorodeoxyglucose (FDG) is used (Abramson & Shulkin, 2005; Mullassy & Losty 2015; Pfuger & Piccardo, 2017). PET scans may also be more beneficial than MIBG for localizing soft tissue metastatic disease (Colon & Chung, 2013). F-fluorodeoxyglucose positron emission tomography (FDG-PET) scans are able to show uptake differences which may lead to a better prognostic value (Kang et al., 2017). Poorly differentiated neuroblastoma will present with a high uptake, distinguishing it from differentiated neuroblastoma or ganglioneuroblastoma.
(Kang et al., 2017). Additionally, some studies found FDG to be superior to combo123-MIBG for detecting neuroblastoma stages 1 and 2 at the time of initial staging (Pfluger & Piccardo, 2017).

In conclusion, neuroblastoma is a pediatric cancer whose management and prognosis are dependent on the stage at diagnosis. Early stage neuroblastoma fares much better than late stage. Treatment options vary depending on the stage and age of the child. Clinical trials for neuroblastoma are available and may offer different treatment options for children with relapsed or refractory disease. Ongoing disease evaluations are an important clinical tool to monitor for disease recurrence.

References


doi:10.1016/j.critrevonc.2019.03.013


doi:10.1016/j.semnuclmed.2016.10.007
Generalization of the Patient Population – First week at Hospital X Cardiac Cath Lab

A common misunderstanding in "Hospital X" when encountering patients who are non-English speakers is that "they speak Spanish". The point is taken that “Hospital X” is in a predominantly Hispanic populated area, therefore, health professionals place implicit bias and generalizations on patients. While at "Hospital X" I made the same mistake and assumed that if patients did not speak English, they spoke Spanish.

Today, in the cardiac catheterization lab we encountered a patient who I thought was a Spanish speaker. I had this perception because the other technologists I was working with assumed he spoke the language and began speaking to him in Spanish. So, I introduced myself to the patient in Spanish. Embarrassed, I found out he did not speak Spanish at all. It turned out that the patient was Greek, a culture that I did not expect from patients from this hospital because of its location.

Before this situation, I felt confident about knowing the patient population and thought that I would be more prepared when encountering patients, not of my culture. After this experience, I learned to keep an even more open mind and to expect the unexpected when dealing with all experiences in the hospital, because each experience we have is unique. This situation showed me the amount of work and learning that I along with other health professionals needed in being culturally competent.

Language barriers are one of the limitations within the hospital specifically in radiology. Luckily in the cardiac cath lab, patients have already consented to the procedure with a family member or authorized personnel who can properly translate and understand the circumstances of the procedure in English. Regardless, as health professionals, we must learn more about cultures we do not identify with to improve patient relations in the hospital.

Hello Good Bye - Week 2 at Hospital X Cardiac Cath Lab

The number one goal in all community service is to reach out and serve the target stakeholders. Often, as an intern and community server, “service” is perceived as the direct one-on-one interaction with stakeholders. For example, for a rad tech intern the direct one-on-one interaction with patients in the hospital is to accommodate their diagnostic imaging needs. However, this is not always the case. Patient care is not always delivered directly to patients. For instance, during my cardiac cath lab rotation, patients are consented for a procedure and for the most part patients come in and out of the procedure room with little interactions with health professionals in the room. This is what I call a “hi and bye” interaction.

Due to this “hi and bye” culture that I noticed during clinical, I realized that indirect patient care is just as important as direct interactive patient care. The idea that comes to mind when being an outstanding health professional is showing compassionate patient care and tending to their needs. How can we express compassionate patient care when we have limited time with patients?

At the cath lab, I learned the importance of my duty even as a student. On a daily basis, I check materials and linen and make sure we are all stocked with materials. We had a code stroke patient, which required fast speed and a quick response to the situation. Every second counted to diagnose and treat the patient. During the procedure, I opened catheters, stents, wires, syringes, and other materials. I realized my importance in the team when I began to question, “what if we didn’t have the proper materials for the procedure, what if I didn’t stock up materials, and what would that mean for the patient?” Indeed, there was little time to talk to the patient, however, my simple job of being prepared with materials made a big difference in this situation for the team and most importantly the patient.

