



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



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THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



THE EARLIEST CARDIAC CATHETERIZATIONS IN CONGENITAL HEART DISEASE BEGAN IN THE **1940'S**

FOR THE FIRST TWO DECADES CARDIAC CATHETERIZATION PROCEDURES **DID NOT CHANGE** VERY MUCH AND REMAINED RELATIVELY **CRUDE** THROUGHOUT THE **1960'S**



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IN 1961, WHEN I BEGAN CATHETERIZATIONS, ALL PROCEDURES:

- 1. WERE PERFORMED BY “CUT DOWN” ON VESSELS OF AN EXTRIMITY**
- 2. CATH LAB FLUOROSCOPY WAS ON FLAT PANEL, DIRECT FLUOROSCOPIC VIEWERS AND WAS ONLY SINGLE PLANE**
- 3. ANGIOGRAPHY WAS ALL ON LARGE “CUT” OR “ROLL” FILM AND AT A MAX OF 3 -6 FRAMES/SECOND**
- 4. IMAGE INTENSIFIERS AND CINEANGIOGRAPHY WERE JUST BEING INTRODUCED – NO INSTANT REPLAY OF ANY IMAGING**



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BY THE **1970'S DIAGNOSTIC CARDIAC**
CATHETERIZATION TECHNIQUES AND EQUIPMENT
HAD BEEN IMPROVED SIGNIFICANTLY FOR
CONGENITAL HEART DISEASE

BY THAT SAME TIME, SEVERAL VERY INNOVATIVE
CARDIOLOGISTS HAD **BEGUN TREATING**
CONGENITAL CARDIAC DEFECTS IN THE
CATHETERIZATION LABORATORY



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**THIS WAS THE VERY BEGINNING OF
ENDOVASCULAR REPAIR IN THE
CARDIAC CATHETERIZATION
LABORATORY**

- ONLY FIVE DECADES AGO



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**THE OPENING OF OBSTRUCTIONS AND THE
CLOSING OF DEFECTS WERE DEVELOPED
CONCOMITANTLY**

**FOR THE SAKE OF CONTINUITY IN THE
DEVELOPMENT OF THE VARIOUS TYPES OF
DEVICES, I WILL DISCUSS THE OPENINGS OF
OBSTRUCTIONS AND THE CLOSINGS OF
DEFECTS SEPARATELY IN MY PRESENTATION**



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I'LL BEGIN MY PRESENTATION WITH
THE **OPENING OF OBSTRUCTIONS**
(WHICH DID HAPPEN TO BE THE FIRST
DEVELOPED)

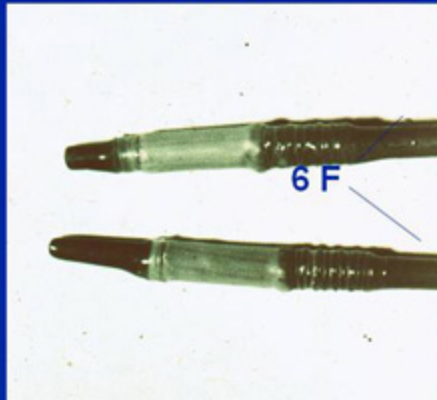


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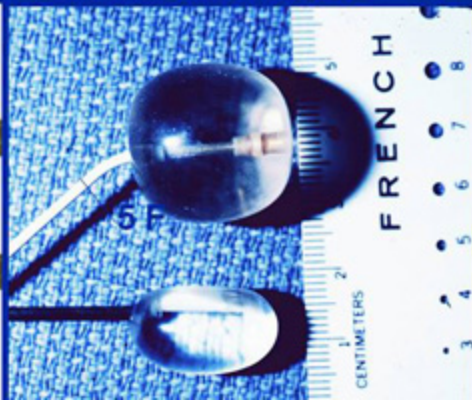


RASHKIND BALLOON ATRIAL SEPTOSTOMY – 1966 THE **VERY FIRST** *INTRACARDIAC* TRANSCATHETER THERAPEUTIC INTERVENTION

1966



1972--2011





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**THE BALLOON SEPTOSTOMY STILL IS IN USE
TODAY.**

**NOW, 44 YEARS LATER, WITH VERY LITTLE
CHANGE COMPARED TO THE ORIGINAL
PROCEDURE, IT STILL IS A LIFE SAVING
PROCEDURE**



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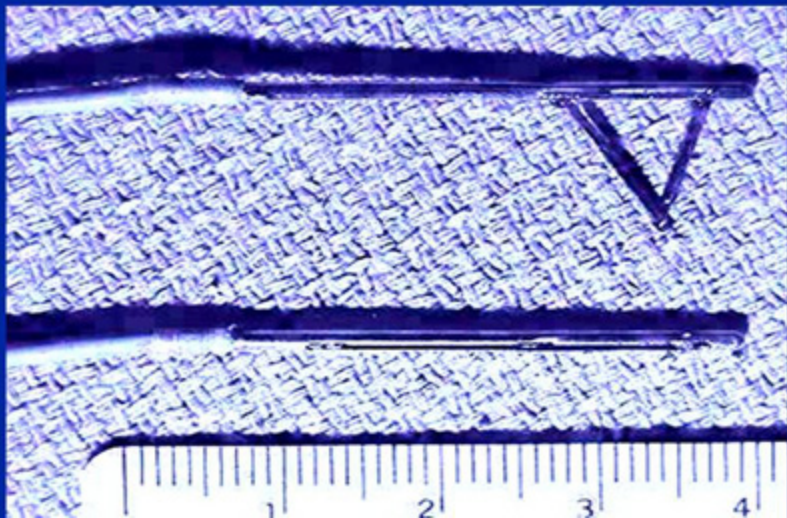
IT WAS ALMOST A **DECADE AFTER**
RASHKIND'S ISOLATED AND VERY BOLD
PROCEDURE THAT THE DEVELOPMENT OF
TRANSCATHETER THERAPEUTIC DEVICES
AND PROCEDURES REALLY BEGAN TO
EVOLVE FOR **CONGENITAL CARDIAC DEFECTS**



