

Ramadas Satya, MD  
Janis P. O'Malley, MD

## Case 86: Meckel Diverticulum with Massive Bleeding<sup>1</sup>

### HISTORY

A 17-year-old athletic boy presented with a history of acute onset of massive hematochezia resulting in syncope. He underwent multiple blood transfusions and endoscopic examination of the upper and lower gastrointestinal tract, with no success in finding the source of bleeding. At the time of admission, the patient had a hemoglobin level of 10 g/dL and a hematocrit level of 30% (0.30), with a white blood cell count of  $2200/\mu\text{L}$  ( $2.2 \times 10^9/\text{L}$ ) and a platelet count of  $128\,000 \times 10^3/\mu\text{L}$  ( $128\,000 \times 10^9/\text{L}$ ). International normalization ratio was 1.2 (normal range, 0.9–1.0), and partial prothrombin time was 25 seconds (normal range, 20–35 seconds). Physical examination findings were unremarkable, and the abdomen was soft, nontender, and nondistended. Computed tomographic (CT) scans of the abdomen and pelvis were obtained shortly after admission. CT was immediately followed by technetium <sup>99m</sup>Tc pertechnetate scintigraphy.

### IMAGING FINDINGS

A helical CT scan (Fig 1) with 5-mm sections of the abdomen and pelvis was obtained after administration of oral and intravenous contrast agents and shows a tubular structure with central hypodensity communicating with the small bowel above the bladder. This was thought to represent blood within a Meckel diverticulum.

Scintigraphy (Fig 2) was performed with 14 mCi (518 MBq) of <sup>99m</sup>Tc sodium pertechnetate administered intravenously. These scintigraphic images revealed a focal area of persistent

increased radiotracer activity in the right lower quadrant just medial to the distal right ureter and superior to the bladder visualized on 5–60-minute planar images. The radiotracer activity in this area appears in synchrony with the stomach activity, which is consistent with a Meckel diverticulum having heterotopic gastric mucosa (HGM).

At laparoscopy, a Meckel diverticulum was found lying in the pelvis at the antimesenteric margin of the small bowel. Laparoscopic Meckel diverticulectomy was performed. No other abnormalities were present. The immediate postoperative course was unremarkable, and this patient was discharged 2 days after surgery. The tissue specimen sampled for pathologic analysis consisted of a 5.0-cm-long segment of small intestine with a 2-cm diameter showing small-bowel mucosa with focal HGM consistent with Meckel diverticulum (Fig 3). In this case, Meckel diverticulum was the correct diagnosis because of the communication with the bowel and the presence of functioning HGM.

### DISCUSSION

Meckel diverticulum is the most common congenital anomaly of the gastrointestinal tract (1). It is seen in 2% of the population, and it is caused by failure of the omphalomesenteric duct to regress (2). The point of attachment of a Meckel diverticulum to the bowel varies. Most (75%) Meckel diverticula are found within 100 cm of the ileocecal valve (3). Most patients do not have symptoms, and the Meckel diverticulum remains undiscovered, with a lifetime risk of complications reported as being 4%–40% (4,5). Painless gastrointestinal bleeding is a common symptom of Meckel diverticulum in children younger than 5 years of age. Other causes of lower gastrointestinal bleeding in children include polyps, clotting disorders, arteriovenous malformations, and Crohn disease. A Meckel diverticulum may become symptomatic in older children or adults, in which case there is a higher likelihood of patients experiencing obstruction (intussusception or volvulus) or inflammatory complications, including perforation.