Patient care should not be limited to the idea of physical interaction and engagement. The act of organizing patient questionnaire forms, stocking linen, cleaning the X-ray room, and familiarizing yourself with the equipment is just as important as physically engaging with patients.

Getting the Job Done – Hospital Y OR rotation

Today I noticed some ongoing issues that occurred between team members and the rad tech in the OR. In
this hospital, technologists go in and out of rooms to take radiographic images of the patient for different cases, while doctors, nurses, and surgical techs stay inside the room for an entire case. I felt that somehow, technologists in the OR are misunderstood because they are going in and out of cases. Therefore, technologists are perceived as individuals who “cannot get the job done”.

In this hospital’s OR, there is very little physical patient interaction between tech and patient. By the time the tech gets in the room, patients are already given sedatives and medication that makes them fall asleep for the entire procedure. The ongoing idea of indirect patient care is still pertinent in the OR.

Make it Quick! – Another day at the OR

The OR was not busy so, I began to work on x-rays. I realized how the environment was so different compared to the OR and other rotations. In this specific hospital, patients are constantly coming in and out of the department to get their x-rays done. This promotes the “fast pace culture” within this department. I have not been in an x-ray rotation in a long time and needed practice myself. Although I still know to take x-rays, my speed was not up to par with what the technologists wanted.

I encountered a patient who I’ve met before and took her x-ray prior to her surgery. Surprisingly, she remembered my face. A bit chattery, she started a conversation while I was taking her x-ray. I enjoyed her conversation however often patients who talk “too much” is perceived as a cause of delay with patients which leads to slow patient turn over. I question how to be an efficient technologist without degrading patient care.

Burnout, Recovery, and Passion – the last week of clinical

The semester is coming to an end. I feel the change and differences from one hospital to another and from one rotation to another. I engaged with a wide variety people from different geographical regions and experienced the different environments of radiology. I discovered my own differences from the diverse individuals I encountered which both broadened and challenged my perspectives.

Although we like to express our work as just “another day in clinical”, it is important to be aware of our bias and hypocrisy when we talk about patient care. By thinking that it’s “just another busy day”, it is implied that every day is the same day and every patient is the same patient. Having this mindset limits our ability to perform patient care and community service. Every patient should be treated as an individual because everyone has their own specific health need. There should not be a “generic form of patient care”. Yes, maybe there should be a guideline but it is important to keep in mind rules are meant to bend, shape, and form your own way. Hence, there is no right or wrong way to express and give patient care.

As I get closer and closer to graduation, I begin to question my passion and think about whether this field is what I want to pursue as it continues to challenge my mind and physically drain my body. During this semester, I realized that I have the power to influence and provide a form of health care that I can shape and mold for the community. This is a privilege, something I thought I had very little of. The “burnout”, the stress, and the tired feeling does not outweigh the amount of satisfaction I feel after caring for a patient in need of medical treatment. At the end of the day the amount of passion you pour into your job is the best reward that anyone can give knowing you’re done your absolute best in your community service.

STUDENT CORNER

The CSRT has opened the application period for the Anna B. Ames and Ruth McMillan student scholarships.

Anna B. Ames Clinical Excellence Student Scholarship. Anna B. Ames, CRT, lived a life of service to others as a radiographer, a founding leader of CSRT, and as a responsible and active citizen in her community. Anna had a strong conviction of personally providing the best patient care possible. In memory of Anna B. Ames and her legacy – a world made better due to her professional competence, responsibility to duty, steadfast ethical principles, and the warmth and vitality she shared with all whom she touched, one CSRT student member exemplifying these qualities and clinical excellence will be selected for this $500 scholarship. The Anna B. Ames scholarship recipient will be announced at the CSRT Annual Conference.

Ruth McMillan Academic Excellence Student Scholarship. Ruth McMillan, CRT, was a long-standing supporter of CSRT and a spirited and enthusiastic advocate of educational projects. In honor of her memory and generosity, one CSRT student member who exemplifies academic excellence in medical imaging or radiation therapy will be awarded this $500 scholarship. The Ruth McMillan scholarship recipient will be announced at the CSRT Annual Conference.

