Winter Edition 2021

The Beam

Mississippi Society of Radiologic Technologists

Inside This Issue

A proud affiliate *of the* asrt

Happy 2022! I saw a joke about how 2022 could be interpreted as "2020 – 2". I certainly hope 2022 is not a repeat of 2020, however I think we have all come to understand that healthcare will continue to be a challenging place to work. As our profession continues to be front-line providers in the battle with COVID-19, I am hopeful that other health professions are starting to see what a critical role we play in the care of our patients.

We were so happy that Natchez was able to host our annual conference this past October. While smaller than some of our other conferences, it was encouraging to see the excitement of our student and technologist members at the event. This truly helped us all see how important this annual event is to our society. The MSRT Board of Directors are again cautiously hopeful that we can hold our annual conference in October 2022. The location and dates for the conference will be forthcoming. We will continue to monitor the situation and any decisions made regarding the 2022 conference will be in the best interest of the health and safety of our members.

It is more important than ever to strengthen the voice of our profession during these challenging times! One way to accomplish this is to get involved. Please contact a member of the Board if you would like information on how you can help. Volunteering is a wonderful way to network, build a resume, develop new leadership skills, meet others, and give back to our profession!

I am excited to see what is in store for 2022 and am again thankful for the opportunity to serve as president of the MSRT!

Stay safe and be well,

Asher Street Beam, DHA, RT(R)(MR), MRSO
MSRT President

The MSRT Business Meeting for the 78th Annual Conference was held at The Magnolia Bluffs Hotel in Natchez, MS, on October 25, 2021. Asher Street Beam, President of the MSRT, welcomed those present and thanked everyone for attending conference.

A quorum was established, and the meeting was called to order by the MSRT President, Asher Street Beam, at approximately 4:05 p.m.

The minutes from Conference 2019 were accepted as published in the BEAM.

The following reports were given:

1. Treasurer:

a. Please refer to Appendix A for Annual Financial Report that was presented at the business meeting.

2. Vice President: Nothing to report.
3. Secretary: Nothing to report.
4. Editor of The Beam: No report given.
5. Executive Secretary/Website Administrator:
    a. Membership is down a little from this time last year.
        - Active Members (RTs) - 130
        - Associate Members- 1
        - Honorary Members- 3
        - Life Members- 10
        - Student Members- 182
        - Total membership- 326

6. ASRT Affiliate Delegates: Mike Ketchum and John Melvin represented the MSRT as ASRT Affiliate Delegates at the June 2021 ASRT House of Delegates Meeting, which was conducted in a virtual format. The report from the ASRT Affiliate Delegates was published in the summer 2021 edition of The Beam.

7. Operating budget:
    a. Lee Brown, Chairman of the Board, presented the proposed operating budget for 2021-2022 that was approved by the board. (See Appendix B)

9. Conference Coordinator/Conference Chair: 90 attendees preregistered for conference. MSRT suffered a financial loss for conference 2021.

10. New Business
    a. Emergency Bylaws:

    Lee Brown, Chairman of the Board, presented the following bylaw amendments to the voting membership. These bylaws were published in the Summer 2021 edition of the Beam for membership to review.

    - Article 13 (copy from bylaws)- motion to accept amendment.
    - Article 2 (copy from bylaws)- motion to accept amendment.

    b. A voting member presented the following question to the Board of Directors:

    MSRT Member: Have you taken any measures to protect MSRT funds?

    Treasurer: No, MSRT is considering dissolving MSRT Districts and consulting legal advice from ASRT and part of this discussion is funds.

    President: In Bylaws (copy from bylaws)

11. Nominations
    a. President- Asher Beam and Jessica Reid
    b. Vice President- Jessica Reid and Zack Gray
    c. Secretary- Brittany W. Barron
    d. ASRT Affiliate Delegate- Lee Brown
        i. Elections were held for President and Vice President.
            - Asher Street Beam was elected President.
            - Zack Gray was elected as Vice President.

With no further business to be discussed, the meeting adjourned at approximately 4:33 p.m.

Respectfully submitted,

Brittany W. Barron, M.H.S., R. T. (R)

Technologist of the Year

Jessica Reid, B.S., R.T.(R)

CONFERENCE SPEAKERS

2021

Kristi Moore

Allison Puente

Deborah Shell

CONFERENCE SPEAKERS

2021

Richard “Fuge” and Dawn Fucillo

Brandon Smith

Asher Street Beam

Donna Cleveland and John Lampignano

Student Manuscripts

All student's papers were mailed to three (3) out of state judges for the student manuscript competition. Of those, six (6) are selected to present their topic at the annual conference. Listed below are the top 3 student manuscripts.

- "Cerebral Radiation Necrosis"
  — Kiana Jones (UMMC)
  1st Place
- "Computed Tomography/Positron Emission Tomography Versus Colonoscopy to Diagnose Colon Cancer"
  — Virginia Wright (UMMC)
  2nd Place
- "Palliative Radiation Therapy for Bone Metastasis and its Effects on Quality of Life"
  — Shae Miller (UMMC)
  3rd Place

Student Exhibits

- "Computed Tomography Imaging and COVID Lung Abnormalities"
  — Samantha Brown, Hannah Burnham, Michelle Green, Bre Waites (JCJC)
  1st Place
- "A Role that Runs Deep"
  — Sarah Cox (UMMC)
  2nd Place and People's Choice Award
- "Chernobyl Nuclear Accident"
  — Ciera Lightsey, Rachel Bryant, Cameron McLaurin, Desi Brunty (JCJC)
  3rd Place

Student Manuscript 1st Place Recipient
Kiana Jones

Abstract

Radiation therapy uses beams of intense energy to treat brain cancers. One significant complication of radiation therapy is cerebral radiation necrosis (CRN). CRN normally occurs after doses higher than 55 Gray (Gy), but also as low as 50 Gy. It is rare for CRN to develop but it is still possible. CRN has a significant impact on patients' quality of life, so it is best to get an early diagnosis and treatment before cognitive and neurological decline. There are challenges to diagnosing CRN because of the similar clinical and radiographic features with tumor growth and recurrence. Different scans, such as MRI and CT can help with the diagnosis but still are not as accurate as a surgical biopsy. There are currently treatment options, but research studies are being done to depict what treatment is best. More work is being done to create radiation therapies that directly attack cancerous brain tumors instead of irradiating the whole brain. We will discuss the pathobiology, symptoms, treatments, and complicated diagnosis of CRN.

