

Panel discussion

Published online: 22 July 2006
© Springer-Verlag 2006

Dr. Avrum Pollock (moderator)

It gives me great pleasure to introduce two experts whose specialties are outside the field of radiology. Dr. David Diamond specializes in pediatric urology and robotic surgery. He is an Associate Professor of Urology at the Harvard Medical School. The second honored guest is Dr. John T. Boyle, who is Professor and Chief of Pediatric Gastroenterology at the University of Alabama at Birmingham.

Dr. David Diamond

I will discuss application of the ALARA concept to the evaluation of vesicoureteric reflux and, specifically, the use of the voiding cystourethrogram. The VCUG is the traditional method to screen children at risk for vesicoureteric reflux. It provides detailed anatomy of the bladder and urethra and if there is reflux, of the ureters as well. The examination is performed mainly in children who are at the greatest risk of harmful effects of ionizing radiation. Therefore, it is important to minimize dosage while achieving diagnostic accuracy. The objectives of my presentation are to review some of the technical advances in the diagnosis of reflux and to propose some recommendations for the evaluation of four groups of children: those who were diagnosed with urinary tract infection, siblings of children with reflux, children diagnosed with antenatal hydronephrosis, and children with one solitary functioning kidney.

With regard to the technical advances which were nicely reviewed earlier today, there has been enormous improvement in the last couple of decades in reducing radiation dose in patients studied for vesicoureteric reflux based on the use of pulse fluoroscopy. This technique results in roughly a 90% dose reduction with minimal loss of resolution. Digital fluoroscopy and limiting the number of spot images enables us to maximize image save acquisitions and thereby decrease the radiation dose.

The leading alternative study to the VCUG in diagnosing reflux is the radionuclide cystogram, or RNC. Its main advantage has been decreased radiation exposure. Its use in our hospital has resulted in about one-tenth the dose that children would be exposed to for the VCUG. The sensitivity of the RNC is at least as great and potentially greater than the VCUG, although the anatomic detail in the RNC is not as good as that in the VCUG.

Indirect cystography has been proposed by some with intravenous use of DTPA as a nuclear medicine study. More recently, ultrasonic indirect cystography has been studied, with the main advantage being avoiding catheterization of the child. Whether we are dealing with the nuclear medicine approach or the ultrasound approach, the high false-negative rates limit the effectiveness of the study such that it has not been embraced by the pediatric urologic community.

More recently the voiding urosonogram has been promoted primarily in European centers. It is an intriguing technique and has been successful due to the development of an intravesical contrast agent. The voiding urosonogram has a 92% concordance with diagnosis of reflux compared with both the VCUG and RNC. It has good sensitivity and equally good specificity. But similar to the RNC, the voiding urosonogram provides no comparable anatomic detail to the VCUG of the bladder, ureter or urethra.

Another exciting recent advance is the MR cystogram. Images of the lower urinary tract are obtained before and after intravesical gadolinium administration and before and after voiding. Its advantages are that there is no additional radiation and it can potentially evaluate the kidneys for reflux nephropathy. The limitations are that the MR cystogram is less sensitive than the VCUG, and in young children sedation is likely to be required. This technique is currently regarded as experimental.

For children with urinary tract infection, a VCUG has been regarded as fundamental to their assessment. It enables us to determine bladder and urethral anatomy, bladder capacity, the ability of the bladder to empty effectively, the presence of reflux and the severity or grade

of reflux. We know that reflux in conjunction with urinary tract infection can result in renal damage. At its worst, it can result in end-stage renal disease.

Reflux is present in 30–50% of children with febrile urinary tract infection upon initial evaluation of children with febrile infection. Up to 40% reported with reflux have renal scarring. Thus, this is a very important diagnosis to make. Once reflux is diagnosed, the likelihood of its spontaneous resolution is determined by the age of the reflux, the laterality of reflux, and its grade. Therefore, the VCUG is of prognostic importance.

The indications for ordering the VCUG are very much tied into one's definition of urinary tract infection. We regard a catheterized specimen or suprapubic aspirate of urine as the gold standards. Greater than 10^5 colonies of midstream urine will be 80% diagnostic of a true urinary tract infection. This colony count on two consecutive urine samples is 90% diagnostic. A bag specimen is only diagnostic if there is no growth, as positive growth is likely to reflect perineal flora.