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1975 - PARK BLADE SEPTOSTOMY CATHETER





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THE NEXT SIGNIFICANT DEVELOPMENT FOR THE
OPENING OF CONGENITAL DEFECTS WAS A
CONSEQUENCE OF A DEVICE AND INTERVENTION
DEVELOPED FOR ACQUIRED ADULT CARDIAC
DISEASE

**1974 - GRUENTZIG-STATIC BALLOON DILATION OF
PERIPHERAL VESSELS**

**1978 - GRUENTZIG-STATIC BALLOON DILATION OF
CORONARY ARTERIES**



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ALTHOUGH THE **CORONARY ARTERY DILATIONS** CAUGHT THE ATTENTION OF THE WORLD, IT WAS GRUENTZIG'S **STATIC BALLOON DILATION OF PERIPHERAL VESSELS** WHICH STIMULATED THE DEVELOPMENT OF THE **LARGE DIAMETER STATIC DILATION BALLOONS** AND A RAPID PROLIFERATION IN THEIR USE FOR THE DILATION OF **CONGENITAL VALVULAR AND VASCULAR LESIONS**



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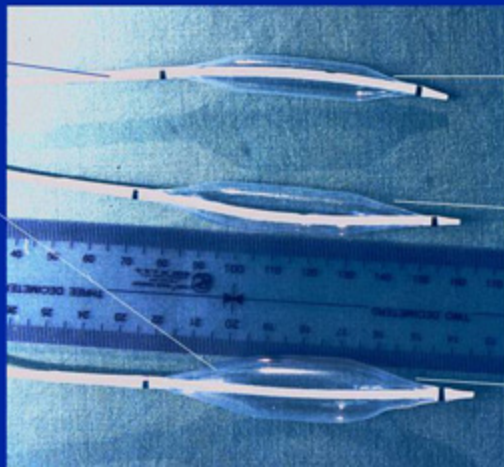


EVEN BY THE 1980'S THE STATIC BALLOONS WERE VERY LARGE AND RELATIVELY CRUDE

ALL BALLOON CATHETERS WERE **9 FRENCH** SHAFTS

LONG SHOULDERS

DELIVERED DIRECTLY OVER A WIRE OR REQUIRED **11-14 FRENCH** INTRODUCER SHEATHS



12 MM BAL

15 MM BAL

18 MM BAL



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IN SPITE OF THE LIMITATIONS OF THE BALLOONS, MANY STUDIES FOR DILATION OF CONGENITAL LESIONS WERE QUICKLY INITIATED

- **1981 SINGER - INFANT RECOARCTATION**
- **1982 DRISCOLL - PULMONARY VEINS**
- **1982 KAN - PULMONARY VALVE**
- **1983 LOCK - RECOARCTATION**
- **1983 FINLEY - NATIVE COARCTATION**
- **1983 LOCK - BRANCH PULMONARY ARTERIES**
- **1984 LABABIDI - AORTIC VALVE**
- **1984 LOCK - SYSTEMIC VENOUS CHANNELS**



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THE WIDESPREAD USE OF THESE BALLOONS
CREATED A **RESPONSIBILITY** TO OBTAIN
DEFINITIVE INFORMATION ABOUT THEIR
ACTUAL **EFFICACY** AND **SAFETY**

THIS, IN TURN, LED TO AN **UNPRECEDENTED**
COLLABORATION OF MULTIPLE OPERATORS
AND INSTITUTIONS

THE **VALVULOPLASTY** AND **ANGIOPLASTY** OF
CONGENITAL ANOMALIES (VACA) REGISTRY
WAS ESTABLISHED IN **1982**



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VALVULOPLASTY AND ANGIOPLASTY OF CONGENITAL ANOMALIES (VACA) REGISTRY

- VOLUNTARY, **NON FUNDED**, COLLABORATION of **27** SEPARATE INSTITUTIONS
- ALL VALVULOPLASTIES AND ANGIOPLASTIES TREATED IN THESE INSTITUTIONS FROM **JANUARY 1, 1981** through **DECEMBER 31, 1986 (6 YEARS)**
- REGISTRY DATA COLLECTED on **1,660** CONGENITAL PROCEDURES
- THE DATA WAS COLLECTED, PROCESSED and ANALYZED by **DR JEAN KAN** at **JOHNS HOPKINS**
- DATA COLLECTED on the DILATION of **5 SPECIFIC STENOTIC LESIONS** and **23** DIFFERENT MISCELLANEOUS VASCULAR STENOSES



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VACA DATA PUBLISHED: 1990 AJC COLLECTION OF 6 PAPERS

- PULMONARY VALVE STENOSIS: 822 PATIENTS (784)
- AORTIC VALVE STENOSIS: 204 PATIENTS (186)
- BRANCH PULMONARY ARTERY STENOSIS: 182 PROCEDURES (122)
- NATIVE COARCTATION OF THE AORTA: 141 PROCEDURES (126)
- RECOARCTATION OF THE AORTA: 200 PATIENTS (190)
- MISCELLANEOUS LESIONS (VEINS, SHUNTS, CONDUITS, SYSTEMIC ARTERIES): 23 DIFFERENT LESIONS: 111 PROCEDURES (79)

() = Number of patients suitable for analysis



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CONSENSUS OF THE VACA REGISTRY-1990:

BALLOON DILATION WAS USABLE, SAFE AND AT LEAST SOMEWHAT EFFECTIVE FOR A NUMBER OF VALVULAR AND VASCULAR LESIONS:

- **PULMONARY VALVE STENOSIS**
- **AORTIC VALVE STENOSIS**
- **PULMONARY ARTERY BRANCH STENOSIS**
- **NATIVE COARCTATION OF THE AORTA**
- **“RE” COARCTATION OF THE AORTA**
- **SYSTEMIC VENOUS STENOSIS**



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VALVE DILATION

**PULMONARY
VALVE**



**AORTIC
VALVE**

**TRICUSPID
VALVE**



**MITRAL
VALVE**



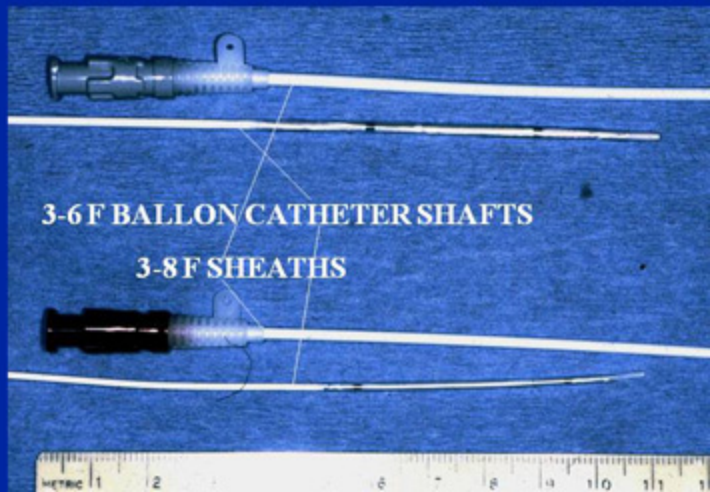
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BALLOONS -- 2011

**WIDE VARIETY OF
MARKEDLY IMPROVED
BALLOONS**

- LOWER PROFILE
 - SMOOTHER PROFILE
 - SHORTER SHOULDERS
 - HIGHER PRESSURES
 - THINNER CATHETER SHAFTS
- SHAFTS**





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BALLOON DILATION – 2011 ACCEPTED STANDARD OF CARE FOR:

- PULMONARY VALVE STENOSIS
- AORTIC VALVE STENOSIS
- PULMONARY ARTERY BRANCH STENOSIS
- NATIVE COARCTATION OF THE AORTA
- “RE” COARCTATION OF THE AORTA
- SYSTEMIC VENOUS STENOSIS



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HOWEVER, EVEN BY 1983-84, IT WAS BECOMING OBVIOUS THAT **BALLOON DILATION ALONE WAS UNSATISFACTORY FOR THE PERMANENT TREATMENT OF CONGENITAL *VASCULAR* LESIONS**



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THE INTRODUCTION OF **INTRAVASCULAR STENTS** FOR CONGENITAL HEART LESIONS

IN A LECTURE, IN **1985**, ON THE “**FUTURE DIRECTIONS OF CATHETERIZATION**”, I DESCRIBED MY CONCEPT OF A DEVICE TO CREATE **INTRAVASCULAR SUPPORT** FOR A MORE PERMANENT THERAPY OF VASCULAR STENOSES



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE

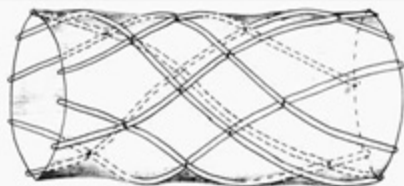


AAP - 1985 - MULLINS TALK: "FUTURE OF CARDIAC CATHETERIZATION" INTRAVASCULAR SUPPORT DEVICE

COMPRESSED



EXPANDED





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



**AGAIN A DEVELOPMENT IN THE ADULT ARENA
PROVIDED A DEVICE AND PROCEDURE FOR
SUPPORTING VESSELS IN THE CONGENITAL
HEART PATIENTS**

1986 PALMAZ - INTRALUMENAL STENTS



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INTRAVASCULAR STENTS DEVELOPMENT INTO A CLINICAL TOOL

- **1986** PALMAZ - INTRALUMINAL STENTS IN THE AORTA OF RABBITS



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INTRAVASCULAR STENTS DEVELOPMENT INTO A CLINICAL TOOL

- **1986 PALMAZ - INTRALUMINAL STENTS IN THE AORTA OF RABBITS**
- **1988 HOUSTON - STENTS IN PUL. ARTERIES AND SYSTEMIC VEINS IN DOGS**



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- **1988 PALMAZ - STENTS IN ATHEROSCLEROTIC ARTERIES--HUMAN TRIALS**



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THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