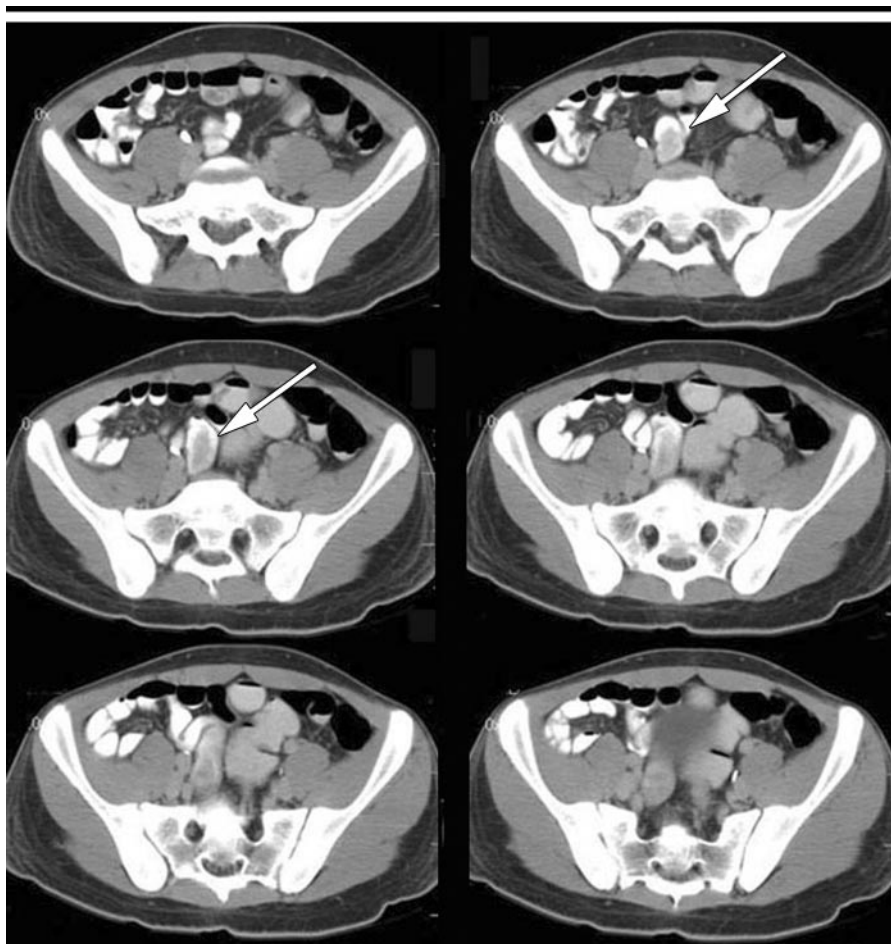
Meckel diverticulum is the most common site of HGM. Other sites include intestinal duplication and the small bowel proper. Heterotopic gastric mucosa may cause gastrointestinal bleeding and severe complications. Abdominal scintigraphy (referred to as a "Meckel scan") with <sup>99m</sup>Tc pertechnetate is a well-established diagnostic technique used in the evaluation of children with lower gastrointestinal tract bleeding to enable detection of HGM in Meckel diverticulum (6). The <sup>99m</sup>Tc per-

Part one of this case appeared 4 months previously and may contain larger images.

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<sup>1</sup> From the Division of Nuclear Medicine, Department of Radiology, University of Alabama at Birmingham, 619 S 19th St, Jefferson Towers Room J258, Birmingham, AL 35249-6830. Received August 7, 2003; revision requested October 22; revision received February 10, 2004; accepted February 16. Address correspondence to J.P.O. (e-mail: jomalley@uabmc.edu).