Cerebral Radiation Necrosis

Cerebral radiation necrosis (CRN) is a major complication and the biggest challenge of radiation therapy for brain cancers. The ionizing radiation damages the endothelial cells and damages the blood brain barriers which leads to CRN. Cerebral radiation necrosis is found mainly in the white matter of the brain in the area where the tumor was radiated. Radiation necrosis usually happens after doses as low as 50 to 55 Gray (Gy). There are typically issues diagnosing CRN because the clinical and radiographic features resemble those of tumor recurrence. Knowing the difference is important because treatment and management are significantly different. Recurrent tumors typically require intervention medicine to prevent further growth, but CRN can be managed with some benign tumor treatment. Even though there are a number of brain imaging modalities, there are still difficulties diagnosing CRN. Whether radiation necrosis is symptomatic or asymptomatic determines which treatment method will be used; they may include monitoring, hyperbaric oxygen treatment, anticoagulants, or surgery. We will discuss the pathobiology, symptoms, challenging diagnosis, and treatment of cerebral radiation necrosis.

Pathobiology

"Cerebral radiation necrosis has been defined as a severe local tissue reaction that occurs at least 3-12 months after completion of RT [radiation therapy], though it has been reported to occur several years after treatment completion" (Ali et al., 2019). Cerebral radiation necrosis (CRN) is a severe, long term complication for patients who receive radiation treatments for brain cancers; it has a major impact on their quality of life. It affects the smaller arterioles and arteries in the brain which lead to edema, or swelling, in the brain; it also damages the endothelial tissue and glial cells. CRN is typically a rare occurrence. According to Buboltz & Tadi (2021), "… the range of risk can be as small as 5% to as high as about 37% of the patients. The incidence of

radiation necrosis of the brain ranges from 2.5% to 24% of irradiated patients." Patients who are at a higher risk of developing CRN are usually those who have had whole brain radiation therapy.

Risk factors that would increase the incidence of CRN are total dose of radiation treatment, fraction size, treatment duration, volume treated, chemotherapy, and previous radiation. Ionizing radiation can permanently insult DNA due to the sensitivity of tumor cells to exposure. "Endothelial cells are also damaged by radiation interacting with the plasma membrane which causes a ceramide-induced apoptosis" (Ali et al., 2019, p. 2). This results in further issues consisting of inflammation and death at the cellular level, with concern of additional cellular sensitivity. This may ultimately result in "fibrin-platelet thrombi and fibrinoid necrosis" due to "subsequent propagation of an inflammatory response involving cytokines and chemokines" (Ali et al., 2019, p. 2).

Symptoms

Symptoms vary per patient. Some radiation therapy patients may be symptomatic, showing clinical signs and symptoms while others may only be asymptomatic and show radiographic signs (asymptomatic). Some of the clinical signs and symptoms include headache, nausea and drowsiness. The most common signs are cognitive dysfunction. Patients' families usually notice a change in behavior and personality, short term memory loss, lack of motivation, and fatigue. "There are some cases where patients' symptoms include seizures, cognitive decline, and focal deficits. The focal deficits depend on the size, side, intracerebral location and associated edema and mass effect of the lesion" (Rahmathulla et al., 2013). There could also be difficulty with speech and weakness. Cognitive and motor functioning tests are usually

performed to pinpoint these issues. Both could result in death, so a quick diagnosis and immediate treatment could lower this incidence.

Diagnosis

Radiation necrosis is a difficult disease to diagnose. The radiographic features of this condition are similar to those of tumor recurrence; therefore the use of certain imaging makes it difficult to distinguish between the two. According to Buboltz and Tadi (2021), "The problem with diagnosing radiation necrosis of the brain is that it is difficult to distinguish tumor recurrence versus radiation necrosis...brain MRI perfusion scanning can be helpful in differentiating because in radiation necrosis there is often a lack of T2 flair usually involving the white matter but is commonly present with tumors". Magnetic resonance imaging and computed tomography usually show a ring around the tumor with excess fluid edema around it. This is what makes the diagnosing process difficult because these presentations are also consistent with tumor recurrence. It is rare that either scan will be able to distinguish between CRN and tumor recurrence. "Both types of lesions are typically hypo- or iso-intense to brain on non-contrasted CT and MR images, and the lesions may be solid or variably cystic. With administration of contrast, the solid component of the lesion will generally be enhanced… MRI is the preferred imaging modality" (Rahmatthulla et al., 2013).

There are various types of MRI exams that can aid in cerebral radiation necrosis diagnosis. Magnetic resonance spectroscopy (MRS) is a non-invasive imaging test that measures the chemical composition and changes in the brain, especially in brain tumors; Diffusion weighted imaging (DWI) and diffusion tensor imaging (DTI) are forms of magnetic resonance that uses image contrast to evaluate the viability and diffusivity of the white matter of the brain; and MR perfusion imaging is a noninvasive scan that evaluates the vascularity of a brain lesion

by assessing blood flow within the brain. In addition to MRI, nuclear medicine scans can image CRN; these scans use radionuclide tracers that assess lesions for any chemical activity by measuring uptake indirectly. Although these are the safest modalities and MRI is the preferred modality, the most reliable diagnostic technique is biopsy of the tissue. Mehrabian et al. (2017) conducted a study that stated chemical exchange saturation transfer (CEST), a form of MR imaging, is one of the best forms of imaging to determine whether the growth is radiation necrosis or a recurrent tumor.

Knowing whether the growth is tumor recurrence or cerebral radiation necrosis is important because the treatment options are tremendously different. "To minimize the possibility of misdiagnosis of RN, our institution utilizes a comprehensive semiweekly tumor board, serial MR imaging, and advanced imaging modalities when surgical intervention is not warranted to establish a diagnosis" (Kim & Miller, 2017).

Treatment/Management

As stated previously, treatment options for asymptomatic and symptomatic patients are different. Treatment for asymptomatic patients are more based on management, while treatment for symptomatic patients is more intense and potentially results in surgery.

For asymptomatic patients, MRI scans are taken, and doctors typically wait to see if there is growth. If there is growth, there may potentially be a biopsy to determine a proper diagnosis, CRN or tumor recurrence. If it is CRN, steroids are given to control swelling in the brain. Anticoagulants can be used to reverse small vessel injury to control the necrosis. The use of anticoagulants has shown clinical improvement without treatment toxicity. Bevacizumab is also used to treat radiation necrosis because it directly targets blood vessels around the necrotic tissue in the brain. "The therapy with the best supported evidence is bevacizumab. Because VEGF is

dysregulated with radiation necrosis and bevacizumab presumably controls VEGF, it can reverse the effects of radiation necrosis. Bevacizumab was given to 8 patients with radiation necrosis and all patients showed a reduction in fluid-attenuated inversion recovery abnormalities (FLAIR) and T1-weighted post-gadolinium abnormalities" (Chao et al., 2013).

