A HISTORY OF CARDIAC CATHETERIZATION

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DISCLOSURES:
NONE

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INTERVENTIONALIST: IN PURSUIT OF NEW TREATMENTS

ACADEMIC: IN PURSUIT OF NEW KNOWLEDGE
In 1929, while working in Eberswalde, he performed the first human cardiac catheterization. He ignored his department chief and persuaded the operating-room nurse Gerda Ditzen, to assist him. She agreed, but only on the promise that he would do it on her rather than on himself.

However, Forssmann tricked her by restraining her to the operating table and pretending to locally anesthetize and cut her arm whilst actually doing it on himself. He anesthetized his own lower arm in the cubital region and inserted a uretic catheter into his antecubital vein, threading it partly along before releasing Ditzen (who at this point realized the catheter was not in her arm) and asking her to call the X-ray department.

They walked some distance to the X-ray department on the floor below, where under the guidance of a fluoroscope he advanced the catheter the full 60 cm into his right heart. This was then recorded on X-Ray film showing the catheter lying in his right atrium.
IT IS OF INTEREST THAT FORSSMANN’S PRIMARY GOAL IN THIS CATHETER STUDIES WAS TO DEVELOP A THERAPEUTIC TECHNIQUE FOR DIRECT DELIVERY OF DRUGS INTO THE HEART:

“IF CARDIAC ACTION CEASES SUDDENLY, AS IN ACUTE SHOCK OR IN HEART DISEASE, OR DURING ANESTHESIA, OR POISONING, ONE IS FORCED TO DELIVER DRUGS LOCALLY. IN SUCH CASES THE INTRACARDIAC INJECTION OF DRUGS MAY BE LIVESAVING. HOWEVER, THIS MAY BE A DANGEROUS PROCEDURE BECAUSE OF MANY INCIDENTS OF LACERATION OF CORONARY ARTERIES LEADING TO CARDIAC TAMPONADE AND DEATH. THEREFORE I STARTED TO LOOK FOR A NEW WAY ...AND I CATHETERIZED THE RIGHT SIDE OF THE HEART THROUGH THE VENOUS SYSTEM.”

FORSSMANN W. DIE SONDIERUNG DES RECHTEN HERZENS. KLIN WOCHENSCHR 8:2085, 1929

OTTO KLEIN MD: B. 1881 in Pilsen, now Czech Republic, died in Buenos Aires, Argentina. Academic career was at the Second Medical Clinic, University Hospital in Prague. His research was carried out there and he was promoted to full professor in 1933. However, as was the case with Forssmann, he was criticized for doing this “dangerous work”. In 1938 all Jews were forced to resign their academic posts, and in 1939 he and his wife escaped the Nazis by fleeing to Argentina. He worked at the Durand Hospital in Buenos Aires but his health was poor and he retired in 1951 at age 70.
ANDRE COURNAND AND DICKINSON RICHARDS
• COLLABORATED AT COLUMBIA UNIVERSITY AND NYU/BELLEVUE HOSPITAL IN NYC
• 1943-1950 RIGHT HEART CATHETERIZATION, MEASURED PRESSURES, CARDIAC OUTPUT

ANDRE COURNAND
• His medical studies interrupted by World War I, Cournand graduated from the University of Paris. He studied at Bellevue Hospital, New York City, where he met Dickinson Richards. Together they collaborated in clinical lung and heart research and perfected Forssmann’s procedure, now termed cardiac catheterization, whereby a tube is passed into the heart from a vein at the elbow.

• With this procedure it became possible to study the functioning of the diseased human heart and to make more accurate diagnoses of the underlying anatomic defects. Cournand and Richards also used the catheter to examine the pulmonary artery, thus enabling improvement in the diagnosis of lung diseases as well.

• Cournand joined the faculty of the College of Physicians and Surgeons of Columbia University in 1934, retiring as emeritus professor of medicine in 1964.

WERNER FORSSMANN, DICKINSON RICHARDS AND ANDRE COURNAND
NOBEL PRIZE CELEBRATION IN STOCKHOLM, SWEDEN, 1956
FURTHER DEVELOPMENTS: PHYSIOLOGY, TECHNICAL ADVANCES

• 1947: LEWIS DEXTER IN BOSTON MEASURED RV AND PA PRESSURE AND DISCOVERED THE "PULMONARY ARTERY WEDGE" POSITION WITH PRESSURE AND WAVEFORM NEARLY IDENTICAL TO THAT OF THE LEFT ATRIUM, RICHARD GORLIN AND THE GORLIN FORMULA.

