Dear Members,

Welcome to another exciting edition of the NMRO newsletter. Following the article “Amyloid PET: Boom or Bust?” in our last newsletter, the special article for this edition is “68Ga-PSMA PET/CT: a novel approach for prostate cancer imaging” written by our international board member, Dr. Sachpekidis. I am sure you will find it an interesting read, and if you want to learn more, Dr. Sachpekidis along with Dr. Liolios presented a virtual journal club (VJC) on the same topic this past January 12, 2015. This was our very first cross Atlantic webinar and proved to be a real success! The recorded webinar will be available online. Also, don’t forget to attend the next VJC this February 23, 2015 on three-phase bone scan interpretation based on vascular endothelial response. Please register online ahead of time.

In other exciting news, I am happy to report that we have worked very hard to bring you some new educational content that will be available over the next few months. Please stay updated either by visiting the ACNM website or through our facebook page www.facebook.com/ACNM.NMRO. The planned content includes:

- A monthly webinar series on MRI Physics to begin this March, 2015 (FREE to our members).
- Updated case reviews via our partnership with IMAIOS
- NEW ACNM Question bank in time for both the ABR and ABNM board exams
- Revamped education website with new articles and resources.

Also exciting news is that thus far due to the efforts of your executive committee, we have increased our resident membership by almost 30% from the previous year and have seen a large increase in the number of abstracts submitted to this year’s ACNM annual meeting in San Antonio, Texas. If you haven’t seen my photography skills, please visit our Facebook page to take notice. The winners of the ACNM travel grants, the ACNM best essay awards, and the prestigious Sino-American Exchange Program can be found on the ACNM website.

Lastly but very importantly, we will be holding elections for the next generation of resident leaders to move this organization forward. I will be sending a description of the different positions of the board of directors soon as the new board will begin their term at the SNMMI annual meeting. In the meantime, if you are interested and will be able to attend the annual meeting if elected, please send your name and contact information to acnm@acnmonline.org title: NMRO Elections.

I hope you enjoy the many articles we bring you, the challenging cases, and of course our always fun and enjoyable word puzzles. If you would like to contribute an article to the newsletter, please submit your article to acnm@acnmonline.org.

Warmest regards,
Alexander Antoniou, MD, MA
NMRO President

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Dr. Ahmed completed a nuclear medicine residency from Yale School of Medicine. He is currently a PET-CT/molecular imaging fellow at the University of Pittsburgh. His work involves studying novel radiotracers for imaging apoptosis. He has served as NMRO board member in the past, and he is also serving as an intern to SNMMI’s Academic Council. His long-term goal is to help empower the resident community to ensure the survival and growth of our specialty.

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My name is Tatianie Jackson. I was born and raised in Boston, Mass., but my medical school training has taken me to Central America and back. I attended medical school at Autonomous University of Guadalajara in Guadalajara, Mexico. From there my medical training took me to New York, where I completed my fifth pathway training at New York Medical College. Upon completing my fifth pathway program, I returned to Boston for a one-year research fellowship in nuclear medicine at Boston University Medical Center with Dr. Rathan Subramaniam. During this fellowship I became extremely intrigued by nuclear medicine and decided to pursue my residency in the field. In 2011, I started my surgical internship at Nassau University Medical Center in Long Island, N.Y. In July 2012, I started my nuclear medicine residency at Stanford Health Care, where I am currently a chief resident.
Prostate cancer (PCa) is the second most frequent form of cancer. In Europe for 2012, 416,732 cases of PCa (incidence rate 96.0) were reported, while the deaths attributed to this malignancy were 92,237 (mortality rate 19.3) (1).

Early detection of PCa is pivotal for the management of this malignancy, since limitation in the prostate gland and lack of spread beyond prostate limits extend the survival rate to 5 years in almost 100% of the reported cases (2). Another key issue is the detection of recurrent disease even at low prostate-specific antigen (PSA) levels, which, unfortunately, cannot be accomplished with 18F-FDG, the ‘workhorse’ of PET imaging, due to the low and heterogeneous utilization of glucose by PCa cells (3). On the contrary, small molecules targeting the prostate-specific membrane antigen (PSMA), which is a highly expressed protein on the surface of PCa cells, can be utilized effectively for PCa imaging.