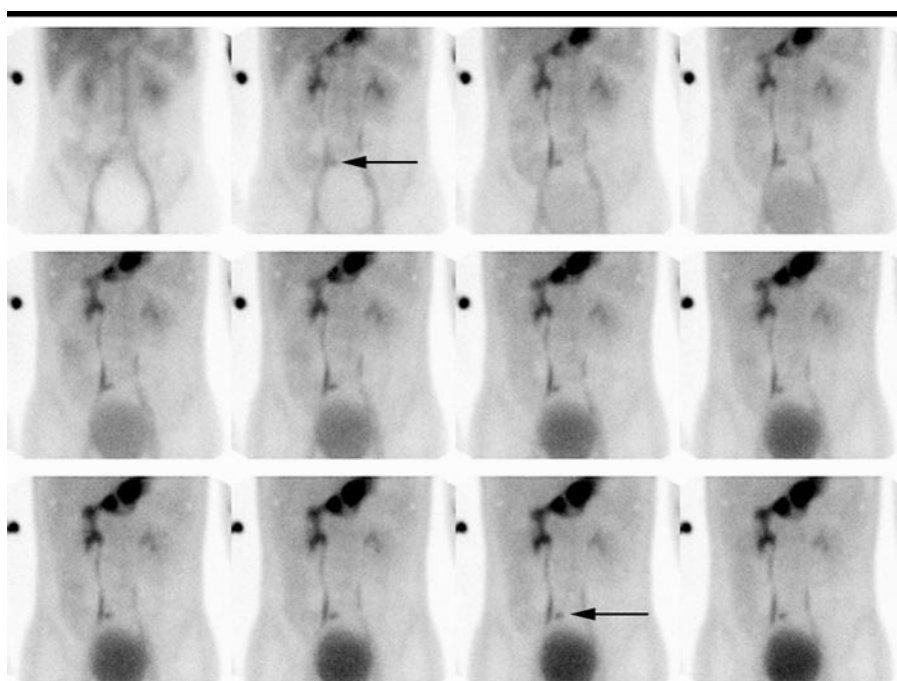
**Figure 1.** Helical CT scans (5-mm sections) of the abdomen and pelvis obtained after administration of oral and intravenous contrast agents. Representative transverse CT images of the lower abdomen obtained at admission show soft-tissue attenuation (arrows) in the small bowel above the bladder, which—given the patient's history—was thought to be a clot.

technetate is taken up and secreted by the tubular glands of the gastric mucosa. The affinity of  $^{99m}\text{Tc}$  pertechnetate for gastric mucosa makes this radiopharmaceutical a valuable tool in the detection of HGM.

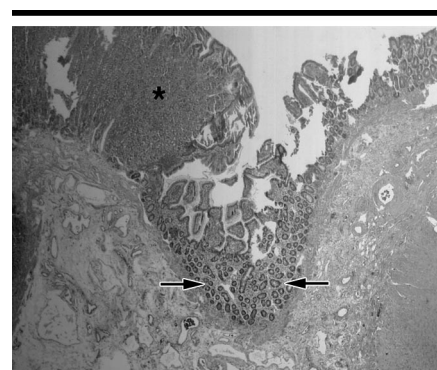
The likelihood of the presence of HGM in surgically resected Meckel diverticula is dependent on the clinical presentation. HGM is found in approximately 50% of symptomatic patients with Meckel diverticulum who have gastrointestinal bleeding, obstruction, diverticulitis, or umbilical abnormalities. If the patient population is limited to those who have gastrointestinal bleeding, the prevalence of HGM in Meckel diverticulum approaches 100% (7). Both Meckel diverticulum and intestinal duplication should be included as differential diagnostic possibilities for a focus of increased radiotracer activity on a  $^{99m}\text{Tc}$  pertechnetate abdominal scintigram because the two conditions cannot be distinguished on the basis of size or location of the HGM. However, because both conditions are treated surgically, preoperative differentiation is not important. At surgery, these conditions are easily differentiated because a Meckel diverticulum is located on the antimesenteric margin of the bowel, whereas intestinal duplication is located on the mesenteric side of the bowel. Intestinal duplication is an uncommon congenital anomaly that is diagnosed in most (80%) patients before the age of 2 years, with gastrointestinal bleed-

ing (which may be painless), intestinal obstruction, or palpable mass as the symptoms (8,9).

Intravenously injected pertechnetate accumulates in the gastric mucosa, thyroid gland, salivary glands, and choroid plexus, and some of the pertechnetate is excreted by the kidneys (10). A normal abdominal  $^{99m}\text{Tc}$  pertechnetate study should not show any focal tracer accumulation other than that seen in the stomach and urinary tract. Some radiotracer may be seen in the bowel later in the course of the examination as a result of gastric emptying. A positive study will show a focal area of uptake that appears simultaneously with the stomach and increases in signal intensity over time. Focal hyperemia or inflammation may mimic HGM on a pertechnetate scan. Causes of false-positive results include intussusceptions (11), bowel inflammation (6), gastrointestinal bleeding unrelated to HGM (12), uterine blush (13), retention of radiotracer in the urinary collecting system, vascular lesions such as hemangiomas (14), and arteriovenous malformations (15). It is important to note that radiotracer uptake in HGM must parallel radiotracer uptake in the stomach; thus, continuous dynamic imaging of the abdomen and attention to the timing of the appearance of abnormal radiotracer uptake will allow physicians to distinguish HGM from nearly all of these false-positive possibilities.