The greatest risk of renal damage in all children both males and females is prior to toilet training. Therefore, aggressive screening is justified for these children and the VCUG would be the study of choice. In prepubertal males with a well-documented urinary tract infection, the VCUG is our choice to define urethral anatomy in addition to assessing for bladder anatomy and ruling out reflux. If the urinary tract infection is less well documented, it is reasonable to perform an ultrasound scan initially as a compromise. This may be the case in uncircumcised males. The key is that in order to image the urethral anatomy clearly, the VCUG is the necessary study. In prepubertal females, if they have pyelonephritis, VCUG would be the study of choice because the likelihood of high yield is greater. If they simply have recurrent urinary tract infections or cystitis, we would regard the RNC as the initial study of choice.

For postpubertal children, there is a minimal risk of renal scarring. Therefore, no imaging is necessary in the presence of cystitis only. Similarly for black children, there is a low incidence of reflux. For post-toilet training black children presenting without fever, cystography is not regarded as necessary and an ultrasound would be regarded as a reasonable initial study.

Sibling reflux, a topic that has received more attention within the last decade or two: the incidence of sibling reflux is 32%. If the sibling is under age 2 years, the incidence of reflux is 44% and drops to 9% if they are over age 6 years. The incidence in males is essentially equal to that in females. In addition, twins are at higher risk for sibling reflux, and monozygotic twins are at particularly high risk. Two-thirds of sibling reflux will be low-grade; half of it will be unilateral. There appears to be a higher resolution rate and an 11% lower incidence of renal damage than in symptomatic reflux. The goal of sibling screening is to prevent renal damage.

One can consider four groups of children for screening: those in the newborn to toilet-training age, those in the age range between toilet-training and puberty, postpubertal

children, and then the symptomatic sibling. For newborns until they are toilet-trained, it is reasonable to perform a RNC for both males and females. It is a sensitive study with low radiation dosage. For the second group of toilet-trained children up until puberty an initial ultrasound scan is a reasonable anatomic assessment. If there is an abnormality in terms of discrepancy in renal size, renal scarring, a dilated ureter, or urothelial thickening, then one can move to an RNC. Given the relatively low prevalence of reflux in this age range, we would not jump to an RNC initially. For the postpubertal child, we would consider that no studies are necessary whereas some would advocate an ultrasound scan. Symptomatic children should be studied as aggressively as any child with a urinary tract infection would be studied.

Of the four topics that we are discussing, the one for which it is probably the most difficult to make firm recommendations is the patient with antenatal hydronephrosis. This is now being diagnosed in 1–2% of all pregnancies. Yet the clinical relevance of this finding is unclear and there are no large prospective studies that truly assess this properly. In terms of the postnatal evaluation of children with antenatal hydronephrosis, the majority of pediatric urologists would say that moderate to severe antenatal hydronephrosis that persists postnatally warrants a VCUG. For mild antenatal hydronephrosis that persists or resolves in the postnatal period, it is controversial as to whether or not the VCUG is warranted. There certainly is a higher risk of reflux in the antenatal hydronephrosis population than in the general population. Roughly 15% of these patients, and males in particular, appear to be at higher risk for bilateral high-grade reflux. Thus, one might lean toward being slightly aggressive with the male.

Our recommendations would be that for bilateral severe antenatal hydronephrosis or the solitary kidney with any grade of antenatal hydronephrosis, a postnatal ultrasound in 1–2 days would be advisable. For all other grades of antenatal hydronephrosis, a postnatal ultrasound scan within the first month of life would be fine. For males and females with moderate to severe antenatal hydronephrosis, we would advocate the VCUG. For newborns with persistent mild antenatal hydronephrosis, we would recommend an ultrasound scan and follow those children sonographically. Other colleagues around the country would regard a VCUG as appropriate, but the majority of us favor sonography in this setting. Newborns with resolved, mild antenatal hydronephrosis may or may not require further imaging. We propose that they probably do not. Others feel that some imaging at a later point, at 6 months or a year, would be appropriate. This is a controversial area.

With regard to the solitary kidney, we really are discussing those children who are diagnosed with multicystic dysplastic kidney as well as renal agenesis. Contralateral reflux has been found in a small number of studies in 13–28% of those with multicystic dysplastic kidney, certainly higher than in the general population. The majority of reflux in these studies was mild to moderate with a high spontaneous resolution rate.

For renal agenesis, which of course may represent involved multicystic dysplastic kidney, the rate of contralateral reflux is comparable at 5–24%. Thus, in patients with a solitary kidney, there is a higher incidence of reflux than in the general population. The stakes are high for these patients in that reflux of nephropathy of the involved kidney could be devastating. Therefore, we believe that the RNC, or potentially the voiding urosonogram should it become common clinical practice in the United States, would be very advisable.