PSMA is expressed in normal prostate, as well as in other tissues such as salivary glands, renal tubular cells and the small intestine (4). However, the antigen expression in PCa is significantly higher than in healthy tissues, increasing progressively with the increase of cancer grade and metastatic involvement (3). A small ligand targeting PSMA labeled with 68Ga (68Ga-PSMA) recently has been proposed as a promising PCa imaging agent. This novel tracer carries all the desirable characteristics for imaging approach of PCa: specific targeting of PSMA, fast blood clearance, low background activity and a relative short half-life (68.3 min).

The published data based on clinical trials regarding the application of 68Ga-PSMA in PCa are limited at this moment, but, nevertheless, promising. Afshar-Oromieh et al. described the biodistribution of 68Ga-PSMA in a group of 37 PCa patients and showed that this tracer revealed carcinomatous involvement with excellent contrast already 1 hour post injection. In particular, even at low PSA levels the method demonstrated satisfying results; lesions suspicious for cancer were observed in 60% of the studied subjects with a PSA below 2.2 ng/ml. This percentage was raised to 100% for patients with PSA levels higher than 2.2 ng/ml (5). For the same group, when 68Ga-PSMA was compared with the standard 18F-choline-based PET/CT in patients presenting a biochemical recurrence of PCa, it was found to have a statistically higher lesion detection rate than 18F-choline PET/CT (6). Furthermore, Demirci et al. recently applied 68Ga-PSMA in a patient suffering from clear cell renal cell carcinoma (ccRCC) with very satisfying imaging results regarding bone metastatic involvement, implying clinical utility of the tracer in ccRCC (7).

In conclusion 68Ga-PSMA seems to be a promising and easy-to-handle PET imaging method. The most significant advantage of this novel agent lies in its high specificity in combination with the low background activity, which leads to sensitive lesion detection. Further clinical studies are required to define the potential role of 68Ga-PSMA in the management of PCa and possibly other malignancies.

Acknowledgments
I would like to thank Dr. Christos Liolios from the Division of Radiochemistry and Radiopharmacology, German Cancer Research Center, for his comments.

References

Clinical Case - V/Q Scan: IPF with progressive dyspnea
By: Alexander Antoniou, MD, MA

History: 70 year old male with IPF (secondary to UIP, diagnosed by biopsy 2 months prior) was found to have deterioration of pulmonary function despite being on a 2-week trial of 20mg prednisone and home oxygen therapy. Follow up Echocardiography demonstrated normal left ventricular size and motion with estimated EF of 60-65%. RVSP of 40mmHg.

To view this issues clinical case, please visit the ACNM Website at www.acnmonline.org/clinicalcases.
“The Atomic Man” The McCluskey Case

Kanta Saha, MD

Harold McCluskey (age 64) was a chemical operation technician in Hanford Plutonium finishing plant (waste management facility) located in Washington. On August 30, 1976, at around 3 am, an americium-241 (Plutonium byproduct) ion exchange column exploded and peeled open the column, blew out leaded glass windows and glove ports and struck Mr. McCluskey in the right side of his face, peppered with glass shrapnel, concentrated nitric acid, resin beads and americium-241. This caused chemical burns on his face, eyes, neck and right shoulder along with lacerations with embedded foreign bodies. He was exposed to the highest recorded amount of radioactivity in history and thus was given the name of “Atomic Man.”

The worker underwent extensive medical treatment for acid burns, as well as wound debridement, extensive personal skin decontamination and long-term DTPA chelation therapy for decorporation of americium-241. Because of the contamination levels and prolonged decontamination efforts, care was provided for the first three months at a unique emergency decontamination facility (which became known as the “McCluskey Room”) with gradual transition to the patient’s home occurring over another two months. Along with an extensive decontamination method of shower—bathe—scrub—debride with Schubert’s solution (tartaric acid, citric acid, DTPA, CaCl₂) and liquid baby shampoo for five months, he was treated with IV Zn-DTPA chelation therapy over 4 years. He was released to home on January 1977, 5 months after the accident.

He lived in a travel trailer for a considerable amount of time, as his family members and neighbors were scared of contamination. By late November he was able to go into the community and have Thanksgiving dinner with his family (Day 103). By November and December, he was home during the day but returned to the trailer at night. The only detectable cross-contamination was found to be on his pillow.

His mental attitude was excellent, and he was reasonably healthy for 10 years. Later on, he had multiple hospitalizations for a pre-existing cardiac condition. On August 17, 1987, he died from congestive heart failure due to coronary heart disease. No evidence of malignancy was found in autopsy. His tissues were analyzed for dosimetry by the U.S. Transuranium Registry.

Four decades later, the “McCluskey Room”—which was closed after he left—was finally demolished along with the rest of the facility on September 2014.