**Figure 2.** Nuclear  $^{99m}\text{Tc}$  sodium pertechnetate planar images show a focal area of persistent increased radiotracer activity (arrows) in the right lower quadrant just medial to the distal right ureter and superior to the bladder seen on 5–60-minute images. Radiotracer activity in this area appears in synchrony with the stomach, which is characteristic of HGM in a Meckel diverticulum.



**Figure 3.** Photomicrograph shows gastric mucosa (black arrows) adjacent to the intestinal mucosa (\*) in the Meckel diverticulum. (Hematoxylin-eosin stain; original magnification,  $\times 100$ .)

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Congratulations to the 230 individuals and three resident groups who submitted the most likely diagnosis (Meckel diverticulum) for Diagnosis Please, Case 86. Credit was given for either Meckel diverticulum or intestinal duplication. The names and locations of the individuals and resident groups, as submitted, are as follows:

#### Individual responses

Amr M. Aajlan, MB, ChB, *Montreal, Quebec, Canada*  
 Hisashi Abe, *Osaka, Japan*  
 Mitri Achram, *Beirut, Lebanon*  
 Gholamali Afshang, MD, *Tinley Park, Ill*  
 Dr Jorge Ahualli, *Tucuman, Argentina*  
 Masaaki Akahane, MD, *Tokyo, Japan*  
 Okan Akinci, MD, *Istanbul, Turkey*

Silvio Cavalcanti Albuquerque, *Recife Pe, Brazil*  
 Matthew Allen, *La Grande, Ore*  
 Canan Altay, MD, *Izmir, Turkey*  
 Albert J. Alter, *Madison, Wis*  
 Nabil Ammouri, MD, *Zahle, Lebanon*  
 Arangasamy Anbarasu, MD, FRCR, *Coventry, United Kingdom*  
 Dr Guenther Antes, *Kempten, Germany*  
 Alexandra Araújo, *Lisbon, Portugal*