Once reflux is diagnosed, it has been the tradition that most pediatric urologists reassess patients annually. This practice is for a variety of reasons. One is that it is easy for a patient to remember and it is fairly easy for office staff to schedule an annual follow-up. The issues involved with regard to follow-up of the study of reflux are radiation exposure, repeated instrumentation of the child, which is a major issue for many families, antibiotic exposure, and finally cost. On the other hand, you could wait for a long time to determine that reflux has resolved. There was an interesting study in *Pediatrics* by Thompson in which he created a model for reflux resolution based on the literature. He proposed, based on his model, that for low-grade reflux, grades 1 and 2, a VCUG could be performed every 2 years and that for moderate to severe reflux, grade 3 and above, the VCUG could be performed every 3 years. With this approach the yield would be a 19% reduction in the number of VCUGs and a cost reduction of 6% with a higher antibiotic exposure in 26%. There are certain problems with this study as you can imagine but the concept is a worldly one. Our feeling based on analysis of this study and consideration of our own practice is that for low-grade reflux, one should continue studying these children annually because the likelihood of resolution is high. If the first study that is done is a RNC, then the follow-up study should be a VCUG whether that should happen in a year, 18 months or whenever. It is important at some point to obtain anatomic detail. For those children with moderate to severe reflux greater than or equal to grade 3, one should consider follow-up at 18 to 24 months until resolution, depending upon the logistics of the family. If there is bilateral reflux, the more severe side should dictate the timing of follow-up.

Following anti-reflux surgery for those children who do come to surgical resolution, we feel that documentary imaging is advisable. This is controversial nationwide. There are centers that no longer study children post-operatively. We feel that it still is valuable to do so and currently prefer the RNC. Should the voiding ultrasonogram become widely accepted, this would be an ideal alternative for studying these children.

I would conclude that in upholding the ALARA concept in the diagnosis of vesicoureteric reflux, we have been aided considerably by the technical innovations that were discussed today, by the use of alternative studies which are expanding, by judicious patient selection, our understanding of who actually requires the study in the first place and by careful consideration of what the ultimate timing of follow-up study should be.

Dr. John Boyle

It was fluoroscopy that introduced gastroesophageal reflux into the United States. I would consider Donald Darline as one of the founding fathers of gastroesophageal reflux in the United States. Gastroesophageal reflux refers to the passage of gastric contents into the esophagus. It can be best conceptualized as three different manifestations in pediatric patients. First, it is a physiologic phenomenon. This has been defined by intraesophageal pH monitoring in asymptomatic infants and children. It is also a very common clinical syndrome in infancy manifested predominantly by chronic vomiting and oral regurgitation. Next, it is a disease called gastroesophageal reflux disease, or GERD, which has gained popularity in all print and television media. GERD occurs when refluxed gastric contents produce symptoms or tissue damage. All of these manifestations have a common mechanism. Reflux is predominantly a dysfunction of the lower esophageal sphincter, the valve at the gastroesophageal junction. Reflux is not caused by a weak sphincter; it is caused by a sphincter that relaxes at times when it should not. This is termed transient relaxation of the lower esophageal sphincter. It is the mechanism for gastroesophageal reflux in premature infants to 90-year-olds.

The mechanisms and causes of transient relaxation are not well understood. One of them certainly is gastric distention, which is something that occurs during a fluoroscopy study. This is a depiction of pH monitoring in asymptomatic patients, infants, children, and adults. In pH monitoring, a pH of 4 is considered the critical pH. Gastric contents with a pH that is acidic are capable of producing tissue damage. Reflux occurs about 73 times over a 24-hour period in a normal asymptomatic infant and up to 45 times per 24-hour period in an adult. Many of these reflux episodes are prolonged, lasting more than 5 minutes. The percentage of time that the pH is less than 4 over a 24-hour period is about 11% in infants, dropping down to 6% in older children and adults. So we all reflux and most of us are asymptomatic.

Reflux as a clinical syndrome in infancy is extremely common. Of all infants, 50–60% vomit or have regurgitation one to three times per day in the first 6 months of life. In around 20%, this is more than four times per day. This frequency dramatically drops off in the second 6 months of the first year. By 1 year, only 5% of infants vomit one to three times per day, and less than 1% are vomiting more than four times per day. So reflux is felt to be a developmental disorder in infancy and most people do not consider it to be a disease. Semantics is a major problem in reading the literature about reflux. Reflux in infants is a developmental dysmotility that is conceptualized. I tell parents it is an exaggerated birth reflex.

