Nonvascular Interventional Procedures in an Urban General Hospital:

Analysis of 2001–2010 with Comparison to the Previous Decade

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Rationale and Objectives: To determine trends in nonvascular image-guided procedures at an urban general hospital over a 10-year period and to compare utilization of nonvascular interventional radiology (IR) over the decade 2001–2010 to a previously reported analysis for 1991–2000.

Methods: With institutional review board approval, a 20-year quality assurance database verified against the radiology information system was queried for procedure location (eg, pleura, liver, bowel, and abdomen) and type (eg, biopsy, catheter insertion, and transient drainage), demographics, and change over time. Yearly admissions and new hospital numbers assigned each year served to normalize for overall hospital activity.

Results: A total of 50,195 IR procedures were performed in 24,309 distinct patients (male:female, 12,625:11,684; average age, 60 years), 940 procedures performed in age <20 years, and 571 procedures performed in patients aged ≥90 years. A total of 15345, 4377, and 1754 patients had one, two, or three procedures, respectively; 470 had ≥10 procedures. Twenty-seven supervising radiologists and 277 individuals participated as operators, double the previous decade. Biopsy (4.8% average yearly increase), abdominal drainage (7.3%), paracentesis (12.9%), tube manipulation (13.0%), suprapubic bladder tube insertion (21.0%), and gastrostomy (44.6%) all increased strongly ($P < .001$) over 120 months but not biliary drainage, nephrostomy, or chest tubes. Procedures increased faster than either admissions or new hospital numbers ($P < .001$). For each 1000 new hospital numbers, IR service performed 48 procedures versus 31 the previous decade ($P < .0005$).

Conclusions: Referrals for nonvascular IR procedures have doubled over 2 decades, outpacing growth in new hospital patients and requiring increased resource allocation.

Key Words: Radiology; interventional; utilization; image-guided biopsy; abdominal abscess.

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Nonvascular interventional radiology (IR) includes an array of imaging-guided special procedures performed in organs and via access routes outside the vascular tree. So accepted and widespread are these techniques that it is impossible to imagine a modern hospital that cannot offer many of them to its patients. Such procedures are considered minimally invasive and include among many others percutaneous biopsy, abscess drainage, biliary, urinary, and gastrointestinal (GI) tract access, as well as simple fluid sampling or drainage like thoracentesis and paracentesis.

As a discipline, nonvascular IR has extensively evolved over the last 60 years. Percutaneous nephrostomy dates from 1955 (1). Biliary drainage evolved from purely diagnostic transhepatic cholangiography and angiography during the late 1970s (2). The details of percutaneous biopsy were worked out in the late 1970s and early 1980s by Haaga et al. and others (3,4). Gerzof et al. (5) began to develop techniques for percutaneous abscess drainage around the same time. As Dondelinger (6) has pointed out in his historical review of nonvascular IR, percutaneous abdominal abscess drainage has been recognized since the 1980s as a major advance for surgery (7). Techniques that permit a needle or small tube to accomplish what previously required surgery have been aided by improved

Acad Radiol 2015; 22:904–908

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http://dx.doi.org/10.1016/j.acra.2015.01.002

imaging equipment such as real-time sonography and faster computed tomography (CT) scanners.

We have previously described the contents of a database of nonvascular IR special procedures, predominantly in the abdomen and pleural space, maintained by our practice for the 10 years from October 1991 through September 2000 (8). Our data showed a steady rise in almost all kinds of procedures and in procedures involving all organs and compartments. The analysis of that decade documented increasing acceptance of nonvascular IR because our procedure volume outpaced growth in admissions and accrual of new patients hospital wide.

We have continued for the subsequent decade to perform nonvascular IR in the same practice setting and to record data from those procedures. The purpose of this study was to analyze the data for this past decade in a fashion comparable to the previous analysis, so that patterns of similarity and difference can be discerned, possibly pointing toward ways that nonvascular IR will be called on to respond in the future.

MATERIALS AND METHODS

This is a single-center retrospective study performed in an urban university-affiliated general hospital in the Northeastern United States. During the decade-long study, the hospital had 855–907 beds. Nearly 80% of these have been general medical and surgical beds, 13% adult intensive care, and 7% intensive and general pediatrics.

Case recording for the nonvascular IR database during the decade October 2000 until September 2010 proceeded in a manner similar to the preceding decade as previously described (8,9). Exhaustive demographic and procedure-specific information was avoided. We collected only patient identifiers (name and hospital number), date of service, operators, up to two lines of free text, and two descriptors of the procedure. These descriptors, "procedure location" and "procedure type," comprise the key information collected for each case and permit identification of most procedures. Procedure location/procedure type pairs identify many procedures uniquely, like liver/biopsy. Others would account for groups of related procedures. For example, bowel/catheter left in would ordinarily define a percutaneous gastrostomy (10). However, a percutaneous cecostomy or a feeding tube placement requiring specialized skills with a guide wire was also characterized as bowel/catheter left in. Abdominopelvic/needle only would denote either a low-volume paracentesis or needle aspiration of a small abscess.

Cases were entered from daily workflow–tracking boards by specially trained secretaries. Because the database was used for quality control, including procedure complications and biopsy results, new entries were checked frequently against the radiology information system (RIS). This was IDXrad (IDX Systems, Burlington, VT) at the beginning of the decade and Centricity RIS-IC (GE Healthcare, Waukesha, WI) at the end. Because each case (even a bedside or operating room case) was scheduled in one of the several available procedure rooms, lists of cases electronically "completed" in these rooms were used to fill in any missing cases and to verify that each case in the database corresponded to a case completed in RIS. We did not expect that the procedure database and RIS examination codes would correspond exactly. For the database, multiple abscess drainages in the same compartment at the same sitting were considered a single procedure but would have multiple RIS entries. In rare cases, discrepancies had to be resolved by reference to the electronic medical record.

Because demographic information collected in the database was deliberately kept elementary (name and hospital number), additional information was added retrospectively from the RIS. This included sex, date of birth, and in- or out-patient status. This was accomplished at the end of the decade by matching database and RIS output lists by corresponding hospital numbers. This process also served as an additional check on the data.

Yearly hospital admissions and yearly assignment of new patient hospital numbers (medical record numbers) served as measures of hospital activity during each year. As in the analysis of data from the previous decade, we used ratios of interventional procedures to admissions and to hospital numbers to assess IR growth relative to overall hospital activity.

Data entry and verification and yearly computation of hospital number assignments were performed in accordance with the methods used to analyze data from the preceding decade. The same system operator maintained the database during the entire 20 years.

Statistical Analysis

In column form (one case per row), the database for October 2000 through September 2010 was exported to Windows 7 Excel 2010 (Microsoft, Redmond, WA) for all descriptive statistics. Trends were modelled by linear regression using Statview v1.03 (Abacus Concepts, Berkeley, CA). This includes yearly change in procedure volume as fraction of admissions and new hospital numbers and yearly proportion of outpatient procedures. For selected procedures, aggregated monthly totals were also modelled by linear regression. Because of multiple comparisons, differences of the regression line from horizontal were considered significant only when $P < .01$.

This study was approved by our hospital human studies ethical committee. Because it was retrospective, based on queries of existing databases, patient informed consent was not required.

RESULTS

During the 10 fiscal years (FYs) from October 2000 through September 2010, the practice performed 50,195 interventional procedures in 24,309 distinct patients (male:female 12,625:11,684). A total of 26,177 procedures were performed on male patients and 24,018 on female patients.

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