Symptomatic treatment options are slightly different than those for asymptomatic patients. One option is hyperbaric oxygen therapy, which is when patients are placed into a chamber with 100% oxygen that is increased to 2.5 the times atmospheric pressure. The increase of atmospheric pressure forces oxygen into the blood plasma and tissues which encourages new vessels to grow throughout the necrotic area. In order to see some benefits, the patient will need at least 30 to 40 treatments. A disadvantage to this treatment option is it can cause oxygen toxicity/poisoning which will cause the patient to cough and have labored breathing and sometimes death. "(HBO2) reduces tissue edema and enhance collagen synthesis by fibroblasts which… is crucial for the healing of damaged tissue" (Buboltz & Tadi, 2021). Hyperbaric oxygen treatment is a good choice for treatment, but it is expensive and time consuming. This treatment will usually be used during radiation therapy to lower the risk of radiation necrosis for high risk patients. The last option for treatment is surgery, which may be needed to remove the necrotic tissue if the other treatment options fail. For patients with complications, surgery is the best, lifesaving option for treatment.

Conclusion

As mentioned earlier, cerebral radiation necrosis is a significant complication of radiation therapy and hard to diagnose. Regardless of how difficult it is to diagnose cerebral radiation necrosis, there has been progress made to make diagnosis safer, non-invasive, and more reliable. Early diagnosis and treatment provide optimum results to prevent irreversible cognitive and

neurological decline. More research is underway to aid with diagnosis and treatment.

There is also work being done with newer modalities to decrease the risk of radiation injury. These studies will bring awareness and help lower the incidence of developing cerebral radiation necrosis during radiation therapy.

References

Ali, F. S., Arevalo, O., Zorofchian, S., Patrizz, A., Riascos, R., Tandon, N. Blanco, A., Ballester, Y. L., & Esquenazi, Y. (2019). Cerebral radiation necrosis: Incidence, pathogenesis, diagnostic chal lenges, and future opportunities. Current Oncology Reports, 21(8), 1–17. https://doi.org/10.1007/s11912-019-0818-y

Buboltz, J. B., & Tadi, P. (2021). Hyperbaric treatment of brain radiation necrosis. In StatPearls. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK431083/

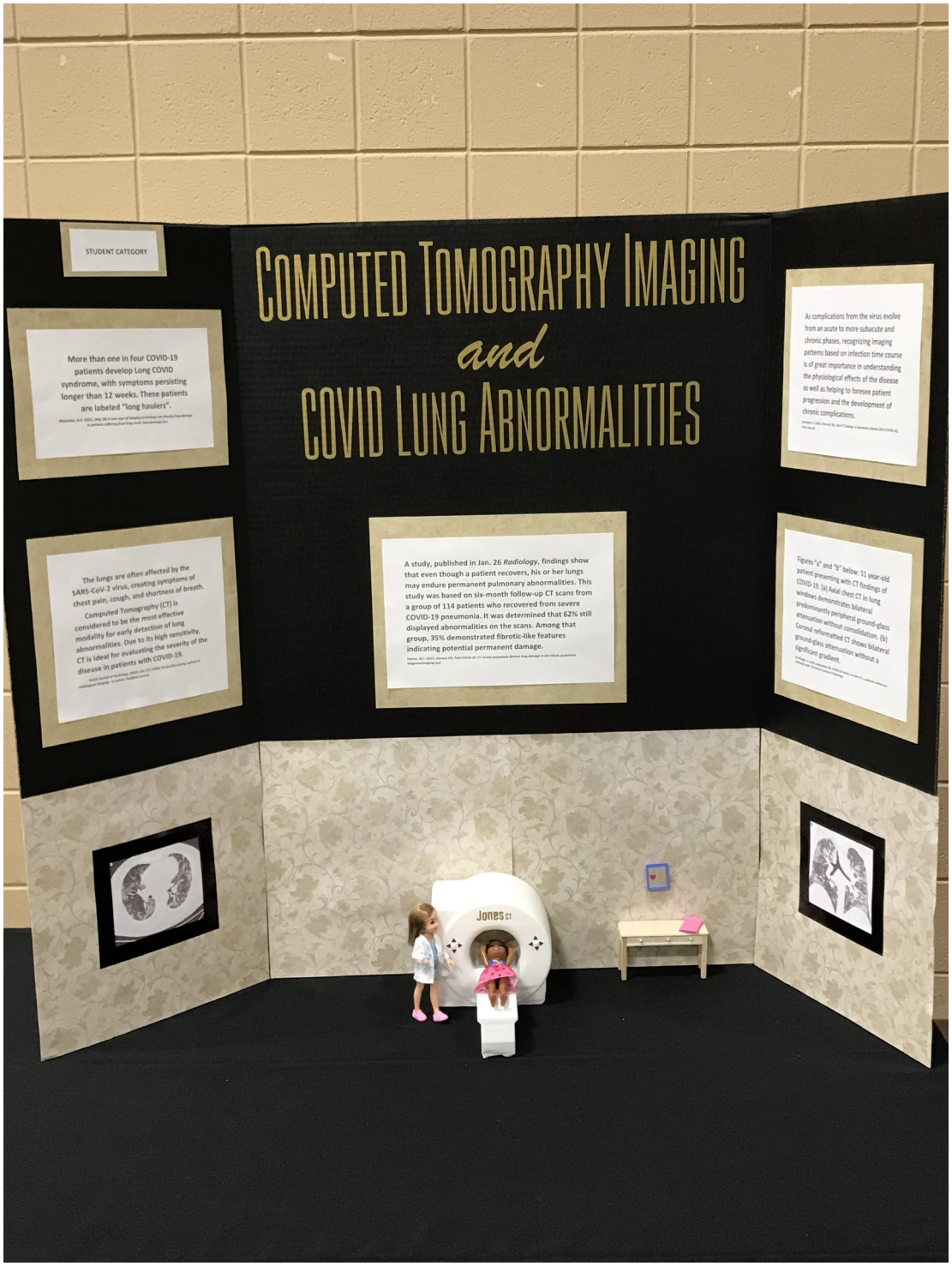
Chao, S. T., Ahluwalia, M. S., Barnett, G. H., Stevens, G. H., Murphy, E. S., Stockham, A. L., Shiue, K., & Suh, J. H. (2013). Challenges with the diagnosis and treatment of cerebral radiation necro sis. International Journal of Radiation Oncology, Biology, Physics, 87(3), 449–457. https://www.clinicalkey.com/#!/content/playContent/1-s2.0-S0360301613005476

Kim, J. M., Miller, J. A., Kotecha, R., Xiao, R., Juloori, A., Ward, M. C.,…Chao, S. T. (2017). The risk of radiation necrosis following stereotactic radiosurgery with concurrent systemic thera pies. Journal of Neuro-Oncology, 133(2), 357–368. https://doi.org/10.1007/s11060-017-2442-8

Mehrabian, H., Desmond, K. L., Soliman, H., Sahgal, A., & Stanisz, G. J. (2017). Differentiation be tween radiation necrosis and tumor progression using chemical exchange saturation trans fer. Clinical Cancer Research, 23(14), 3667–3675. https://doi.org/10.1158/1078-0432.CCR-16-2265