GERD occurs when refluxed gastric contents produce symptoms or disease. It is a functional disorder. There are no specific structural, infectious, inflammatory, or biochemical causes for these transient relaxations. You cannot do a culture and define reflux. You cannot do a blood test and define reflux. In most patients with GERD, there is an

increased frequency of reflux or prolonged exposure of the esophagus to an acid environment above those physiologic parameters we discussed before. However, and this is where things really start to get confusing, GERD may occur in patients with physiologic reflux.

It is best to conceptualize the symptoms or clinical manifestations as esophageal symptoms and extra-esophageal symptoms. In an infant, esophageal symptoms of GERD may include excessive vomiting, unexplained irritability, feeding difficulty or poor weight gain, and sleep disturbance, which are very common symptoms in infants in general. Older children behave more like adults with chronic heartburn, epigastric abdominal pain, oral regurgitation, episodic vomiting, dysphagia, and rarely hematemesis. Everyone knows the esophageal symptoms of reflux. About 2% of children between the ages of 3 and 9 years have heartburn or oral regurgitation weekly and between 5 and 8% of adolescents between the ages of 10 and 17 years have reflux at least weekly. This number jumps up to about 20% of adults being described as having either heartburn or oral regurgitation at least one to two times a week. So a very, very common problem in infancy drops off in early childhood, starts to increase in adolescence and then starts to go back up as an adult. All are caused by the same mechanism but yet the causes of these transient relaxations are not known.

This is an area that has blossomed over the last 10 years. The extra-esophageal manifestations of GERD now include chronic cough, chronic sore throat, dental erosions, hoarseness, recurrent otitis or sinusitis, wheezing or chronic asthma and in small babies, apnea or bradycardia.

The mechanism for extra-esophageal GERD is primarily felt to be aspiration but not overt aspiration that produces changes in chest radiographs—microaspirations triggering either inflammation or reflux changes in airway resistance, cough, palatal dysfunction. A lot of mechanisms have been described.

In most patients, reflux is a clinical diagnosis. Diagnosis is reasonably assumed in clinical practice by a substantial reduction or elimination of suspected reflux symptoms during a therapeutic trial of lifestyle modifications and acid-reduction therapy. However, many physicians still want an objective test. They want to know that GERD or another phenomenon is the cause of clinical concern, especially in a child who has vomiting in excess of four episodes per day or symptoms that suggest esophageal pain or respiratory disease that is not responding to usual therapies.

What are the diagnostic tests for reflux? Barium contrast upper GI series, the founding father of reflux, intraesophageal pH monitoring, upper endoscopy with an esophageal biopsy, multichannel intraluminal impedance and technetium sulfur colloid scintigraphy. We are just going to concentrate tonight on barium contrast.

Barium contrast. There is no debate that there is a definite role for the upper GI series for the evaluation of chronic vomiting. Fluoroscopy is the test of choice to determine if the patient has an anatomic abnormality in the upper gastrointestinal tract. It allows evaluation of the

esophagus for stricture, ring, hiatal hernia, of the stomach size, gastric outlet, and malrotation. It provides a lot of information and helps to solidify a diagnosis of reflux.

What are the indications? Well it certainly is not indicated in all vomiting babies. Reflux is indicated in bilious vomiting, forceful or projectile vomiting. Radiologists do not have a lot of say in who gets an upper GI series because of scheduling, but radiologists do have a say in evaluation of the acute vomiter. If a pediatrician, gastroenterologist, or a surgeon is worried about pyloric stenosis, then radiologists have input to say that an upper GI series can be replaced by an ultrasound scan. But in most vomiters, radiologists are stuck. The schedules extend far enough into the future that the infant shows up, what are you going to tell the parent? They are forced to do these studies. A lot of these are done for what is perceived to be forceful vomiting on the parent's part. They are trying to push the doctor to do something different because there are no therapies for gastroesophageal reflux. Feeding difficulty or dysphagia, poor weight gain, or weight loss are reasons for evaluation with barium contrast UGI. Probably the biggest reason that these studies are done is to reassure the parent, not so much the physician, that this child does not have any anatomic abnormality. This is a controversial area in medicine. I think we have to recognize more and more that there are many times when a negative test really does significantly help in the management of a patient. There are many infants with reflux whose parents start to manipulate their diets; start to change formulas, inadequately feed them to avoid the symptom of vomiting. It helps the pediatricians sometimes give a parent more objective evidence that the child does not have a serious problem.

