

Demystifying Interventional Radiology

A Guide for
Medical Students

Sriharsha Athreya
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Preface

Interventional radiology (IR) is a subspecialty of radiology that utilizes minimally invasive image-guided procedures to diagnose and treat conditions in nearly every organ system. Interventional radiology is a relatively new specialty, and the year 2014 marked the 50th anniversary of the specialty. The growth of IR has been particularly noticeable in the last two to three decades. This is a specialty that requires a good combination of clinical expertise and technical skills. Many of the procedures have replaced some of the established surgical treatments. The minimally invasive (“pinhole surgery”) nature of the IR techniques reduces infection rates and recovery time, as well as shortens hospital stay.

Interventional radiology is driven by innovation and rapidly evolving technology. A sound understanding of diagnostic radiology is essential for one who is aspiring to be an interventional radiologist. The knowledge and exposure to IR in medical schools is limited. Early exposure of medical students to IR would attract future interventional radiologists as well as increase awareness among future referring physicians. The goal of this book is to provide medical students with a basic understanding of IR. Therefore, the authors of each chapter of this book were recruited among medical students who expressed interest in pursuing radiology and interventional radiology as their career.

This book is divided into three parts: Introduction, Techniques, and Common Interventional Radiology procedures. The introductory chapters cover the history of IR, basic physics of X-rays, radiation safety, and the tools and medications used for the various procedures. Chapters 7 through 10 describe techniques such as biopsy and drainage, vascular access, embolization, and tumor ablation. The final part of the book discusses the most common interventional radiology procedures and outlines their indications, patient preparation, post-procedure care, and complications.

I hope that students find this book informative, educational, and easy to read and understand.

Hamilton, ON, Canada

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Part I
Introduction

Chapter 1

Interventional Radiology: The Early Days and Innovation

Jason Martin

The Beginning

Interventional radiology (IR) was developed through the pioneering work of early diagnostic angiographers. Charles Dotter was an American vascular radiologist, considered the “father” of interventional radiology. He first conceived IR in the 1960s and spoke about it on June 19, 1963, in Czechoslovakia [1]. During his presentation, Dotter discussed catheter biopsy, controlled catheterization, occlusion catheterization, and the basis for catheter endarterectomy [2]. He urged a change in paradigm, envisioning the diagnostic catheter as a means for delivering novel therapy. This radical shift was a shock for many, as angiographers at the time were trained to help referring clinical colleagues with diagnosis, not treat patients themselves with percutaneous methods.

The first IR case was performed on January 16, 1964. Dotter percutaneously dilated a stenosis in the superficial femoral artery (SFA) in an 82-year-old woman with painful leg ischemia and gangrene who refused leg amputation. After the procedure, circulation returned to her leg. The patient was kept in the hospital for weeks, waiting for the dilated artery to thrombus. However, the pain resolved and she started walking. Her dilated artery remained patent until her death (from unrelated causes) two-and-a-half years later.

This success encouraged Dotter to not only treat SFA stenoses but also SFA occlusions. A paper published by Dotter and Melvin Judkins (his trainee at the time) in the November 1964 issue of *Circulation* outlined their 5-month experience with angioplasty [3]. It detailed the treatment of 11 extremities in 9 patients, including 4 short SFA occlusions and 4 long SFA occlusions. While not all the procedures were successful, 4 out of 7 scheduled amputations were averted. As Dotter’s experience

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grew, in 1966 he reported outcomes of 82 lesions in 74 patients, including 6 iliac artery stenoses. This experience allowed Dotter to refine his technique, decreasing the size of dilation catheters and improving their design. Two years later, he reported 217 dilations of 153 lesions in 127 patients [4], with excellent results.

The term “interventional radiology” was coined by Alexander Margulis (a gastrointestinal radiologist) in an editorial in the *American Journal of Roentgenology* in 1967. At the time, radiologists worldwide were exploring the treatment of non-vascular disease through percutaneous methods. They included treatment of frozen shoulders by joint distension during arthrography, drainage of abscess, intrauterine transfusion of the fetus under fluoroscopic guidance, pulmonary and liver biopsies, and transjugular cholangiography. Margulis realized that a new specialty was developing and, in his editorial, defined IR and also set requirements for its performance. Central to IR training was the need for specific training, technical skills, clinical education, and the ability to care for patients before, during, and after the procedure.

Dotter was not enthralled with the term “interventional,” as he thought it would generate confusion among the public and physicians about what an IR could do. However, the term allowed for the creation of a new field and the semantic and conceptual separation from general diagnostic radiology and its subspecialties.

1960s–1980s

The mid-1960s–1980s were a time of great development for radiology, as Dotter’s work challenged the knowledge of diagnostic angiographers and spurred their transition to interventionalists. In the earlier years, new techniques were often introduced to clinical practice without experimental and patient safety testing. Many emergencies in clinical medicine forced radiologists to innovate, creating new procedures and techniques to combat a variety of pathology. Arterial embolization of upper gastrointestinal bleeding was a major advancement created in this manner. The application of experience and techniques in one organ system to a different system led to new indications for interventional procedures. As newer techniques were developed, detailed experimental testing in animals was performed before introduction to clinical use, promoting the use of ethical innovation and patient care, as well as evidence-based medicine.

Percutaneous Transluminal Angioplasty

After his successful first procedures, Dotter began to recruit patients for percutaneous transluminal angioplasty (PTA) mainly from general practitioners and internists. Surgeons were not interested in nonsurgical treatment of atherosclerotic disease and were adamantly opposed to PTA. Through media advertising, Dotter was able to