- Juan Ramón Ayuso, *Barcelona, Spain*  
 Basem M. Azar, MD, *Havre de Grace, Md*  
 Angus Baird, *Birmingham, Ala*  
 Ken Baliga, *Rockford, Ill*  
 Gregory J. Balmforth, MD, *Tucson, Ariz*  
 Richard Benedikt, MD, *San Antonio, Tex*  
 Philip Beuchert, *Smithtown, NY*  
 Sanjay Bhat, *Temple, Tex*  
 Stephen M. Borstelmann, MD, *Winter Park, Fla*  
 Dr Adrian Brady, *Cork, Ireland*  
 Eric L. Bressler, MD, *Minnetonka, Minn*  
 Douglas C. Brown, MD, *Virginia Beach, Va*  
 Michael P. Buetow, MD, *Okemos, Mich*  
 Peter Buetow, MD, *Bellingham, Wash*  
 P. J. Cadman, *High Wycombe, Buckinghamshire, United Kingdom*  
 Antonio Cavalcanti, MD, *São Paulo, Brazil*  
 Luisa Fernanda Cervantes, *Miami, Fla*  
 Marcos Nogueira Chagas, MD, *Brasilia, Brazil*  
 Nancy Chandler, MD, *Baton Rouge, La*  
 Paul J. Chang, *Pittsburgh, Pa*  
 Chris Chernesky, MD, *Springfield, Mo*  
 Dr N. Chidambaranathan, *Chennai, India*  
 Surin Chonmaitri, MD, *Bangkok, Thailand*  
 Haris Chrysikopoulos, MD, *Kerkyra, Greece*  
 Richard J. Cobb, MD, *Hartford, Conn*  
 Jay M. Colby, MD, *Stonington, Conn*  
 John J. Combs, MD, *Heidelberg, Germany*  
 Neal R. Conti, MD, *Seattle, Wash*  
 Yves Cordoliani, MD, *Paris, France*  
 Theresa M. Corrigan, *Louisville, Ky*  
 Alexandre Calabria da Fonte, *São Paulo, Brazil*  
 Thuan Dang, MD, *Colton, Calif*  
 Anil Kumar Dasyam, *Pittsburgh, Pa*  
 Peter C. De Baets, MD, *Damme, Belgium*  
 Alejandro de la Vega, MD, *Rio Negro, Argentina*  
 J. F. K. de Villiers, *Gisborne, New Zealand*  
 Jon De Witte, *Athens, Ga*  
 Mustafa Kemal Demir, MD, *Istanbul, Turkey*  
 Thaworn Dendumrongsup, MD, *Songkla, Thailand*  
 Bart D'herde, *Hasselt, Belgium*  
 T. Dhurairaj, *Roseville, Minn*  
 Susana Dias, *Porto, Portugal*  
 Mark T. DiMarcangelo, DO, MS, FACR, *Cherry Hill, NJ*  
 Nam Ky Do, *Duluth, Ga*  
 Dr Heratch Doumanian, *Merrillville, Ind*  
 Seyed Emamian, MD, PhD, *Rockville, Md*  
 Laura Z. Fenton, MD, *Denver, Colo*  
 Djamil Fertikh, MD, *Philadelphia, Pa*  
 Francis Flaherty, MD, *Ridgefield, Conn*  
 Ricardo B. Fonseca, MD, *Nashville, Tenn*  
 Jordi Catala Forteza, *Barcelona, Spain*  
 Ángeles Franco, *Madrid, Spain*  
 Arie Franco, MD, PhD, *Pittsburgh, Pa*  
 Akira Fujikawa, *Tokyo, Japan*  
 Ann S. Fulcher, MD, *Richmond, Va*  
 Mitsuhiro Furusawa, MD, *Kumamoto, Japan*  
 Bill Gallmann, MD, *Shreveport, La*  
 Roberto Garcia Figueiras, MD, *Santiago de Compostela, Spain*  
 Juan Francisco Garcia, MD, *Monterrey, Mexico*  
 Douglas Gardner, MD, *Windsor, Ontario, Canada*  
 Gilles Genin, MD, *Annecy, France*  
 Paulo Gil Agostinho, *Coimbra, Portugal*  
 Ted A. Glass, MD, *Jackson, Miss*  
 Brad S. Gluck, MD, *Southampton, NY*  
 Mark Goldshein, MD, *Andover, Mass*  
 Francisco J. Gonzalez, MD, *Cantabria, Spain*  
 Nihal Gooneratne, *Hinsdale, Ill*  
 Dr Enrique Gorri, *Mendoza, Argentina*  
 Christopher Govea, MD, *Austin, Tex*  
 Thomas Grant, DO, *Chicago, Ill*  
 Daniel Gridley, MD, *Goodyear, Ariz*  
 John D. Grizzard, MD, *Midlothian, Va*  
 Joseph Grunz, MD, *Ladue, Mo*  
 Flavius Guglielmo, MD, *Basking Ridge, NJ*  
 Ehsan A. Haider, MB, ChB, *Montreal, Quebec, Canada*  
 Ferris M. Hall, MD, *Boston, Mass*  
 Yukihiko Hama, MD, PhD, *Bethesda, MD*  
 Satoshi Hamatake, *Kumamoto, Japan*  
 Srinivasan Harish, *Cambridge, United Kingdom*  
 Rufus W. Head, MD, *North Bridgton, Me*  
 Richard Herman, MD, *Boston, Mass*  
 Marla R. Hersh, *Tampa, Fla*  
 Helen T. Ho, MD, *Chicago, Ill*  
 Ronald J. Homer, MD, *Los Angeles, Calif*  
 Suzanne Yoon Homer, MD, *Los Angeles, Calif*  
 Alfred L. Horowitz, MD, *Asheville, NC*  
 Brian Hu, MD, *Nashua, NH*  
 Felix A. Hughes, III, MD, *Virginia Beach, Va*  
 Teresa Juliá, *Sevilla, Spain*  
 Eric Kakinami, *São Paulo, Brazil*  
 Andrew J. Kapustin, *Merion, Pa*  
 S. Pinar Karakas, *New Hyde Park, NY*  
 Katsuhiko Kato, MD, PhD, *Nagoya, Japan*  
 Robert A. Kaufman, MD, *Memphis, Tenn*  
 Ravinder Kaur, *Chandigarh, India*  
 Myeong-Jin Kim, MD, PhD, *Seoul, Korea*  
 Takuji Kiryu, MD, *Gifu, Japan*  
 David S. Klein, MD, *Fairfield, Conn*  
 Steven A. Klein, MD, *Shrewsbury, Mass*  
 Yu-Ting Kuo, MD, *Kaohsiung, Taiwan*  
 Robert L. Kushner Jr, MD, *Atlanta, Ga*  
 Stefanos Lachanis, MD, *Athens, Greece*  
 Mario Laguna, *West Allis, Wis*  
 Daniel Lahan Martins, MD, *Campinas, Brazil*  
 Luis A. Landeras, *Trujillo, Peru*  
 Dr Matias Landi, *Buenos Aires, Argentina*  
 John R. Leahy, MD, *Austin, Tex*  
 John T. Lim, MD, *Newport Coast, Calif*  
 David A. Lisle, *Brisbane, Australia*  
 Patricia Lowry, MD, *Richmond, Va*  
 Jason Lynn, MD, *Columbia, SC*  
 Andrew B. MacKersie, *Niceville, Fla*  
 Faaiza Mahmoud, MD, *Baltimore, Md*  
 Walter Mak, MD, *Peoria, Ill*  
 Stephen Manghisi, MD, *Closter, NJ*  
 N. B. S. Mani, MD, *Nassau, Bahamas*  
 Timothy A. Manzone, MD, JD, *West Chester, Pa*  
 Alberto A. Marangoni, MD, *Córdoba, Argentina*  
 Vance McCollom, MD, *Oklahoma City, Okla*  
 Frank McKowne, MD, *Vancouver, Wash*  
 Carla Giannine P. Medina, MD, *Brasilia, Brazil*  
 Sunil Mehta, *Mississauga, Ontario, Canada*  
 Gaston Mendez, Jr, MD, *Pompano Beach, Fla*  
 Luis Mendez-Uriburu, *Tucuman, Argentina*  
 Edward Menges, *Aptos, Calif*  
 Koen Mermuys, MD, *Heverlee, Belgium*  
 Jonathan Meyer, MD, *Chicago, Ill*