It certainly makes sense to see how we can decrease fluoroscopy time and radiation exposure but to not necessarily eliminate the test. There is definite reason to debate whether or not the radiologist should note the presence of gastroesophageal reflux or altered esophageal motility, or delayed gastric emptying during fluoroscopy. There is no standard methodology of doing an upper GI series. Radiologists treat this test differently, even amongst radiologists within the same institution. The volume of barium meal changes. Many radiologists are not very patient with an infant; if they do not swallow the barium, they get a tube. The duration of observation of spontaneous reflux, provocative maneuvers to elicit reflux and fluoroscopy times all vary.

The radiologists in this room—and I am sure the physicists, too—view gastroesophageal reflux detected by fluoroscopy as a descriptive phenomenon and acknowledge that reflux detected by fluoroscopy does not equal GERD. But I must try to emphasize that it is important for radiologists to recognize how profoundly descriptive radiography reports impact on clinical management. If you write reflux on a radiography report, I can guarantee you the pediatrician or the family practitioner is going to take that to the bank and that child will be started on pharmacotherapy. That pharmacotherapy is going to be stepped up and people are going to forget that they ever

ordered it in the first place. The child will grow up on acid-reduction therapy and we do not know the long-term implications of chronic acid reduction therapy in children.

Does reflux during fluoroscopy correlate with GERD? There have been few studies, the majority being adult case series, where pH monitoring is the standard for diagnosis. These have shown low sensitivity and moderate specificity. It is because of this low sensitivity, or the perception in adults, that the concept of using provocative maneuvers was introduced to improve the sensitivity of this test as a test for reflux. As a result, people do abdominal compressions, Valsalva maneuvers, positional changes; they will put the patient upright, right lateral prone oblique has been described, rolling from side to side, leg lifting, which I guess is just Valsalva, coughing, water siphon test.

Basically, if you look at spontaneous reflux in an adult, the sensitivity is in the range of 20–50%, which is a fairly low sensitivity, but the adults report very high specificity. So a patient who does not have GERD should not show reflux on a fluoroscopic examination. By doing provocative maneuvers, the sensitivity increases into the 40–70–90% range, but the specificity decreases; reflux is elicited in patients who have no disease.

Pediatric series have been mostly case series; reflux is present in a large percentage of pediatric patients who are studied for any reason. The percentage of patients who have reflux progressively diminishes with age. Reflux is present in a number of children whose symptoms would not suggest its presence, and the height of reflux does not distinguish symptomatic from asymptomatic patients. A study by Cleveland in 1983 looked at spontaneous reflux. He did intermittent fluoroscopy over 5 minutes, reported that the total fluoroscopic time was 15–20 seconds for these studies, so it was sort of intermittent pulse. He found 82%, or basically 80%, of patients in the first 1½ years of life had reflux demonstrated on an upper GI series. It did not really make a difference if these patients were symptomatic or asymptomatic. This was in the early 1980s when upper GIs were still being done to evaluate malabsorption. He got most of his asymptomatic infants from rule-out malabsorption studies.

The number of cases of gastroesophageal reflux drops as children age such that by 12–18 years of age, even though the numbers are very, very small, only about 13% of patients are found to have reflux, so the data are more like the data in adults than in adolescents. While there have not been good calculations of sensitivity and specificity in the pediatric age group, it would seem that in infants and very young children, there is a very, very high sensitivity and a relatively low specificity. The sensitivity goes down with increasing age and the specificity goes up.

Children with cervical reflux. Again, there did not seem to be any correlation between cervical reflux and whether the patients were symptomatic or asymptomatic. The numbers are very small, but it is the only study that I know of that has really looked at height of reflux with barium studies.

Regarding societies, this guideline is from the North American Society of Pediatric Gastroenterology, Hepatology and Nutrition. Our guideline basically states that although there is no doubt that fluoroscopy can demonstrate gastroesophageal reflux, this observation does not equate to GERD. And although fluoroscopy may detect reflux of barium to the cervical esophagus in patients with or without clinical symptoms of GERD, there are presently no prospective data showing that this observation can identify patients with extra-esophageal symptoms likely to respond to anti-reflux surgery. This is the take-home message from the pediatric gastroenterologist.