INTRAVASCULAR STENTS DEVELOPMENT INTO A CLINICAL TOOL

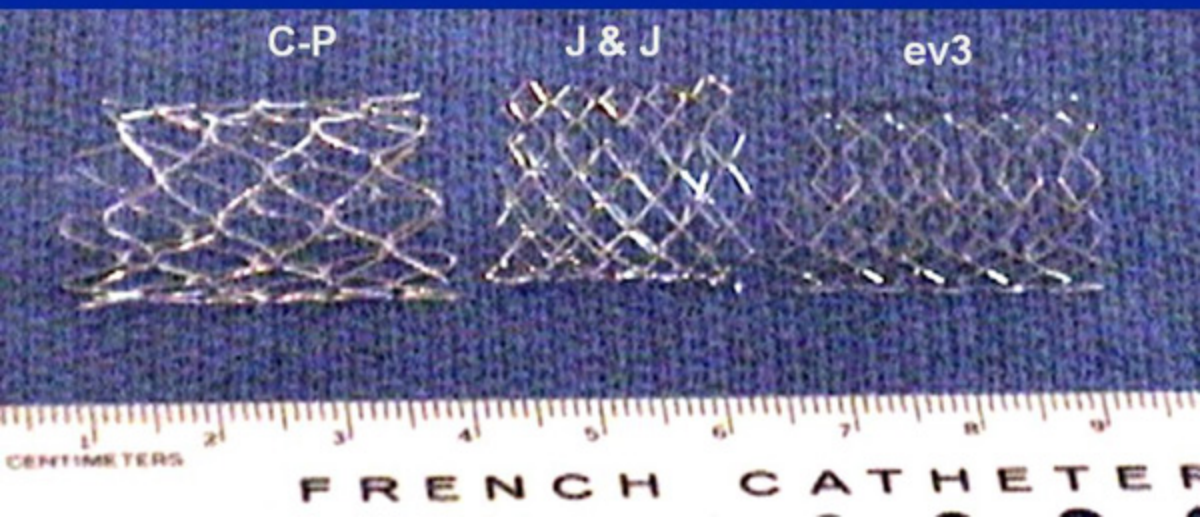
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- **1995 STENTS APPROVED FOR ADULT "HUMAN" USE BY THE U.S. FDA -- THE COMPLETION OF CONGENITAL TRIALS WERE CONSIDERED "NON PROFITABLE" AND UNNECESSARY BY THE MANUFACTURER -- STENTS USED "OFF LABEL" IN THE CONGENITAL HEART POPULATION SINCE THAT TIME.**



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CURRENT STENTS FOR CONGENITAL DEFECTS

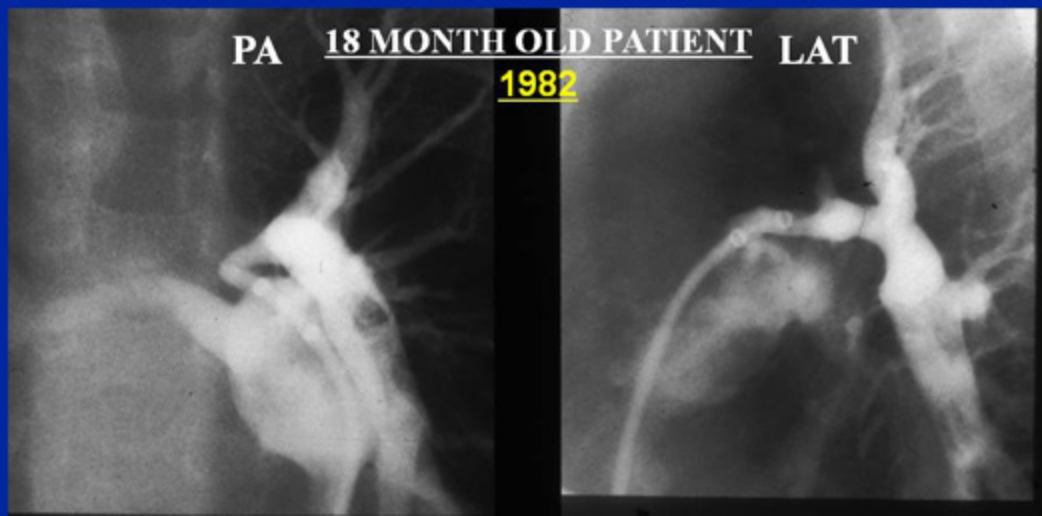




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BRANCH PULMONARY ARTERY STENOSIS

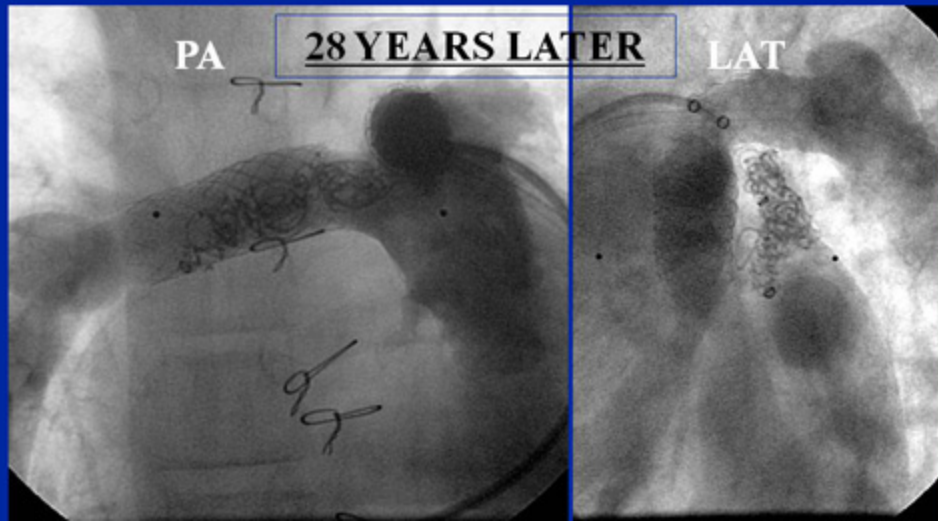




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BRANCH PUL. ARTERIES S/P STENT/DILATION



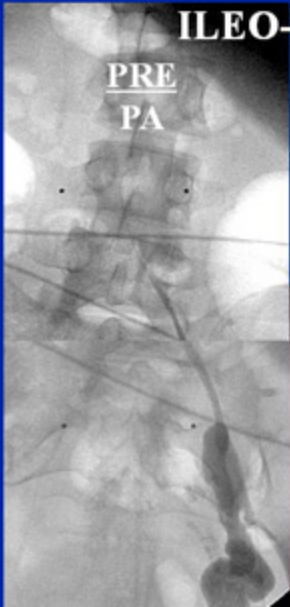


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ILEO-FEMORAL VEIN RECONSTRUCTION