Rahmathulla, G., Marko, N. F., & Weil, R. J. (2013). Cerebral radiation necrosis: A review of the pathobiology, diagnosis and management considerations. Journal of Clinical Neurosci ence, 20(4), 485–502. https://www.clinicalkey.com/ - !/content/playContent/1-s2.0-S0967586812005759

Student Exhibits



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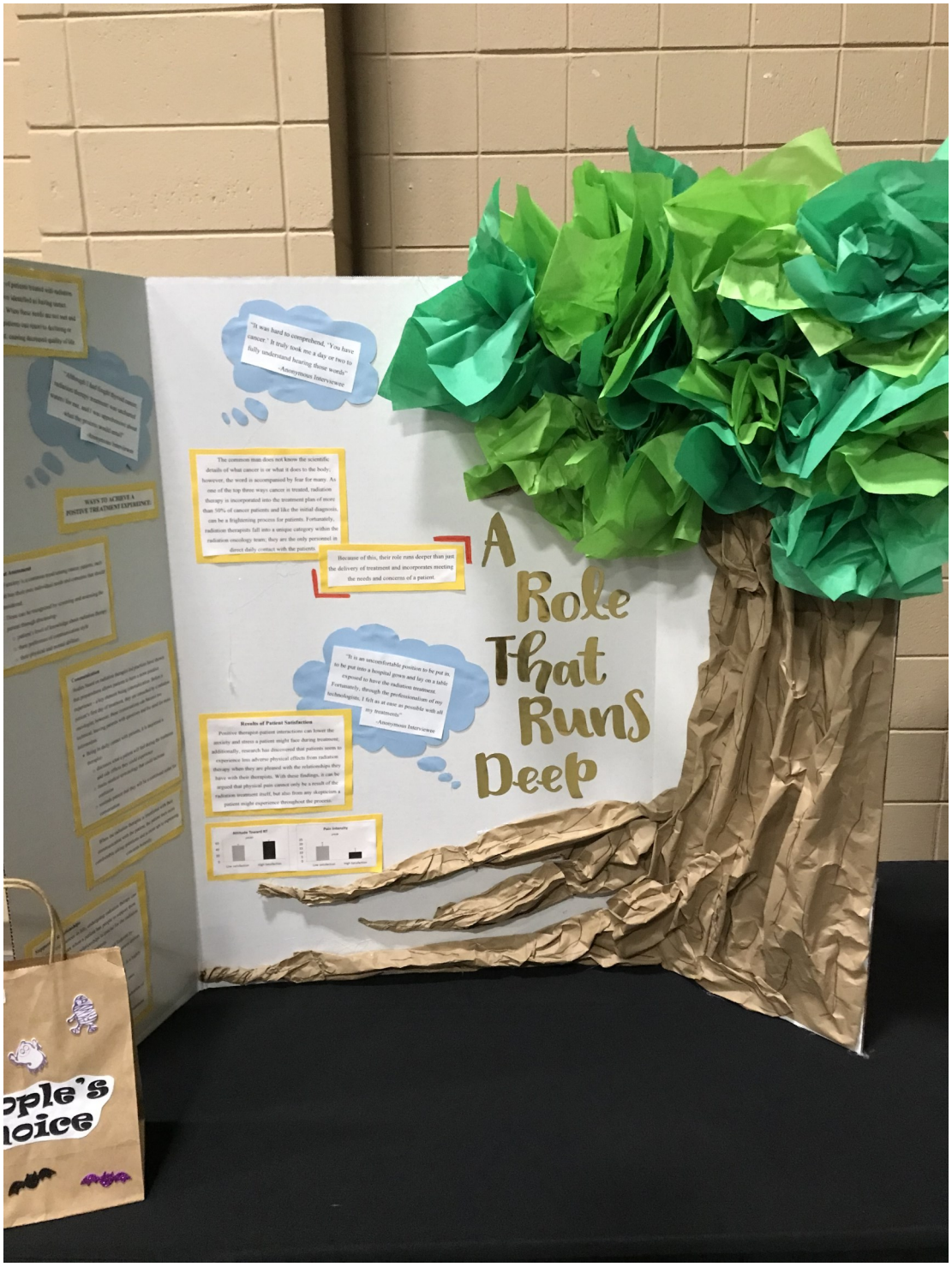

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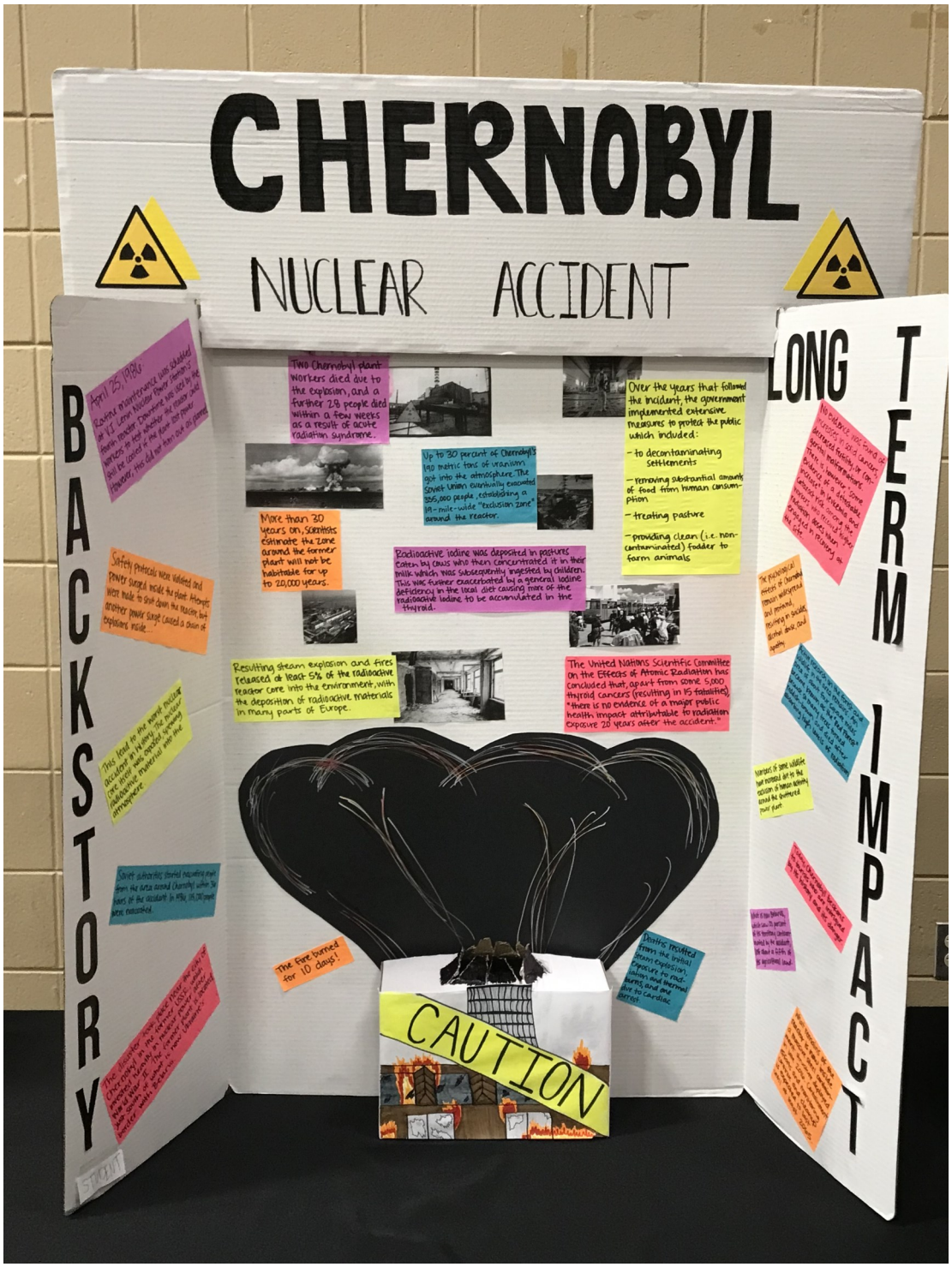