So fluoroscopy in our world should not be prolonged in an attempt to demonstrate gastroesophageal reflux during a barium contrast upper GI series. There are no data to justify prolonged fluoroscopy time to perform provocative maneuvers to demonstrate reflux during a barium contrast upper GI series.

Radiology reports should describe the presence or absence of reflux; I think that does help. However, I suggest putting a disclaimer at the bottom of the report saying “recommend clinical correlation before consideration of therapy.” I think it is reasonable to put disclaimers on reports. It is OK to say, “Does it fit? Does it fit with what you are seeing clinically?”

I liked the radiologists this afternoon who said they actually interview the patients; that is very good. A lot of times the radiologist is talking to the doctor but the technician is talking to the parent, and the parent walks out of the room thinking their child is about to die from reflux. In most cases, a careful history and physical examination are sufficient to diagnosis GERD. The upper GI series is the best test of choice to rule out upper GI anatomical disorders. Upper endoscopy is the most reliable test to diagnose and assess the severity of esophagitis, and that is a whole other story.

Esophageal pH monitoring is the most reliable test to document abnormal esophageal acid exposure in endoscopy-negative symptomatic patients, to assess adequacy of acid-suppression therapy, and to correlate specific symptoms with reflux in those who are refractory to the PPI therapy and are being considered for anti-reflux surgery. Notice I did not say that esophageal pH monitoring is the most reliable method to diagnosis reflux.

Questions (Q) and Answers (A)

Q: I was really surprised by your recommendation to do an ultrasound scan 1–2 days after birth for antenatal hydronephrosis. I always thought that we had to wait past that period for physiologic oliguria before we studied these patients. I would like to hear your comments about that.

A. Dr. Diamond: That approach is just for the group who has a prenatal diagnosis of bilateral severe hydronephrosis or solitary kidney with a diagnosis of hydronephrosis. In general, if you do a postnatal ultrasound scan within the first couple days of life, you may fool yourself into thinking that it truly is milder than it in fact

is because of the relative dehydration of the child. But the concern here is to not miss the child with values who you want to pick up early. So while in general what you say is true, for this group of patients we think that looking early, and confirming that there is nothing that ought to be done in the acute setting, is reasonable. That does not get you off the hook if things look good to not study them again at about a month of age or so to get a more acute baseline.

Q: I noticed that you avoided talking about quantification of severity. What would you consider severe, 8 mm, 1 cm, in prenatal hydronephrosis?

A. Dr. Diamond: We use as our criterion of mild hydronephrosis as dilation of the renal pelvis only. Moderate if that hydronephrosis extends into the calyces and severe if there is parenchyma thinning in addition to calyceal dilation. So if there was parenchyma thinning, independent of the size of the renal pelvis, we would consider that severe.

Q: When you say mild in terms of renal pelvis, we often see kids who come in with an outside ultrasound and they are labeled as having hydronephrosis when in fact it is just an extrarenal pelvis. How often do you encounter that problem?

A. Dr. Diamond: That is a very common phenomenon but we put a lot of stock in calyceal anatomy as an indication that the process is becoming a more severe process.

Q: We as physicians interested in the urinary tract are severely criticized by many people for saying that we have really not asked the right questions. It has been pointed out in the literature, I believe your literature, how much it costs to avoid end-stage renal disease in one child with a urinary tract infection; the numbers approach 5–15 million dollars in the literature. So I do not really care too much about scars necessarily; I want to know the outcome. I think we do too many cystograms and I want to know how the outcome of what you described versus not doing the cystogram because I think the real issue is that within 5 years, we will not be doing cystograms nor even ultrasonic cystograms because I think catheterizing is invasive unless there is a real reason to do it. What is your feeling about this?

A. Dr. Diamond: This is an opinion that has been in the literature. There was a study from Australia not long ago that voiced this similar opinion. The sense that I have and I think that some of my colleagues have, as well, is that it is exceedingly uncommon for us nowadays to see a patient present in renal failure due to vesicoureteral reflux. My belief is that this is because we are probably doing something right.

What does it cost? Is it worth it? Those are questions that I cannot answer. I think that it is a very uncommon phenomenon now that we see that, and I think that is a result of being more vigilant. Undoubtedly, more studies are being done than absolutely need to be done. From our perspective, and our perspective is different from the radiologist's perspective in terms of what your threshold

should be for doing this study. It is largely because we as the tertiary consultants do not want to miss pathology and then have the child end up at another hospital and low and behold pathology that may be regarded as significant is found. So, I think our feeling is that it is still important to err on being aggressive when the clinical indications are there, but at the end of the day there are going to be many negative studies in children who were studied who would perhaps do just as well without it.