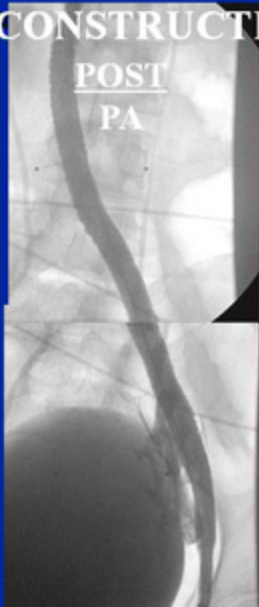
PRE
PA



PRE
LAT



POST
PA



POST
LAT





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



INTRAVASCULAR STENTS - 2011

CURRENTLY, THE **ACCEPTED PRIMARY TREATMENT**
AND **STANDARD OF CARE** FOR:

- OPENING AND SUPPORTING STENOTIC **BRANCH PULMONARY ARTERIES**
- OPENING AND REBUILDING STENOTIC AND/OR OBSTRUCTED PERIPHERAL AND CENTRAL **SYSTEMIC VEINS**
- OPENING AND MAINTAINING THE PATENCY OF **SYSTEMIC ARTERIES** (COA, ARTERITIS, COLLATERALS, SHUNTS, PDA IN “PDA DEPENDENT” LESIONS)



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



INTRAVASCULAR STENTS DEVELOPMENT INTO A CLINICAL TOOL

- 1986 PALMAZ - INTRALUMINAL STENTS IN THE AORTA OF RABBITS
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- 1995 STENTS APPROVED FOR ADULT "HUMAN" USE BY THE U.S. FDA -- THE COMPLETION OF CONGENITAL TRIALS WERE CONSIDERED "NON PROFITABLE" AND UNNECESSARY BY THE MANUFACTURER -- STENTS USED "OFF LABEL" IN THE CONGENITAL HEART POPULATION SINCE THAT TIME.
- **2007 BEGINNING OF A FDA, MULTICENTER, CONTROLLED CLINICAL TRIAL OF THE USE OF C-P STENTS FOR COARCTATION OF THE AORTA**



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PERFORATION OF TOTALLY OBSTRUCTED STRUCTURES - BEGAN IN THE 1960'S

- SEPTAE (TRANSSEPTAL)
- VESSELS (CTO RECANALIZATION)
- PULMONARY VALVE

UTILIZING

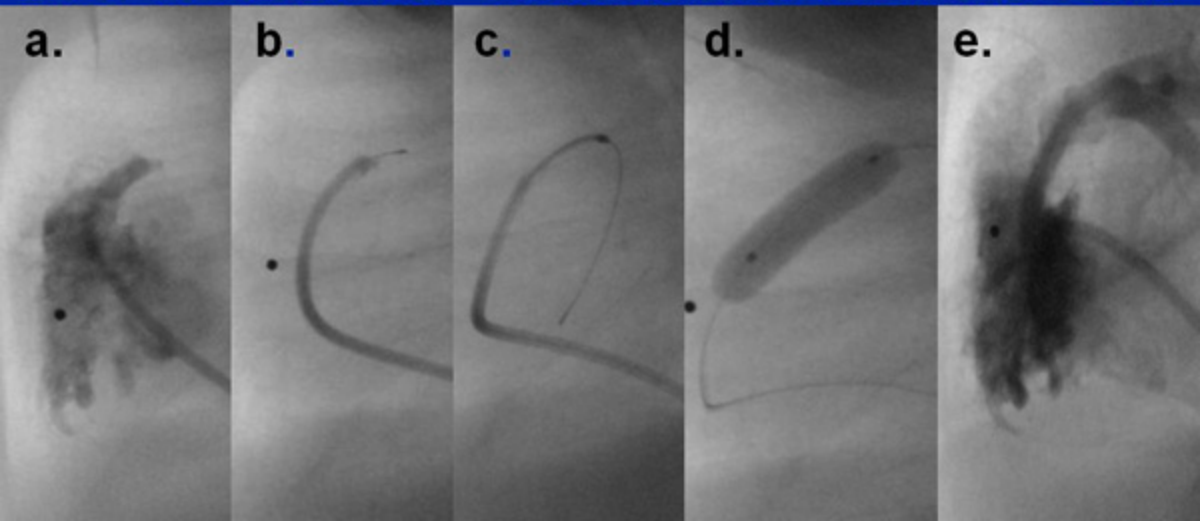
- STIFF WIRES, LONG NEEDLES
- LASERS
- RADIO FREQUENCY (RF)



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RF PERFORATION - PULMONARY VALVE ATRESIA





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TRANSCATHETER IMPLANTABLE VALVES

THE LATEST IN DEVICE/TECHNIQUE FOR
“OPENING STRUCTURES”

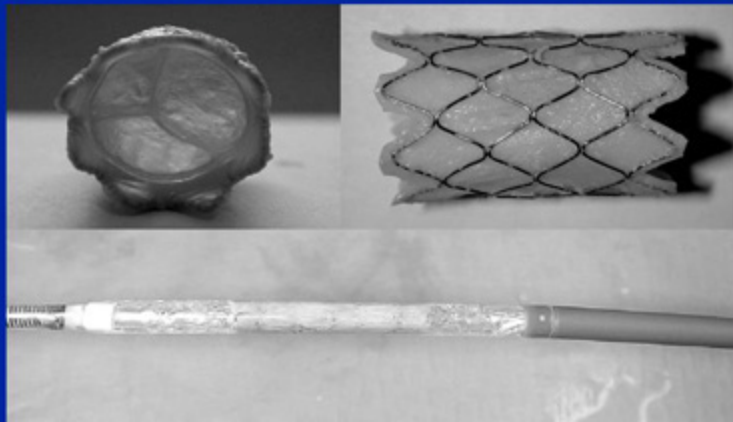
UNDER DEVELOPMENT AND IN CLINICAL
TRIALS FOR 12+ YEARS