Technologist Manuscripts

Radiologic technologists have the opportunity to participate in the RT category of both manuscript and exhibit also. All technologist's papers were mailed to three (3) out of state judges for the manuscript competition. Listed below are the top 3 technologist manuscripts.

- "Differentiating Between PJI and Aseptic Loosening in Lower Extremity Athroplasty"
  — Brittany Freeman, B.S., R.T.(R)
  1st Place
- "The Use of Nuclear Medicine in the Diagnosis of Brain Death"
  — Zack Lyles, B.S., R.T.(R)
  2nd Place
- "Migraines and the Use of Functional MRI"
  — Allison Crane, B.S., R.T.(R)
  3rd Place

Technologist Exhibits

- "Using Radiolabeled Leukocytes to Image Infection"
  — Brittany Freeman, B.S., R.T.(R)
  1st Place

Technologist Manuscript 1st Place Recipient
Brittany Freeman, B.S., R.T.(R)

Differentiating Between PJI and Aseptic Loosening in Lower Extremity Arthroplasty

Advancements in medicine are continuously emerging and evolving. As a result, new and improved medical treatments are allowing the general population to live longer. A longer life expectancy, by consequence, means that bones and joints are having to remain functional for more extended periods. Arthroplasties are climbing in number due to the wear and tear people are putting on their joints over multiple decades (Arvieux & Common, 2019; Signore et al., 2019). Total knee and hip replacements are the most common arthroplasty procedures performed in the United States, with more than one million completed each year (Beam & Osmon, 2018). This number will rise to 3.48 million procedures per year by 2030 (Beam & Osmon, 2018). Although knee and hip replacements may not seem like necessary procedures, they are crucial in reducing pain and improving joint functionality; both of which will enhance the patient's quality of life (Beam & Osmon, 2018).

An increase in arthroplasty procedures results in an increased number of surgical complications. According to Palestro & Love, 2017, complications arise in 1%-3% of all prosthetic joint replacements. These complications can cause the patient extreme pain and discomfort and require treatment or revision. While proper treatment can fix the complication, a problem arises when it comes time to solve what is happening to the prosthesis that is causing the patient such pain. Possible complications include prosthetic joint infection (PJI) and aseptic loosening, which require different treatment routes and are challenging to differentiate from one another (Signore et al., 2019; Selter et al., 2019). Treatment options can be invasive and costly, making correct diagnosis obligatory before the patient can begin receiving necessary remedies (Signore et al., 2019). Diagnosing the source of prosthetic joint pain is a multistep process that includes conventional x-ray, laboratory tests, and advanced imaging modalities. These steps start

small and eventually lead to the most effective imaging modality used to differentiate between PJI and aseptic loosening, nuclear medicine.

Prosthetic Joint Infection (PJI)

PJI is an infection involving the prosthesis and its surrounding tissues (Palestro & Love, 2017). It is often debilitating and investigated if the patient is experiencing pain, swelling, redness, fever, and limited joint movement (Signore et al., 2019). The most common cause for total knee arthroplasty revision is PJI (Beam & Osmon, 2018). It is the third most common cause for hip arthroplasty revision, resulting in an annual revision cost of $1.62 billion in 2020 (Beam & Osmon, 2018). Quick diagnosis of PJI is imperative as a delay in diagnosis delays necessary treatments such as antibiotic therapy or surgery (Signore et al., 2019). A delay in treatment could negatively affect the chances of the patient maintaining the functionality of the prosthesis and joint (Signore et al., 2019). PJIs fall into three separate categories determined by the time of infection onset (Signore et al., 2019). Early infections occur within three months of the surgery date, with Staphylococcus aureus being the usual culprit (Signore et al., 2019). If the infection occurs between three months and two years, it is considered a delayed infection (Signore et al., 2019). Lastly, a late infection is any infection that occurs after the two-year mark (Signore et al., 2019). Streptococci, coagulase-negative Staphylococci, Enterococci, and anaerobes are often the source of late PJIs (Signore et al., 2019). Patients are at the highest risk for PJIs during the first two years after surgery, with one-third of those PJIs developing within the first three months post-operative (Palestro & Love, 2017; Beam & Osmon, 2018). 90%-100% of patients with PJIs experience pain, fever, and swelling, resulting from inflammation (Palestro & Love, 2017). Inflammation is also present in prosthetics undergoing aseptic loosening, thus, making the two complications hard to differentiate.

Aseptic Loosening

Aseptic loosening occurs when the implant fixation process fails (Apostu et al., 2017). Titanium is the favored metal for orthopedic implants because of its strength, biocompatibility, coefficient of elasticity, and corrosion resistance (Apostu et al., 2017). These titanium implants fixate to the bone by one of two methods; they are either cemented or fixated by bone ingrowth (Apostu et al., 2017). A cemented orthopedic implant attaches precisely as the name would infer. The implant fixates to the bone with a fast-drying cement (Apostu et al., 2017). However, the process of cementless fixation is more complex. The implant lies in apposition to the bone, where dynamic bone tissue forms a fibrin matrix around the implant (Apostu et al., 2017). Osteoblasts then migrate to the fibrin matrix, where they begin the process of osseointegration and new bone forms, fixating the implant to the bone (Apostu et al., 2017). If the process of osseointegration fails, the fibrin matrix is the only thing adhering the implant to the bone resulting in poor strength and a loose implant (Apostu et al., 2017). Whether the implant is loose because the cement failed or osseointegration failed, pain and inflammation are associated with aseptic loosening, just as observed with PJI. Most diagnostic tests specifically look for PJI, and aseptic loosening becomes the favored diagnosis when those tests come back negative.