Application Deadline: Scholarship applications must be received by August 15, 2019.

Click here for the Anna B. Ames Clinical Excellence Student Grant Application.

Click here for the Ruth McMillan Academic Excellence Student Grant Application.
Update on State of California Online Renewal of Certification

By Will Edmunds, MEd, RT(R), ARRT

The Fall 2017 Radiologic Technology Certification Committee (RTTC) meeting introduced plans to begin the process of creating an online license renewal system. The draft minutes of this meeting reflect the goals of the New Online Licensing Application (NOLA). The RTCC draft minutes (2017) reported that representatives described this new process as "in its simplest form will be an enterprise licensing platform to allow physicians and physician assistants to submit online applications for new licenses to use x-ray equipment and to renew those same licenses. The application will include an online payment process with an automated workflow functionality" (p. 10).

The California Department of Public Health (CDPH) does have an online certificate, licenses, permits, and registrations portal that has been started for a select group of professions regulated by the state. Progress is being made and now established for manufacturing cannabis, laboratory personnel, and lead related construction professionals by the CDPH. According to Gonzalo Perez, Chief of the RHB in a recent email to the author:

“I look to hopefully find out more updates on this being opened to those technologists licensed by the Radiologic Health Branch (RHB) at the upcoming Fall 2019 RTCC meeting in Sacramento. The goal is to soon be able to renew our state licenses online based on the success of a more limited and controlled roll out to other licensees regulated by the state. Stay tuned!”

References

Hunters Point is named after the Hunters family of San Francisco dating back to the 1800s. The land sits on 638 acres of waterfront property south of the Bay Bridge that represents land mass that is the farthest point extending east into the water of the bay towards Oakland from the San Francisco Peninsula (HPSA History, n.d.). This location on the waterfront naturally became home to a shipyard. The land was privately held as a shipyard until the U.S. Navy moved in during the 1940s and 1950s to create a Naval base. The base was decommissioned in 1974, leaving part of the land as a Navy repair station (HPSA History, n.d.). Over time, the land was privatized and unused buildings that use to make up the naval base were sublet out to different groups. This included “Jacques Terzian, whose business fabricated found-object based furniture and wall installations. Jacques’ vision saw the possibility of transforming several of the neglected buildings into affordable workspaces, and in 1983, a handful of artists began renovating and renting their studios at the Shipyard” (HPSA History, n.d., para. 2). This group at “The Point” claims to be America’s largest artist community. With space being at a premium in San Francisco, this waterfront property is a great location to offer artists a place to work.

In more recent years, Hunters Point has been zoned for residential properties overlooking the San Francisco Bay. The FivePoint development company has plans to continue to phase out the development of a residential, commercial, and parks/recreational community known as the San Francisco Shipyard. “As of January 2018, the development consists of 283 homes located within The SF Shipyard” (SFSY, n.d.). Fagone and Dizikes (2019) report that “military radiation experiments during the Cold War left the shipyard’s soil and buildings tainted with large quantities of radioactive substances. Some of these materials remain dangerous for tens of thousands of years and can cause cancer if inhaled or ingested in extraordinarily small amounts” (para. 8). A 15 year clean up project of this property has led to a great deal of cost and questionable results from those companies involved in the review of the long terms results of the past work on this land.