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BONHOEFFER/MELODY PULMONIC VALVE: BOVINE JUGULAR VENOUS VALVE – FDA APPROVED -FOR HUMANITARIAN USE IN THE U.S. - 2010

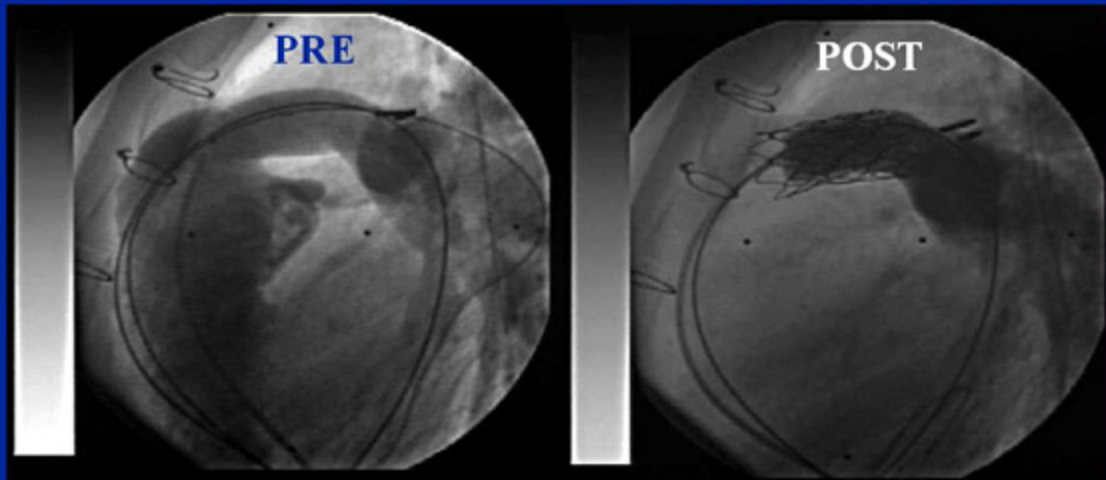




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BONHOEFFER VALVE--LATERAL ANGIOS





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CATHETER IMPLANTABLE VALVES -- 2011

- **BONHOEFFER PULMONIC VALVE: BOVINE JUGULAR VENOUS VALVE – FDA APPROVED FOR HUMANITARIAN USE IN THE U.S.**
- **EDWARDS-SAPIEN AORTIC VALVE: EQUINE PERICARDIUM – IN CLINICAL TRIALS IN U.S.**
- **MEDTRONIC-COREVALVE™: SWINE PERICARDIUM – IN CLINICAL TRIALS IN U.S.**
- **PANIAGUA VALVE: AUTOLOGOUS TISSUE ENGINEERED MICRO THIN PERICARDIUM – IN CLINICAL TRIALS IN S.A.**
- **PALMAZ/BAILEY VALVE: -- ADVANCED BIOPROSTHETIC SURFACES™ MICRO THIN NITINOL™ MEMBRANE**



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I'M NOW GOING TO **REVERSE** MY
DISCUSSION FROM

OPENING OBSTRUCTED LESIONS
TO

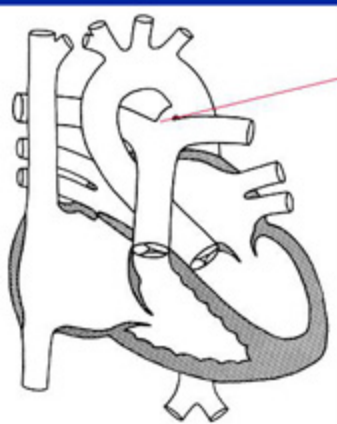
CLOSING ABNORMAL OPENINGS
IN CONGENITAL HEART LESIONS



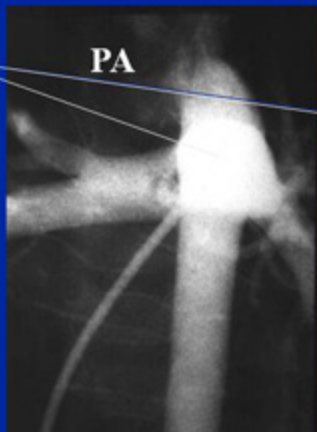
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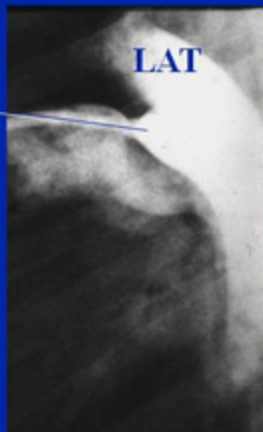
THE **FIRST** TRANSCATHETER CORRECTION FOR A SPECIFIC LESION WAS FOR:
THE **PATENT DUCTUS ARTERIOSUS (PDA)**



PDA



PA



LAT



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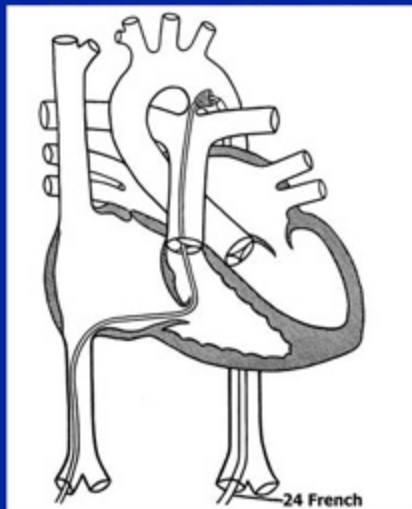
PORSTMANN PDA PLUG - 1967

