Developments in Imaging: ‘A Huge Difference in Primary Care’

Here is another in our series of discussion and debate over advances in pediatrics over the past 40 years.
~ Stanford T. Shulman, MD

James S. Donaldson, MD: The past 40 years have been revolutionary with regard to imaging. Back in 1971, radiology consisted of plain X-ray and fluoroscopy with an image intensifier. In Sweden, radiologists were doing great angiography, so we also had angiography. Additionally, we had nuclear medicine. In the 1970s, ultrasound became more widely used, but that was the gamut of available imaging modalities.

The 1980s brought computerized tomography (CT) scans. Godfrey Hounsfield invented the first CT scanner in 1972, but it didn’t get to clinical applications until the 1980s. In the 1980s, we also saw the introduction of magnetic resonance imaging (MRI) and positron emission tomography (PET) scanning, which later became a fusion technology with PET CT and PET MRI.

One of the revolutionary changes in imaging in the 1980s was digital imaging, or computed radiography, which led to picture archiving and communication systems (PACS). PACS began because of a Digital Imaging and Communications in Medicine (DICOM) standard that had been introduced across the field of imaging. All the vendors, even different vendors that agreed to a particular digital standard, could communicate. The revolution to PACS was amazing.

Interventional radiology, which existed as angiography back in 1970s, really developed in the 1970s through the 1990s in adult medicine. However, pediatric interventional radiology has lagged significantly behind that. I think these modalities were introduced to children’s hospitals and to university settings at different times, depending on the institution’s resources and other factors. But all of those developments have changed the field of what now we call medical imaging.

Ram Yogev, MD: I was much more impressed by the ability of invasive radiology. We send patients home much earlier. We now have the ability to drain abscesses in areas that help us in diagnosis, and much better treatment to relieve all fluids. I think invasive radiology caused some surgeons to look for another job.

Stanford T. Shulman, MD: As a fellow, almost 40 years ago, I recall recognizing on a plain film a right pleural effusion. This observation led to a potential diagnosis of a liver abscess in a child. It was very difficult, given what we had available at that time, to confirm that kind of diagnosis. We relied upon a scintigraphic liver scan, which did not give very good imaging at all. Then you fast-forward several decades, and you have the ability to image intra-abdominal structures.

Thomas J. Selva, MD: I’ve been at this now for about 22 years. It used to take longer to get the patient on and off the...
gantry than it would to do a multidetector helical CT from which you can have a 3-D reconstruction. More recently, I’ve watched our plastic surgeons show 3-D reconstruction to the parents and say, “This is what I’m going to make your child look like when I’m done.” It’s impressive to watch all that progress.

Dr. Donaldson: As an insider, it has been incredible for me to watch the CT scanner develop. It’s enabled us to see anatomy down to almost a submillimeter resolution. The exploratory laparotomy is a thing of the past. We’ve had very few negative appendectomies because we know in advance if the child does or doesn’t have appendicitis. CT scan use has increased dramatically since the machine was invented in the 1980s.

Around 2000, there were some landmark articles that showed the potential risk of radiation to children and the potential risk of developing a cancer related to the radiation. So now we’ve begun to ratchet back the use of CT scan. When we use the CT scanner, we reduce the dose almost to the point where we get such fuzzy images they’re not diagnostic anymore. So we’ve gone from thinking it was the absolute best tool in the world to something we’ve got to be careful of. The radiation concern has now come full circle, and in the past decade, we’ve become aware of the potential harm.

Welton M. Gersony, MD: Imaging techniques have revolutionized the field of pediatric cardiology. Echocardiography has become an extremely important modality for the diagnosis of congenital heart disease; in some instances, even better than angiography. MRI and CT are also helpful at times, but often unnecessary. They should not be overused. This is especially true for CT, which has long-term risks related to radiation. Unfortunately, as clinicians rely more on imaging techniques, clinical skills have eroded. This trend is a growing negative for the full assessment of a child with congenital heart disease, and represents a challenge for those who are training the next generation of cardiologists. For every advance, there is the threat of a step backwards, which should not be overlooked.

Dr. Donaldson: Functional MRI (fMRI) has allowed us to see blood oxygen activation and consumption. We can see when certain parts of the brain are activated, and it allows surgeons more precision and avoidance of critical functional areas. They can go in and resect the tumor, and know what they need to be careful of. The functional aspect certainly is new and different from what radiology had been.

We also see function with some of the nuclear medicine testing. In PET imaging, metabolites are taken up with an isotope and we can see which areas are more active or less active, and which tumors are still viable or no longer viable. So certainly, it has gone from an anatomic specialty to add other aspects such as function.

As far as interventional radiology, it was interesting that some of the technical developments in catheters and guide wires in the 1990s were largely driven by the desire to instrument the coronary arteries. Many Americans need coronary artery instrumentation and catheterization. Previously, we didn’t have catheters and materials that were able to perform sophisticated techniques in small children because the materials were too big. So the manufacturers of these devices figured out how to make tinier wires and smaller catheters. The coronary market drove the product to be much more user-friendly in pediatrics, and that has affected the development of interventional radiology in pediatrics.

Robin H. Steinhorn, MD: Not only are you able to now provide detailed imaging of almost every organ of newborn infants, but the imaging techniques for fetal medicine have advanced tremendously in the past 5 years. So for instance, now when we’re trying to determine how severe a diaphragmatic hernia is going to be, the mother gets an MRI of the fetus and we review it before delivery. We see exactly what we are going to encounter after the baby is born. It’s nothing short of astonishing how much detail we are able to get.

Stan L. Block, MD, FAAP: Imaging has added so much detail to what we do in routine medicine. I am a team physician for our local football team. I relish the thought of being able to look at a knee a day or two after an injury and say either, “We need to send you to the orthopedist, or “Your knee is OK. You have a tiny meniscus tear, you can wait it out.” Better imaging makes a huge difference for us in primary care.

REFERENCES

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