The California Department of Public Health (CDPH) has been working to test this land over the last year in multiple phases. According to the website (that publicly posts the results of this work), “in response to public concern and at the request of the US Environmental Protection Agency, the U.S. Navy, the Department of Toxic Substances Control, and partners from the City of San Francisco, the California Department of Public Health is performing a phased approach radiological survey to assess the health and safety of the public and the environment at Hunters Point” (HPSA History, n.d., para. 2). This article does go on to report on the CDPH reports of this find not having any safety concerns for those living in the area already. The amount of dose measured and no residual readings once removed, allowed the RHB to conclude “the amount of radiation output by this deck marker would not have resulted in a health or safety hazard to anyone who happened to be at that spot previously” (RHB Parcel A-1 Report, 2019, p. 23).
I found this report from the RHB to be very comprehensive and in learning about the history of Hunters Point, there has been a lot of history having to do with this parcel of land by the Bay. It is unfortunate that alleged falsification of results having to do with the cleanup and testing on this prime real estate has caused the public to be concerned and perhaps slowed the development plans to improve this area. Education is the key to this as many that work around radiation in the medical field know. Part of the RHB A-1 Parcel report (2019) discusses the Navy Deck Marker finding in comparison to the average annual dose for Americans of around 620 mrem per year (p. 23). If someone was to stand over this buried Navy deck marker (emitting 0.09 mrem/hr), they would need to be there for approximately 287 days to match the average annual dose of 620 mrem or approximately 0.07 mrem/hour annually. This reading was 0.02 mrem/hr over the national annual average does received by Americans.

As with everything to do with radiation dose, perspective is the key to an understanding of the findings of readings of radium in a deck marker in proximity to residential housing. To help illustrate this, I look back to the history of this radium Navy deck marker. Myers, Wagner, Witte, and Villarreal (2019) report that a landmark on Hunters Point is a massive crane on the southeast point of the shipyard used as a part of the logo for the new development that “towers 500 feet above a paved strip called Gun Mole Pier. This is where a former sailor said he removed deck markers from warships during the height of the Cold War, according to an interview transcript included in the radiological assessment. He recalled wearing special protective clothing and working a special seven-hour shift with no lunch break” (para. 31). The RHB team today used only a radiation monitoring badge along with the survey equipment as protection during their work. Better testing tools and education can change the understanding of many different aspects of radiation safety and protection.

References


CT Scanning of Pregnant Patients

By Cory Shaffer

Introduction

CT is an invaluable diagnostic medical tool within the medical field. Yet it comes with the high price of radiation exposure to the patient. The amount of exposure is one of the largest within diagnostic medical imaging (DMI). Nonetheless, it’s still a widely used modality, and for good reason. It provides thorough patient imaging, with superior spatial resolution within a timely manner. For this reason, I decided to investigate how CT is applied to pregnant patients, and how it may affect the conceptus (developing fetus or embryo). There are many defensive medical practices regarding pregnant patients, and CT is no different. The following discussion will explain the significance, benefits and risks of CT imaging, the necessary precautions including common exams, with focus on pregnant patients, measurements of fetal dosage, and the effects on the conceptus.

Significance of Irradiating Pregnant Patients

Irradiating a pregnant patient may affect the development of the growing conceptus. The cellular tissues of the conceptus are very susceptible to radiation. Cell susceptibility can be best described by the ‘Law of Bergonie and Tribondeau’. In short, the law states that cells with the following characteristics are most radiosensitive: stem cells, highly mitotic cells, high metabolic activity, younger tissues (Bushong, 484). The developing conceptus is composed of young, undifferentiated stem cells. These same cells will continue to grow through mitosis and require large amounts of metabolic activity. Therefore, the conceptus is highly susceptible to radiation exposure. The maternal abdomen acts as a natural buffer between the conceptus and anything that may be harmful to the conceptus from the outside world. However, CT’s high amounts of kVp x-ray will penetrate the abdominal buffer, causing significant amounts of radiation exposure to the conceptus. The measurement of fetal exposure is called fetal dosage. High levels of fetal dosage may result in a large number of birth defects, and even death. This is why all radiologic exams performed on pregnant patients must be taken seriously, measured, and recorded.

Fetal dose per Exam

For the sake of discussion I will be adopting the International Standard Unit (SI unit) measurement known as Gray, which is the measurement of absorbed dose. Table 1 lists the ranges the fetal dose for common radiologic exams. The exams with the least amount of fetal dose (considered negligible ranges) are: Head/Neck 0.001-0.01, Chest CT or CT pulmonary angiography (0.01-0.66), limited CT pelvimetry (<1.0 mGy). Exams with the highest amount of fetal dose are, abdominal CT (1.3-35 mGy) and pelvic CT (10-50 mGy). The closer the CT scan is to the pelvis region, the higher the fetal dose. It is apparent that CT scans within the abdomen and pelvis have considerably high fetal dose as compared to the natural annual amount (0.28 mGy) of fetal dose at sea level (Miller, 2012)).