Q: Do you have a strong feeling about the volume of contrast if you put in more than age plus 2 times 30? I am talking about a radiographic VCUG. In most of the situations, the child will just not void with that small a volume. There is the belief that reflux can be induced in an otherwise normal system by over extending them. Do you think that is the case?

A. Dr. Diamond: I think that is a hard determination to make because very often children that we evaluate for reflux are dysfunctional voiders who may have gotten into the bad habit of prolonged holding and have developed a pathologically high bladder volume. I think it is important to know what your predicted endpoint is, but sometimes that is not the right endpoint.

Q: Dr. Diamond, at what point do you consider reimplanting a child's ureters as opposed to persistent follow-up in VCUG?

A. Dr. Diamond: In general, I think of a surgical approach to the problem when there is breakthrough pyelonephritis; when the child is on a proper prophylactic antibiotic and they still become infected and so medical management really is failing. I would consider surgical management if the child has quite a prolonged history of reflux. In general, it is uncommon for me to give up on a child who has severe reflux in less than, say, 4 years. I would normally give a child a fair observation period before I concluded that it was just impossible for them to outgrow reflux.

I would also consider surgical management in the older female with persistent reflux. As an example, if we have the rather unusual scenario of an 8-year-old female who presents with a grade 3 reflux, that is a situation where I may wait a year or two but beyond that point, I would regard it as probably not being in her best interest to wait her out longer and think in terms of correcting that surgically.

A third scenario is any situation where there is an anatomical abnormality like a Hutch diverticulum, which I regard as a surgical indication.

Q: What you mentioned about volume, dropping an NG tube, etc. We think nothing of reproducing a bolus on the child who has a G-tube and has a wrap to try and provoke reflux. When a child comes in for just an upper GI, I am happy to get enough barium to document the ligament then I am done. I do not think it is my job to show reflux unless it is obvious.

A. Dr. Boyle: I would agree completely with your approach. The goal is to show the anatomy with the least amount of fluoro, and it does not require a sharp

picture. Whether or not reflux is present is not important. When I see an upper GI that says gastroesophageal reflux, I consider it to be a normal study in an infant.

Q: **To Dr. Boyle:** I think that for the past 23 years as a radiologist, I have been subjected to the most incredible ridicule if I were to say “clinical correlation is recommended.” I think too many of my clinicians, if they see that in a report, immediately think I am ducking the job. As a result, when I teach my residents, I do not allow them to say that statement. I tell them that if you are about to let those words come out of your mouth, then they should stop and replace it with what they really mean. In other words, if there is a nodule on a chest X-ray and they say, “clinical correlation recommended,” what clinical correlation could that be? You have to stop and think of what you really want to say. In the event of reflux, it is to use what you have just taught us. Instead of saying the bland statement, “clinical correlation recommended,” the statement that you said was beautifully stated “the presence of gastroesophageal reflux is not necessarily indicative of reflux disease.” This will help educate the clinicians because some of my pediatricians do not understand this, either. As you say, the way we word it makes them react and start treating the kids.

A. Dr. Boyle: I think that is excellent. The way you put it is more factual and yet does throw it back to the pediatrician to think about what you are going to do with this information.

Q: I think we were taught that a lot of physicians find it offensive when we say “clinical correlation is suggested” because they obviously saw the patient before they sent them in.

A. Dr. Boyle: A lot of pediatricians still send in the patient for you to make a diagnosis of reflux. We have done a tremendous job of educating pediatricians and family practitioners about this disorder.

Q: The radiation-producing test that is not done reduces radiation 100%. I think that it is our job when we think a test is ordered inappropriately, and we may well be wrong, to call the physician up and talk to him about it. How do you as referring physicians feel about that?

A. Dr. Diamond: I have no problems. The problem is trying to get a hold of the physicians.

Q: The other scenario that comes from some people that do not have an understanding of malrotation and bilious emesis will often get a request that says “upper GI and small bowel follow through show the ligament of Treitz.” When you call the physician and say, “I don’t need to do a small bowel follow through to demonstrate the ligament of Treitz,” then they say, “I also want to see whether there’s a stricture or something.” It just seems like the time that you put into making the call to try and educate people oftentimes it works against you. I am not saying do not do it, but most of the time we have to do the study, anyway.