IVALON PLUG

- VERY LARGE DELIVERY SYSTEM
- VERY COMPLEX
- THRU AND THRU ARTERIO-VEINOUS "RAIL" DELIVERY TECHNIQUE

IT WAS THE VERY **FIRST**
"CORRECTIVE" PROCEDURE

NOT SUITABLE FOR
CHILDREN BECAUSE OF SIZE

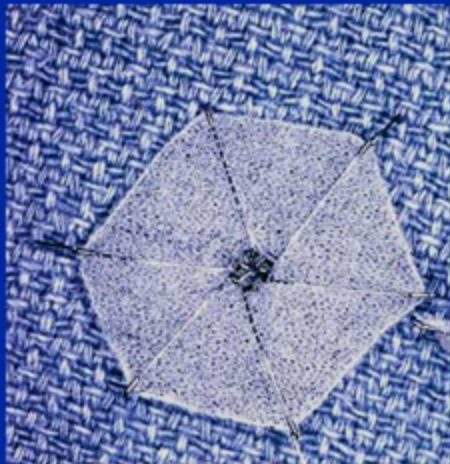




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RASHKIND "HOOKED" PDA DEVICE - 1979



8 FRENCH
DELIVERY
SYSTEM

FIRST
REASONABLE
SIZE FOR
CHILDREN



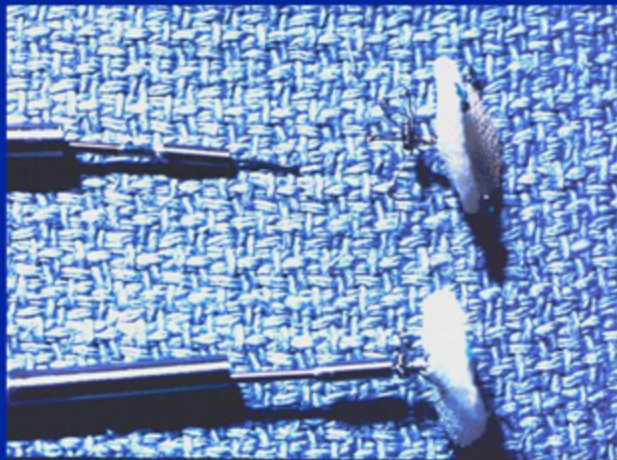
"FISH"
HOOKS



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RASHKIND SINGLE UMBRELLA PDA OCCLUDER 1981
-- FIRST PRACTICAL AND SAFE PDA DEVICE --



RELEASED

INTRODUCED
INTO U.S. FDA
CLINICAL
TRIAL - 1982

ATTACHED



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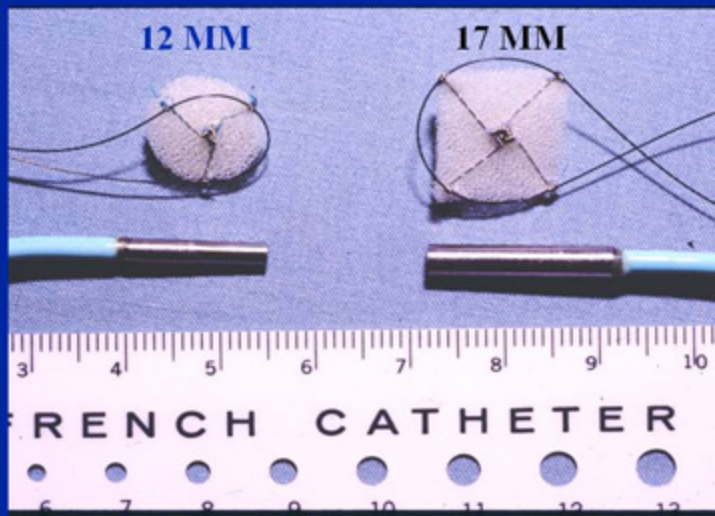


MODIFICATIONS OF THE ORIGINAL RASHKIND PDA-1982

1. DOUBLE DISKS
2. 12 & 17 MM OCCLUDERS
3. LONG SHEATH DELIVERY TECHNIQUE

1982 THRU 1987
EXTENSIVE, VERY SAFE
AND SUCCESSFUL USE IN
THE U.S. FDA TRIAL

1988 - THE DEVICE WAS
SUDDENLY AND TOTALLY
WITHDRAWN FROM THE
MARKET





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1988 - THE UNEXPECTED TOTAL WITHDRAWAL OF THE WIDELY ACCEPTED RASHKIND PDA DEVICES CREATED AN ALMOST FRANTIC URGENCY TO DEVELOP AN ALTERNATIVE, NON SURGICAL TREATMENT FOR PDA

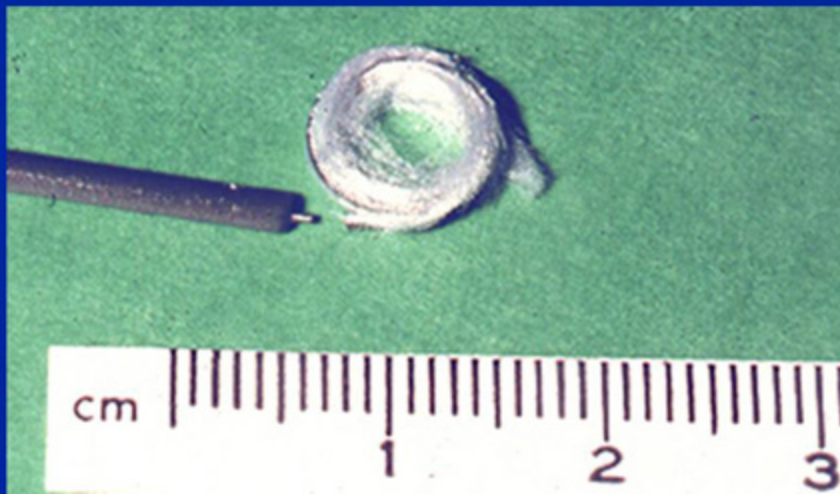
- **1989 - BABIC DOUBLE DISK PLUS IVALON PLUG**
- **1991 - SIDERIS PDA BUTTON DEVICE**
- **1992 - REDEL DUCT/OCCLUD “DOUBLE CONE” COIL**
- **1992 - CAMBIER-MOORE USE OF THE GIANTURCO COIL SPECIFICALLY FOR PDA OCCLUSION**