Table 1: Fetal Radiation Doses Associated with Common Radiologic Examinations

<table>
<thead>
<tr>
<th>CT Exam</th>
<th>Fetal Dose</th>
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<tbody>
<tr>
<td>Head/Neck</td>
<td>0.001-0.01 mGy</td>
</tr>
<tr>
<td>Chest CT / CT pulmonary angiography</td>
<td>0.01-0.66 mGy</td>
</tr>
<tr>
<td>Limited CT pelvimetry (single axial through femoral heads)</td>
<td>&lt;1.0 mGy</td>
</tr>
<tr>
<td>Abdominal CT</td>
<td>1.3-35 mGy</td>
</tr>
<tr>
<td>Pelvic CT</td>
<td>10-50 mGy</td>
</tr>
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Threshold for Teratogenesis

Resulting birth abnormalities (teratogenesis) from CT scans vary considerably and are directly related to the region of the body being imaged. Table 1 (above) & table 2 (below) provide the estimated threshold dose for abnormalities during birth. This threshold is composed of two periods, the gestational period (date since last menstrual period) and fetal period. Both periods are susceptible low amounts of dosage, 50-60 mGy, and may result in intellectual disabilities or early termination. If the fetal dosage exceeds a specific amount, typically 150 mGy, the patient should consult with a radiation physicist in order to calculate the specific amount of fetal exposure. Depending on the amount of fetal dosage, the patient may need to consider an abortion through medical necessity (therapeutic abortion).
abortion). Another complication caused by high fetal dosage is carcinogenesis (in-utero induced carcinoma). However, the exact amount of fetal dosage required to cause carcinogenesis is unclear. It is estimated that 10-20 mGy may increase the risk by 1.5 to 2 (Sadro, 2014). It is important to be aware that radiation exposure is permanent and cannot be removed from the irradiated subject, even during in-utero.

Table 2: Effects of Gestational Age and Radiation-Induced Teratogenesis

<table>
<thead>
<tr>
<th>Gestational Period</th>
<th>Effects</th>
<th>Estimated Threshold Dose</th>
</tr>
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<tbody>
<tr>
<td>0-2 weeks after fertilization</td>
<td>Death of embryo or no consequence (all or none)</td>
<td>50-100 mGy</td>
</tr>
<tr>
<td>2-8 weeks</td>
<td>Congenital anomalies (skeleton, eyes, genitals)</td>
<td>200 mGy</td>
</tr>
<tr>
<td></td>
<td>Growth Restrictions</td>
<td>200-250 mGy</td>
</tr>
<tr>
<td>Fetal Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-15 weeks</td>
<td>Severe intellectual disability (high risk)</td>
<td>60-310 mGy 2 per 1,000 mGy</td>
</tr>
<tr>
<td></td>
<td>Intellectual deficit</td>
<td>5 IQ-point loss</td>
</tr>
<tr>
<td></td>
<td>Microcephaly</td>
<td>200 mGy</td>
</tr>
<tr>
<td>16-25 weeks</td>
<td>Severe intellectual disability (low risk)</td>
<td>250-280 mGy</td>
</tr>
</tbody>
</table>

Confirmation If The Patient is Pregnant

When greeting a potentially pregnant patient (female age puberty - 55 years) it is important to identify if she is pregnant. Determination can be done by one of two ways: reviewing the clinical history or taking a pregnancy test. Clinical history will be sufficient in most radiographic procedures (ex: traditional radiography, CT of Head, neck, chest), and may include the patient’s verbal confirmation that she is not pregnant, confirmation of medication including birth control, hysterectomy, ongoing oncologic therapy, etc. If the clinical history fails to determine whether the patient may be pregnant then a pregnancy test is required.

Methods In Reducing Fetal Dosage

List 1 below highlights methods of reducing fetal dose when imaging pregnant patients.

These methods should be incorporated when CT scanning pregnant patients in an effort to reduce fetal dosage.