Juan A. Millan, MD, *Seattle, Wash*  
 Manabu Minami, MD, *Ibaraki, Japan*  
 Sankar Ranjan Mondal, MD, *Nassau, Bahamas*  
 Eduardo Mondello, MD, *Buenos Aires, Argentina*  
 Moataz Montasser, MD, *Alexandria, Egypt*  
 John R. Mootz, MD, *Elmira, NY*  
 Jonathan Movson  
 Tetsuo Nakayama, MD, *Osaka, Japan*  
 S. Namasivayam, MD, DNB, DHA, *Atlanta, Ga*  
 Tammam Nehme, *East Wenatchee, Wash*  
 Chris Ng, MD, *Nashville, Tenn*  
 Mizuki Nishino, MD, *Boston, Mass*  
 J. J. Noguera, *Pamplona, Spain*  
 Maura Noordhoorn, *New York, NY*  
 Michael T. O'Loughlin, MD, *West Hartford, Conn*  
 Ann B. Owen, MD, *Murfreesboro, Tenn*  
 David M. Panicek, MD, *New York, NY*  
 Harish K. Panicker, MD, *Takoma Park, Md*  
 Linda Pantongrag-Brown, MD, *Frederick, Md*  
 Raj Mohan Paspulati, MD, *Cleveland, Ohio*  
 Maria Olga Patino, MD, *Houston, Tex*  
 Christopher Payne, MD, *Greensboro, NC*  
 Constantino S. Pena, *Key Biscayne, Fla*  
 Joseph R. Perno, *Hamilton, NJ*  
 Alexander Petersen, MD, *Nowra, Australia*  
 Timothy J. Phalen, MD, *Cincinnati, Ohio*  
 David Pham, MD, *Toronto, Ontario, Canada*  
 Hilton W. Pittman, *Pensacola, Fla*  
 Rubem Pochaczewsky, *Bronx, NY*  
 Norman Rahn, MD, *Gadsden, Ala*  
 Lorenz (Larry) Ramseyer, MD, *Enid, Okla*  
 Matt Rheinboldt, *Nashville, Tenn*  
 Jordi Rimola, MD, *Sabadell, Spain*  
 Uri Rimon, MD, *Tel-Hashomer, Israel*  
 Mathieu H. Rodallec, *Paris, France*  
 Prof Dr Thomas Roeren, *Aarau, Switzerland*  
 Murray J. Rosensweig, MD, *Bronx, NY*  
 Kris Saadeh, *Mount Pleasant, SC*  
 Fabio Sandomenico, *Naples, Italy*  
 Shuichi Sato, *Tokyo, Japan*  
 Pierre J. Sauvage, MD, *Mâcon, France*  
 Dr Mark Schiffer, *Woodstock, Ill*  
 Steven M. Schultz, MD, *Fort Worth, Tex*  
 Anthony J. Scuderi, *Johnstown, Pa*  
 Mustafa Secil, MD, *Izmir, Turkey*  
 Carol L. Seifert, MD, *Gibsonia, Pa*  
 Jonathan M. Shapiro, MD, *Sharon, Mass*  
 Matt Shapiro, MD, *Charlottesville, Va*