Early Steps to Diagnosing the Source of Arthroplasty Pain

Conventional Radiography, Blood Tests, and Joint Aspiration

Obtaining conventional radiographs is one of the first steps in diagnosing arthroplasty pain (Seltzer et al., 2019; Signore et al., 2019). Radiographs lack sensitivity and specificity and often look normal during the early stages of infection (Palestro & Love, 2017). However, radiographs may be able to visualize aseptic loosening. If the radiologist can visualize a radiolucent line with a width greater than 2 mm where the bone and implant meet, or endosteal

bone genesis, aseptic loosening is possible (Apostu et al., 2017). In general, conventional radiographs do not have the specificity or sensitivity to definitively diagnose PJI or aseptic loosening (Palestro & Love, 2017).

Several blood tests convey potential infection. A white blood cell (WBC) count is a relatively inexpensive and easy to obtain blood test that can detect bacterial infections and viruses within the body. Although WBC counts can show elevated numbers of bacteria-fighting cells, they are highly non-specific, meaning an elevated WBC count could be arising from anywhere in the body, not necessarily around the affected joint (Signore et al., 2019). C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) blood tests are more reliable when looking for potential PJI (Signore et al., 2019). These blood tests are quick, inexpensive, and have fast turnaround times (Beam & Osmon, 2018). Although more reliable than the WBC count, neither a CRP nor ESR blood test can definitively determine whether prosthetic joint pain arises from an infection (Signore et al., 2019). However, their values decide whether the patient's joint requires aspiration for fluid analysis (Signore et al., 2019). A CRP value greater than 10 mg/L and an ESR value greater than 30 mg/L indicate the need for synovial fluid aspiration (Signore et al., 2019).

Joint aspiration, often guided by ultrasonography, involves inserting a needle into the affected joint and removing synovial fluid for relief and testing (Arvieux & Common, 2019). Aspiration is indicated when there is a concern for PJI (Signore et al., 2019). WBCs in the localized joint can be counted, and the microorganism causing the inflammation and infection can be identified when culture tests are ordered on the aspirated fluid (Signore et al., 2019). While joint aspiration alone should not be used to diagnose PJI, it is a valuable tool in the series of events that effectively diagnose PJI (Signore et al., 2019).

Advanced Imaging Modalities

Neither magnetic resonance imaging (MRI) nor computed tomography (CT) can give conclusive diagnoses of PJI or aseptic loosening. Still, they can provide clues to help guide physicians toward verification of one or the other (Arvieux & Common, 2019). Soft tissue inflammation and osteomyelitis manifest beautifully on MRI images (Seltzer et al., 2019). However, the metal prosthetic generates artifacts that hinder the visualization of the anatomy (Arivieux & Common, 2019). Artefact-suppression techniques can help with metal artifacts, but MRI cannot definitively determine whether or not an infection is present (Arivieux & Common, 2019). CT can evaluate the bone structure, but it cannot rule out whether an infection is present or not in the bone or surrounding tissues (Seltzer et al., 2019). These modalities may hint toward PJI or aseptic loosening, but a nuclear medicine exam is the only modality that can confirm or deny the diagnosis.

Nuclear Medicine's Role in Differentiating Between PJI and Aseptic Loosening

Nuclear medicine techniques have radically improved over the past 20 years (Arivieux & Common, 2019). After blood, synovial fluid, and imaging tests end in allusive conclusions, a nuclear medicine exam is a final step (Seltzer et al., 2019). Unlike other imaging modalities, nuclear medicine offers insight into the physiological processes of the body. (Palestro & Love, 2017). Radionuclides and gamma camera imaging are incredibly useful when looking for the presence or absence of infection (Signore et al., 2019). With a radiation exposure level similar to a CT scan, nuclear medicine exams are a safe and effective method to determine the root of prosthetic joint pain (Seltzer et al., 2019). The amount of time passed since the arthroplasty procedure determines which nuclear medicine exam to perform (Signore et al., 2019). If joint pain occurs later than two years after the prosthesis implantation, bone scintigraphy is indicated

(Signore et al., 2019). Within the first two years of arthroplasty, WBC scintigraphy is recommended (Signore et al., 2019).

Bone Scintigraphy

A bone scan, or bone scintigraphy, is relatively affordable and available, making it a commonly ordered screening exam for patients with suspected PJI or aseptic loosening (Signore et al., 2019). Both blood flow to the skeletal system and new bone development attract the radiopharmaceutical, often Technetium-99m methylene diphosphate, to specific areas of the body (Palestro, 2014). A typical bone scan occurs 3 hours after the radionuclide injection, but a three-phase bone scan is a standard order for PJI and aseptic loosening (Palestro, 2014). A three-phase bone scan includes a perfusion phase, a blood pool phase, and a bone phase (Palestro, 2014). If a three-phase bone scan shows increased uptake around the affected prosthesis in all three phases, PJI is probable (signore et al., 2019). However, radiopharmaceutical uptake on a bone scan can indicate a fracture, metabolic diseases, cancer, and many other issues other than infection (Signore et al., 2019). Contrarily, if a three-phase bone scan does not show increased uptake around the prosthesis, the three-phase bone scan rules out infection, and aseptic loosening may be the offender (Signore et al., 2019). In the case that a three-phase bone scan does show uptake, an even more specific nuclear medicine test is available for a definitive diagnosis of PJI (Signore et al., 2019).

Within the first two years of arthroplasty, bone scans are contraindicated because new bone growth occurs around the new prosthesis (Seltzer et al., 2019). This new bone growth will attract the radiopharmaceutical, concluding in a false-positive diagnosis (Palestro & Love, 2017). Bone is still attempting to fixate the metal prosthesis within the first 24 months of implantation, leading to an inaccurate diagnosis (Signore et al., 2019). If a patient receives a three-phase bose

scan after this 2-year growth phase and all three phases show increased uptake, PJI is suspected, but the patient often receives WBC scintigraphy for a more accurate diagnosis (Signore et al., 2019; Seltzer et al., 2019).

White Blood Cell Scintigraphy

"In vitro labeled leukocyte (WBC) imaging is the radionuclide gold standard for imaging most infections in the immunocompetent population," according to Palestro & Love, 2017. The advantages to WBC scintigraphy are numerous and solve many of the differentiation issues that occur with blood testing, synovial fluid testing, and other imaging modalities. The diagnostic accuracy of WBC scintigraphy is superior to that of different imaging modalities (Signore et al., 2019). It also offers the ability to tell the difference between infection and normal post-surgery wound healing, unlike bone scintigraphy (Signore et al., 2019; Palestro & Love, 2017).