• 1947 – 1950: PHYSIOLOGIC STUDIES BY R. BING (JHH), EUGENE STEAD (EMORY, DUKE), JOHN McMICHAEL (UK), J. LENEGRE (PARIS), EARL WOOD (MAYO CLINIC)

• 1950: FIRST RETROGRADE HEART CATH BY ZIMMERMAN (CLEVELAND) AND LIMON-LASON (MEXICO CITY)

• 1953: SVEN SELDINGER (KAROLINSKA, STOCKHOLM) PERCUTANEOUS TECHNIQUE

• 1959: TRANSEPTAL CATHETERIZATION: JOHN ROSS, GLENN MORROW AND EUGENE BRAUNWALD

SWAN-GANZ PULMONARY ARTERY CATHETER

The Pulmonary Artery Catheter

Swan, HJ; Ganz, W; Forrester, J; Marcus, H; et al. (August 1970). Catheterization of the heart in man with use of a flow-directed balloon-tipped catheter. New England Journal of Medicine

FURTHER DEVELOPMENTS: TECHNICAL ADVANCES

• 1966; WILLIAM RASHKIND AND WILLIAM MILLER (CHILDREN’S HOSPITAL, PHILADELPHIA), BALLOON ATRIAL SEPTOSTOMY, IN WHICH A BALLOON IS USED TO CREATE/ENLARGE A PFO OR ASD IN ORDER TO INCREASE O2 SATURATION IN PATIENTS WITH CYANOTIC CONGENITAL HEART DISEASE.

• 1970; JEREMY SWAN AND WILLIAM GANZ (CEDARS-SINAI HOSPITAL, LOS ANGELES) BALLOON FLOTATION CATHETERIZATION OF THE RIGHT HEART.

FURTHER DEVELOPMENTS: CORONARY ARTERY DISEASE

• 1959; F. MASON STONES JR. (CLEVELAND CLINIC); SELECTIVE CORONARY ANGIOGRAPHY (1st CASE OCT 1958)

• 1967; MELVIN JUDKINS (PORTLAND, OR) PERCUTANEOUS CORONARY ANGIOGRAPHY (JUDKINS CATHETERS) AND PIGTAIL CATHETER

• 1977; ANDREAS GRUNTHET (ZURICH), PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOPLASTY
FURTHER DEVELOPMENTS:
CORONARY ARTERY DISEASE

• 1979-1981: K. PETER RENTROP (GOTTINGEN, GERMANY), W. GANZ (LOS ANGELES), J. MARKIS/E. BRAUNWALD/W. GROSSMAN (BOSTON), INTRACORONARY STREPTOKINASE FOR ACUTE MI

• 1982; JOHN SIMPSON AND DON BAIM (STANFORD), GUIDEWIRE SYSTEM FOR CORONARY ANGIOPLASTY

• 1987-1989: ULRICH SIGWART (GENEVA, SWITZERLAND), CORONARY STENT, SELF EXPANDING; RICHARD SCHATZ AND JULIO PALMAZ, BALLOON EXPANDABLE STENT

CONTRIBUTIONS FROM UCSF

• ABE RUDOLPH AND JULIEN HOFFMAN; TWO OF THE VERY EARLIEST PERFORMING CATH IN INFANTS. RUDOLPH’S “CONGENITAL DISEASES OF THE HEART” WAS THE BIBLE IN THIS FIELD.

• ELLIOTT RAPAPORT DEVELOPED CATH-BASED USE OF INDOCYANINE GREEN TO MEASURE PULMONARY BLOOD VOLUME, AND ALSO LV AND RV VOLUMES.

• MEL SCHEINMAN AND ELLIOT RAPAPORT DESCRIBED CLINICAL USES OF A FLOW-DIRECTED RIGHT HEART CATHETER IN 1969.

• ELECTROPHYSIOLOGY; CATHETER ABLATION PIONEERED BY MEL SCHEINMAN.

• PAUL YOCK AND JOHN MacGREGOR WERE AMONG THE FIRST TO DESCRIBE INTRAVASCULAR ULTRASOUND FOR THE ASSESSMENT OF CORONARY DISEASE.
UCSF CONTRIBUTIONS

- TOM PORTS DID EARLY PIONEERING WORK IN ALCOHOL SEPTAL ABLATION FOR HOCM
- UCSF WAS EARLY LEADER IN QUANTITATIVE CORONARY ANGIOGRAPHY

FURTHER INTERVENTIONAL DEVELOPMENTS: VALVULAR HEART DISEASE

- 1982: JEAN KAN & ROBERT WHITE (JHH), (ALSO CARL PEPINE AND ROBERT FELDMAN (GAINESVILLE FL), PERCUTANEOUS BALLOON VALVULOPLASTY FOR PULMONIC STENOSIS
- 1984: K. INOUE (JAPAN) AND IGOR PALACIOS (BOSTON), BALLOON VALVULOPLASTY FOR MITRAL STENOSIS; (ALSO JAMES LOCK, RAYMOND MCKAY & W. GROSSMAN, BOSTON, MA)
- 1986: ALAIN CRIBIER & BRICE LETAC (ROUEN, FRANCE), RAYMOND MCKAY & W. GROSSMAN (BOSTON, MA), PERCUTANEOUS BALLOON VALVULOPLASTY FOR AORTIC STENOSIS

FURTHER INTERVENTIONAL DEVELOPMENTS

- ALCOHOL SEPTAL ABLATION FOR IHSS/HOCM
- CLOSURE OF CONGENITAL DEFECTS (ASD, VSD, PDA)
- DRUG ELUTING STENTS
- ELECTROPHYSIOLOGY; PACEMAKERS, ICDs, CRT, ABLATIONS FOR WPW, SVT, FLUTTER, AF, VEA, VT

FURTHER INTERVENTIONAL DEVELOPMENTS

- TAVR
- MV REPAIR (MITRACLIP, RING, VALVE-IN-VALVE)
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