Dr Vinod A. Shenoy, *Norwich, United Kingdom*  
 Waka Shimada, *Tochigi, Japan*  
 Grady Shue, *Heidelberg, Germany*  
 L. Siddappa, MD, *Karnataka, India*  
 Richard Silberstein, *San Jose, Calif*  
 Ken Simmons, *Sydney, Australia*  
 S. Horatio Slawson, MD, *Peoria, Ill*  
 James D. Sprinkle, Jr, MD, *Spotsylvania, Va*  
 Efthymios Stamoulis, *Athens, Greece*  
 Paul Stark, MD, *La Jolla, Calif*  
 Marius Stellmann, MD, *Stade, Germany*  
 Jonathan D. Stephenson, MD, *Hershey, Pa*  
 Daniel M. Stovell, MD, *Smiths, Bermuda*  
 Chirochana Suchato, MD, *Bangkok, Thailand*  
 Kouichi Sugiyama, *Hamamatsu, Japan*  
 Norio Takahashi, MD, *Fukui, Japan*  
 Satoru Takahashi, MD, *Nijmegen, the Netherlands*  
 Varaha S. S. Tammisetti, MD, *Seattle, Wash*  
 Marie Tartar, MD, *La Jolla, Calif*  
 Ann Tate, *Ipswich, United Kingdom*  
 Douglas L. Teich, MD, *Brookline, Mass*  
 Kazuma Terauchi, MD, *Fukuoka, Japan*  
 Juan Carlos Terrero, MD, *Miami, Fla*  
 Eugene Tong, MD, *Austin, Tex*  
 William C. Torreggiani, *Dublin, Ireland*  
 Hiroyuki Ueda, *Kyoto, Japan*  
 Ricardo Videla, *Córdoba, Argentina*  
 Joan C. (Kai) Vilanova, MD, *Girona, Spain*  
 Javier Villanueva-Meyer, MD, *Houston, Tex*  
 Christopher Vittore, MD, *Rockford, Ill*  
 Yukari Wakabayashi, MD, *Tokyo, Japan*  
 David J. Wright, MD, *Lake Oswego, Ore*  
 Satoru Yoshida, MD, *Muroran City, Japan*  
 F. Yoshimitsu, *Kanagawa, Japan*  
 Stanko Yovichevich, MD, *Sydney, Australia*  
 Joe Yut, *Olathe, Kan*  
 Jeffrey H. Zapolsky, MD, *Oshkosh, Wis*  
 Yu Zhang, *San Francisco, Calif*  
 Dahua Zhou, MD, *East Meadow, NY*  
 Sérgio Zoriki, *Limeira, Brazil*

#### **Resident group responses**

Hospital of the University of Pennsylvania Radiology  
 Residents, *Philadelphia, Pa*  
 MLU-RDC DM Residents, *Buenos Aires, Argentina*  
 Oregon Health and Science University Radiology Residents,  
*Portland, Ore*