To accomplish a WBC scintigraphy exam, the patient's WBCs must be tagged with the radiopharmaceutical (Shackett, 2019). 111-Indium and 99m-Technetium are the radiopharmaceuticals commonly used to diagnose infection with these exams (Signore et al., 2019). 40-80 mL of blood are drawn from the patient and added to a tube with an anticoagulant, such as heparin (Shackett, 2019). This tube is then sent to a radiopharmacy where a nuclear pharmacist will tag the patient's WBCs with the radiotracer (Shackett, 2019). Upon the patient's return to the nuclear medicine department, they are then injected with their tagged WBCs (Shackett). These white blood cells, or leukocytes, are attracted to infection (Palestro & Love, 2017). Neutrophils are the essential leukocytes in WBC scintigraphy because they migrate toward bacterial infections (Palestro & Love, 2017). Normal healing processes do not attract the radiolabeled WBCs, but infection does (Palestro & Love, 2017). For this reason, WBC scintigraphy is the exam of choice within the first two years of arthroplasty (Palestro & Love). If

the uptake of the radiolabeled WBCs increases in the arthroplasty joint, PJI is the culprit of the patient's pain (Signore et al., 2019). PJI is likely not the culprit if the uptake decreases over the scan time, and aseptic loosening should be considered (Signore et al., 2019).

30 years of research has shown that bone marrow imaging, in addition to WBC imaging, can result in both a highly specific and highly sensitive test (Palestro & Love, 2017). The addition of bone marrow imaging to WBC imaging gives the ability to differentiate between septic and aseptic joints (Seltzer et al., 2019). It has been reported the combination of both tests results in diagnostic accuracy between 83%-98% (Signore et al., 2019). In a bone marrow study, 99m-Technitium sulfur colloid is injected into the patient intravenously (Shackett, 2019). The sulfur colloid will migrate to the patient's bone marrow and highlight active areas (Shackett, 2019). When both WBC scintigraphy and a sulfur colloid exam are performed, the joint is considered not infected and possibly loose if the activity looks similar on both scans (Seltzer et al., 2019). Consequently, if the uptake differs between the WBC and sulfur colloid exams, the joint is considered positive for PJI (Seltzer et al., 2019.)

Conclusion

As average life expectancy continues to climb, the medical community must continue making advancements in the diagnosis of lower extremity prosthetic joint pain. Arthroplasty pain resulting from PJI or aseptic loosening requires a composite process of both complex and straightforward exams. The simpler tests, such as blood work or synovial fluid analysis, can give clues and indicate the need for further, more in-depth testing. Once a nuclear medicine bone scan or WBC scan is ordered and performed, physicians receive a definitive diagnosis. These physicians are then able to treat the patients properly without unnecessary surgeries and costs.

Further research into new diagnostic methods, such as PET/CT and PET/MRI, will surely improve the confident diagnosis of PJI and aseptic loosening (Signore et al., 2019).

References

Apostu, D., Lucaciu, O., Berce, C., Lucaciu, D., & Cosma, D. (2017). Current methods of preventing asep tic loosening and improving osseointegration of titanium implants in cementless total hip ar throplasty: a review. Journal of Internal Medicine Research, 46(6), 2104–2119. https://doi.org/10.1177/0300060517732697

Arvieux, C., & Common, H. (2019). New diagnostic tools for prosthetic joint infection. Orthopaedics & Traumatology: Surgery & Research, 105(1), S23–S30. https://doi.org/10.1016/j.otsr.2018.04.029

Beam, E., & Osmon, D. (2018). Prosthetic joint infection update. Infectious Disease Clinics of North America, 32(4), 843–859. https://doi.org/10.1016/j.idc.2018.06.005

Palestro, C. J. (2014). Nuclear medicine and the failed joint replacement: Past, present, and future. World Journal of Radiology, 6(7), 446–458. https://doi.org/10.4329/wjr.v6.i7.446

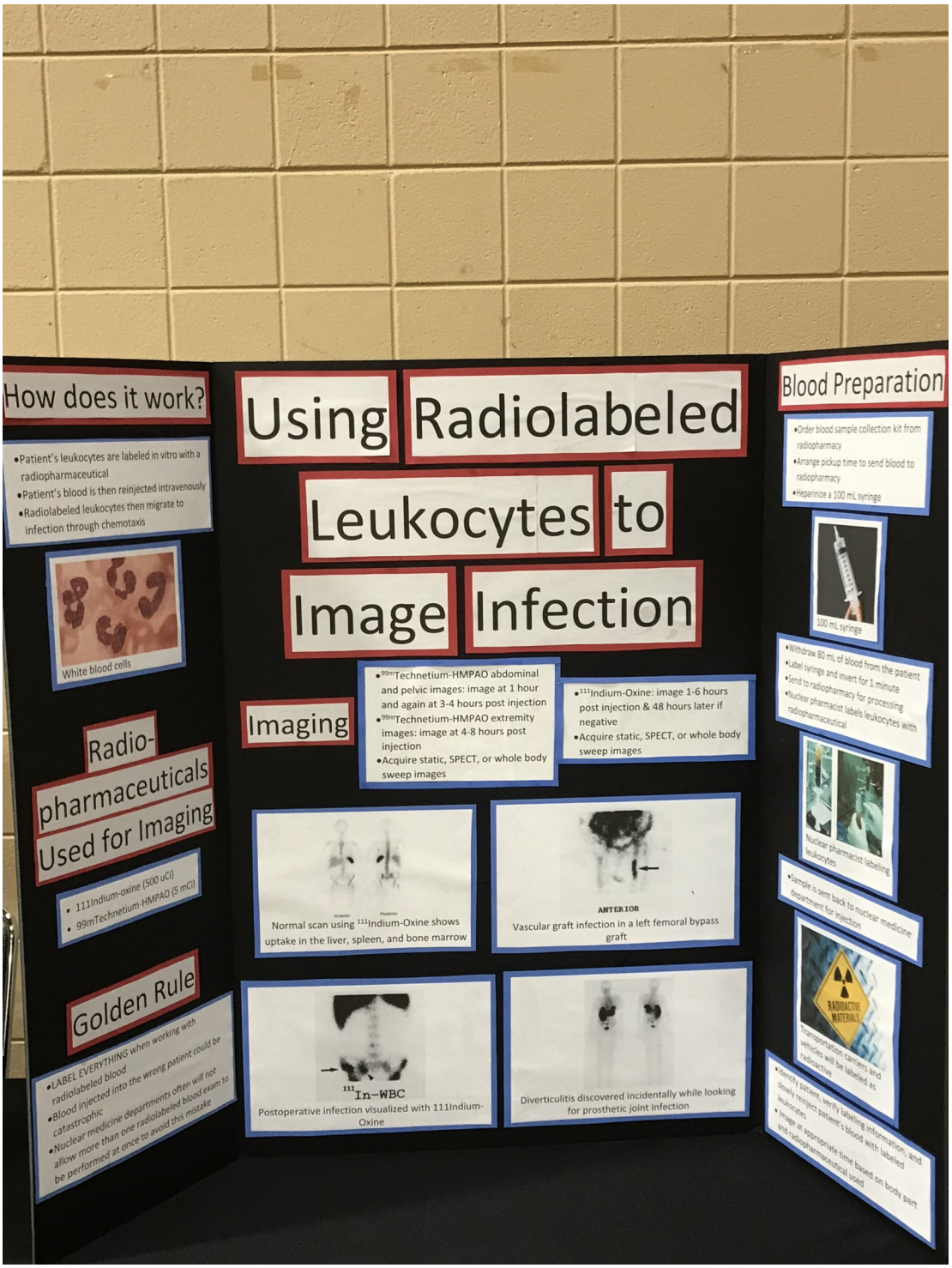
Palestro, C. J., & Love, C. (2017). Role of nuclear medicine for diagnosing infection of recently Implant ed lower extremity arthroplasties. Seminars in Nuclear Medicine, 47(6), 630–638. https://doi.org/10.1053/j.semnuclmed.2017.07.008