List 1

- One size does not fit all: avoid standard protocols
- Reducing the scan range for the exam to strictly the anatomy of interest (if clinically allowed).
- Decreasing kVp in smaller patients
- Decreasing the amount of current (mAs) produced by the CT machine.
- Increase the pitch, the distance traveled in one gantry rotation divided by total thickness of all acquired slices (Morgan).
- Limit the field of View
- Avoiding imaging in multiple phases
- Use recently more novel imaging reconstruction algorithms to reduce noise in images, thus allowing reduction in milliamperage or increase in noise level requirements during scanning
- Lead shielding of the mother, most profound effect with circumferential shielding
- Internal Barium (Ba) shielding with of oral 30% Ba sulfate solution
- Local quality assurance program to monitor CT protocols and the resulting dose

Common Non Obstetric Exams Involving CT

Ultrasound is the preferred method for diagnostic imaging in regards to pregnant patients due to its non ionizing nature. However, there are times when ultrasound cannot provide enough diagnostic information, and may require an additional CT scan. For example, Claudia Sadro, author of the article “CT and Pregnancy: Risks and Benefits”, states appendicitis, the most common non-obstetrical emergency, may require a CT scan due to the limitations of ultrasound. In non-pregnant patients appendicitis can be diagnosed with the use of ultrasound. Yet due to the altered anatomy of the pregnant patient, the location of the appendix may not be clear. Magnetic Resonance Imaging (MRI) may be used, but it is still not as efficient as CT when locating the appendix, and takes an average of 25-45 minutes to scan. Time is a critical factor when there is risk of the appendix rupturing due to appendicitis, and is even more so for pregnant patients. One of the common symptoms of pregnancy is abdominal pain, which can cause the patient to overlook the symptoms of appendicitis, thus increasing the chances of appendix rupture. This increased rate of appendix rupture has a fetal loss rate of 6-37% (Sadro, 2014). The only other option to locate the appendix may be exploratory surgery, which poses too great of a risk for the pregnancy. An abdomen CT scan with oral or intravenous contrast is a quick, reliable means to identify the location of the appendix. The average fetal dose for this exam is 25 mGy. Other examinations that may require CT scans with similar conditions are: renal colic obstruction, ovarian torsion, hemmorhagic cyst, adnexal mass, and degenerating fibroid. The stated conditions are limited when being able to identify key anatomy in order to properly diagnose and prepare for surgery.

Trauma

Trauma is the leading cause of non obstetric maternal mortality and affects 7% of pregnancies (Ridge, 2009). Trauma can lead to a miscarriage, or even worse death of the mother and conceptus. That is why it is crucial to use any resources, such as CT scans, that would ordinarily


3 Imaging in Pregnant Patients: Examination Appropriateness.
be given to non pregnant patients. This especially pertains to blunt abdominal trauma (BAT). BAT is a serious form of trauma that may result in internal bleeding, contusions, or injury to the bowel, intestines, liver, spleen, and conceptus. In such circumstances it is imperative to image the patient's abdomen. Additionally, in certain instances the patient may have multiple orders of CT scans for one exam (ex: pelvis, abdomen). Or, there may be instances where the patient may require multiple consecutive scans in order to follow the progress of an injury or pathology. When multiple exams are required the fetal dose will also become higher, and may exceed the 50 mGy threshold. In order to limit the amount of fetal dose the radiologic technologist will need to modify the exam using low-dose protocols.

Conclusion

When imaging pregnant patients it is best to use non radiation modalities such as MRI and ultrasound. Yet, there are times during a pregnancy when there are non-obstetric pathologies. It is crucial for the health of the conceptus to have a healthy mother. Therefore, it is important for the mother to receive any necessary care, including CT. CT does have high amounts of fetal dose, thereupon requiring the radiologic technologist to incorporate methods of reducing fetal dose. By using these methods, the radiologic technologist will be able to substantially reduce the chances of teratogenesis and carcinogenesis. However, these chances do increase when it is required for the patient to receive multiple CT exams. Ultimately, it is a matter of whether the benefits outweigh the risks. And if the benefits of the CT scan help with the health of the mother, then they too will help with the health of the pregnancy.

References


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