Source: REACTS lecture series on Advanced radiation medicine.

Radiation Measurements and Units

Rafay Ahmed, MD

Activity: The amount of radioactive decay (amount of disintegrations per second) is referred to as activity. The original unit to measure activity was the Curie (Ci). It was first defined as the number of decays per second from a gram of radium.

1 curie (Ci) = 3.7 x 10¹² disintegrations per second.

The Curie is slowly being replaced by the International System of Units (SI) unit, the becquerel.

1 becquerel (Bq) = 1 disintegration per second

Specific activity is activity per unit mass (mCi/g or Bq/g).

Exposure: Exposure is the amount of x-ray or gamma ray radiation needed to liberate 1 electrostatic unit of charge of either sign (negative electrons or positive ionized atoms) in 1 cm³ of air at standard temperature and pressure.

Exposure rate (e.g., roentgens per hour) can be used to define intensity of the photon beam at a particular point in time. Exposure is defined only for photon (x-rays and gamma rays) radiation and is not used to describe intensity of beams such as electron, protons, betas, alphas and neutrons.

Exposure can be directly estimated using an ionization chamber, which measures the amount of gas ionization.

Air kerma is used as alternative to exposure.

Continued on page 4. See Radiation Measurements and Units.
Gridiron games

Across
3. “Double density” benign lesion on bone scan (2 words)
8. Competitor of positron decay (2 words)
10. Like a brain macrophage
11. F18 Sodium fluoride uptake via _____ diffusion

Down
1. This beta-blocker gets flagged for interference of MIBG
2. “Huddled” genes; condensed and inactive
4. Syringe shield 511 keV “blocker”
5. Rare developmental disorder with microgyria and clefts lined with gray matter
6. The IVC is out, so don’t get irate when you see Tc99m MAA here (2 words)
7. Visualization of the superior sagittal sinus signifies the beginning of this (2 words)
9. Cells that clear radiocolloids from circulation

See Answers on page 5.
Kerma: Kerma is energy released per unit mass from radiation. Kerma is a practical substitute for exposure and uses units of energy per mass. The SI unit of kerma is the gray.

Radiation Absorbed Dose: Radiation absorbed dose is energy absorbed per unit mass of tissue. It is the energy transferred to any material from ionizing radiation. Ionizing radiation is any radiation that is sufficiently energetic to produce ion pairs; this includes x-rays, gamma rays, alpha and beta particles, and neutron and protons.

The original unit for radiation absorbed dose was the rad.

1 rad = 100 ergs of energy absorbed per gram of tissue

Now the rad is being replaced by an SI unit, the gray (Gy). 1 gray is equal to 100 rads.

1 gray (Gy) = 1 J/kg

An average person in the United States receives about 3 mGy per year from background radiation. A single acute dose of 5 Gy is fatal. Calculation example: 30 J of energy are absorbed uniformly in a 10 kg mass of tissue. What is the absorbed dose?

Dose (Gy) = 30/10 = 3 Gy

Organ dose is a quantity defined in relation to the probability of stochastic effects (mainly cancer induction) as the absorbed dose averaged over an organ, i.e., the quotient of the total energy imparted to the organ and the total mass of the organ. The unit of measurement is the joule per kilogram and/or the gray.

Equivalent Dose (DE)/Absorbed Energy: The rem (roentgen-equivalent man) is the unit of absorbed energy that takes into account the estimated biologic effect of the type of radiation that imparts energy to the tissue. Particles with higher linear energy transfer (LET)—such as alpha particles, protons and neutrons—produce greater tissue damage per rad than beta particles, gamma rays or x-rays.

The relative damage for each type of radiation is referred to as its quality factor (QF). The QF for alpha particles is 20, for protons and neutrons is 10, and for beta particles (electrons and positrons), gamma particles and x-rays is 1.

The absorbed dose (or absorbed energy) is the product of dose times the quality factor.

Dose equivalent (in rem) = absorbed dose (D) (in rad) × QF

Dose equivalent (in sievert) = absorbed dose (in Gy) × QF

CROSSWORD ANSWERS

Across:
3. Osteoid osteoma
8. Electron capture
10. Microglia
11. Exchange

Down:
1. Lebetalol
2. Heterochromatin
4. Tungsten
5. Schizencephaly
6. Caudate lobe
7. Venous phase
9. Kupffer

Please email acnm@acnmonline.org if you are interested in running for a position in the NMRO elections.

A schedule of the Upcoming VJC/Virtual Journal Club webinars will be sent out soon – please keep an eye out for this information.