A. Dr. Diamond: I think it is a healthy practice, and in the course of a busy morning when you are an hour behind seeing patients, it might not be welcomed at that particular moment. Whenever I get a call from the radiologist, I will pull out the chart to see why I ordered that test. Sometimes there will be a little piece that was not communicated to the radiologist and he will say, “Fine, that makes sense.” Sometimes he will say, “David, an ultrasound will do the job. What do you say we just send the kid over to ultrasound?” I always respect that call because it shows that they are doing a very thorough job. My perspective is that the practice of pediatric urology has changed. It has become a much busier enterprise. We are asked to see more patients in less time and sometimes these details slip through the cracks.

Q: What is your feeling about cystoscopically directed VCUG for those cases where you have recurrent infection and the VCUGs that we do have not been positive? I know in your literature that people are now doing cystoscopy and direct the cystoscope by the orifice of the ureters and trying to show reflux.

A. Dr. Diamond: I do not believe in it. I do not believe it bears any resemblance to the way things truly work physiologically. We do not do it and we do not believe in it.

Q: With regard to gastroesophageal reflux. We have had a change in our chief of surgery and we also are advocating nuclear medicine or pH probe for reflux evaluations. However, we have not seen as good sensitivity with nuclear medicine because there has not been enough material given in the stomach. Thus, they are starting to rely again on our upper GIs and are now demanding that we give a lot of details to what volume we are giving. We are in the middle of a struggle to re-educate. Has that come up with you?

A. Dr. Boyle: One of the mechanisms of transient relaxation is gastric distention. If you start to just fill up the stomach, the lower esophageal sphincter pressure will actually start to decrease and the curled diaphragm will relax, resulting in one of these transient relaxations. I know a lot of adult gastroenterologists ask the radiologists to have the patient drink the barium until they feel full and see if they unmask reflux. There is a definite problem with endoscopy because there is no standard technique. I did not get to go into pH probes.

We are starting to have a lot of problems with pH probes because they are considered to be the gold standard of esophageal reflux. There is extremely high sensitivity. If you have erosive esophagitis, then you will have a positive pH probe. However, a large percentage of adults are starting to have what is called noninflammatory reflux. That is that they have normal endoscopies but significant heartburn, and that has to do with visceral hypersensitivity. Those patients will often have negative pH probes.

If we consider children, I think erosive esophagitis in an infant is extremely rare. When we endoscope babies with reflux, they have histologic esophagitis. There are a number of reports in case series that show symptomatic

reflux. Heartburn or regurgitation is described in roughly the 3- to 17-year-old range who have negative pH probes. There are also a number of studies in asthmatic patients with severe intractable asthma who have minimal symptoms of reflux but have positive pH probes. So it is beginning to look like a positive pH probe does not necessarily dictate GERD and a negative probe does not exclude GERD.

We have got to find a better way of looking at this issue. Impedance is a potential method, but the problem is going to be finding norms. The nice thing about impedance is that it detects nonacidic reflux so we can investigate postprandial reflux, prolonged postprandial reflux and night-time reflux. On paper it is a nice study but it is still invasive.

Q: For both: In ordering a procedure, do you feel that it is your obligation to discuss with the parents what the procedure involves in terms of catheterization, potential pain, radiation exposure, etc., or do you then relegate that responsibility to the radiology personnel? Often-times, parents arrive and say, "what, a catheter?!" or "what radiation?!" and there has been absolutely no preparation for these families coming for both procedures. An upper GI may involve a gastric tube. What do you think should be the clinician's responsibility for preparing the family for both procedures that can involve pain?

A. Dr. Diamond: I have never as a routine gone into the radiologic details because there are limited times in the day for me to see the patients that I need to see. The better answer now is that in my current situation, this is done by the Department of Radiology with a child life specialist so that actually when these children are scheduled for a study, the family will get a call the night before or the day before. They will get some background information about what the kids will be coming in for and they are well prepared by someone in child life working with the Radiology Department that can spend the time to go over those details with the parents. Most of those details relate to instrumentation as opposed to radiation. Given the number of studies that we order throughout the day, there is not time to go over real issues with the parents. I think it is proper that someone do it but it is not workable for us to do it.

A. Dr. Boyle: We do not order that many GIs as specialists, but our nurses do tell the parents that their child may be restrained and if they refuse to swallow the barium would potentially have a nasogastric tube placed, which is at the discretion of the radiologist; and that we are asking the radiologists to give us information and they are going to work to provide that information.