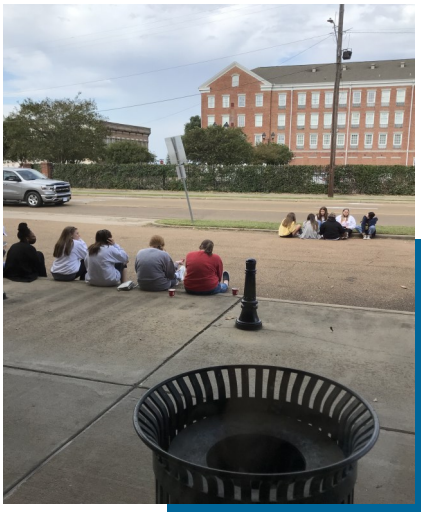
Seltzer, A., Xiao, R., Fernandez, M., & Hasija, R. (2019). Role of nuclear medicine imaging in evaluation of orthopedic infections, current concepts. Journal of Clinical Orthopaedics and Trauma, 10(4), 721–732. https://doi.org/10.1016/j.jcot.2019.04.024

Shackett, P. (2019). Nuclear medicine technology: Procedures and quick reference (3rd ed.). Wolters Kluwer.

Signore, A., D'Arrigo, C., & Lauri, C. (2019). Nuclear medicine imaging of prosthetic joint infections. In Nuclear medicine in infectious diseases (pp. 119–132). Springer International Publishing. https://doi.org/10.1007/978-3-030-25494-0_9

Technologist Exhibit



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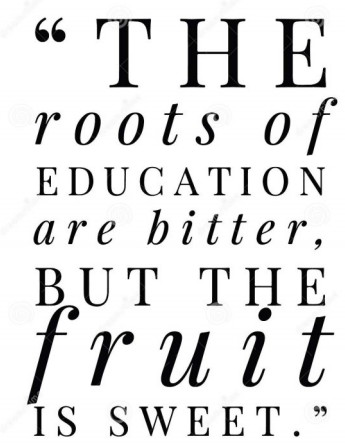
MSRT Scholarship Recipients

Each of these students have demonstrated outstanding academic and clinical performance throughout their education. The MSRT Board of Directors salutes them and wishes them well in their future endeavors.



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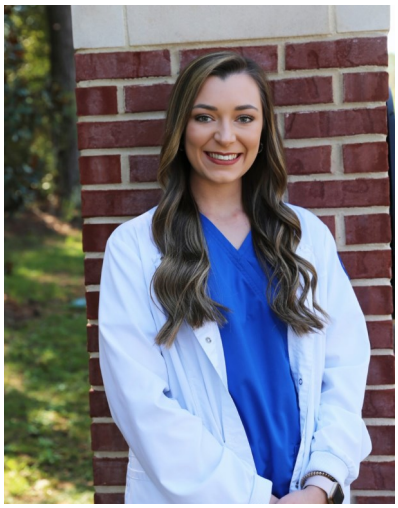
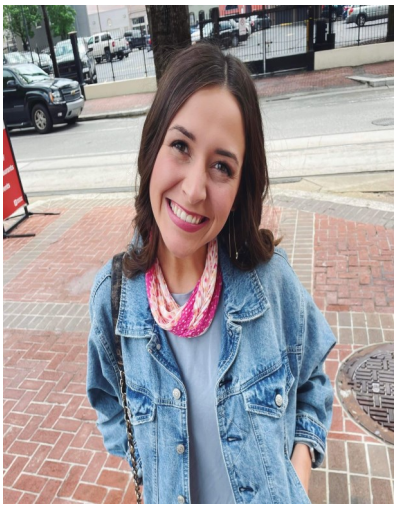


Ashlyn Borne
Co-Lin



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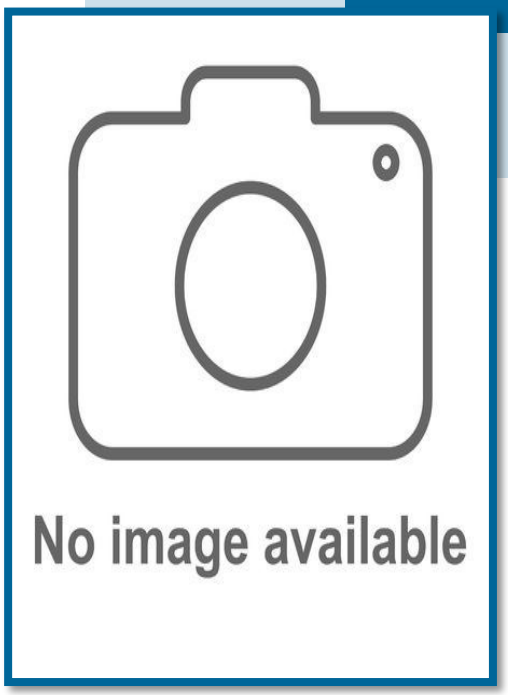

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Letter from the Editor

Hello everyone!

Thank you to everyone who came to Natchez and helped make our first conference since COVID a great one!

Don't forget the MSRT is always looking for new members and volunteers. Something we hold tight to everyday is "there is power in numbers." Whatever it is you can do to help, supporting the MSRT and fighting for our profession is so important right now. Feel free to reach out to any of us on the Board of Directors (names are listed on our website) and we will help you find a way to get involved.

We are looking forward to being back in Natchez this October for conference! Students, be thinking about and preparing for the Student Prep Bowl that happens at conference. Not only is it a good way to study and be more prepared for registry, it's a fun time! Also, be thinking about the Manuscript and Exhibit Competition. If you have any questions about either of these, reach out to your instructors or anyone with the MSRT.

Thank you all again for your hard work and for being members of the MSRT. See you in October!

Adrian Brewer, R.T. (R)