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GIANTURCO COIL





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



GIANTURCO COILS HAD BEEN AVAILABLE IN ADULT CATHETERIZATION LABORATORIES SINCE **1975** FOR THE **OCCLUSIONS OF ABNORMAL VESSELS** IN ACQUIRED CARDIOVASCULAR DISEASE

BY **1992**, THE COILS HAD BEEN INCORPORATED INTO THE INVENTORIES OF THE PEDIATRIC CATH LABS FOR THE OCCLUSION OF **ABNORMAL VESSELS**



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AFTER CAMBIER AND MOORE'S PUBLICATION, THERE WERE RAPID AND MULTIPLE **"MODIFICATIONS"** OF **COILS** AND **COIL DELIVERY** FOR PDA OCCLUSION

- ORIGINAL GIANTURCO COIL - FREE RELEASE ("SLINKY")
- MODIFIED TECHNIQUES FOR DELIVERY OF COILS:
 - **"SNARE"** CONTROLLED DELIVERY
 - **"BIOPTOME"** CONTROLLED DELIVERY
 - **"DETACHABLE"** COILS
 - "COOK DETACHABLE"-US.
 - ***"JACKSON"** COILS
- **0.052"** LARGER, MORE RESISTANT COILS

* Only available outside of the United States



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



AMPLATZER PDA OCCLUDERS

FIRST
AVAILABLE
IN 1997

U.S. FDA
APPROVED
IN 2003

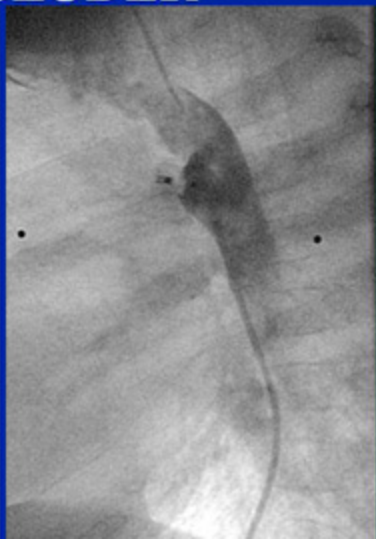
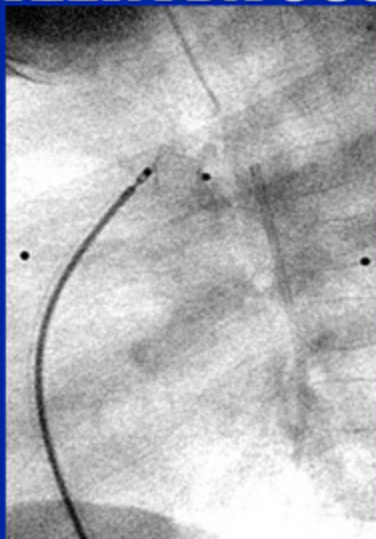
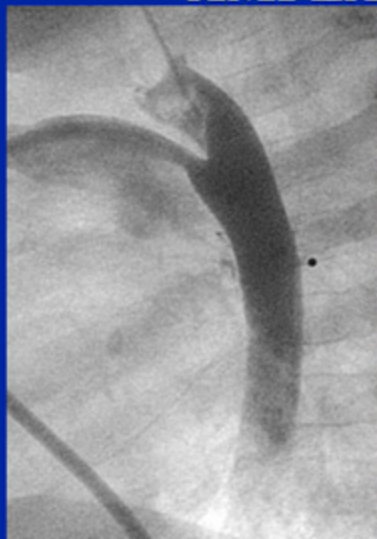




THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



AMPLATZER PDA OCCLUDER





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



PATENT DUCTUS OCCLUSION DEVICES - 2011

- **COILS**
 - **GIANTURCO - FREE RELEASE**
 - **GIANTURCO MODIFICATIONS**
 - **0.052" COILS**
- **GIANTURCO-GRIFKA BAG**
- **AMPLATZER PDA OCCLUSION DEVICE**
- ***PFM NIT-OCCLUDER DEVICE**
- ***AMPLATZER PDA OCCLUDER II DEVICE**

* NOT YET AVAILABLE IN THE U.S.

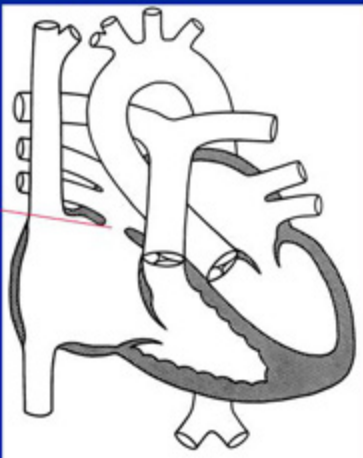


THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



OCCLUSION OF SECUNDUM ATRIAL SEPTAL DEFECTS (ASD)

SECUNDUM
ATRIAL
SEPTAL
DEFECT





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE

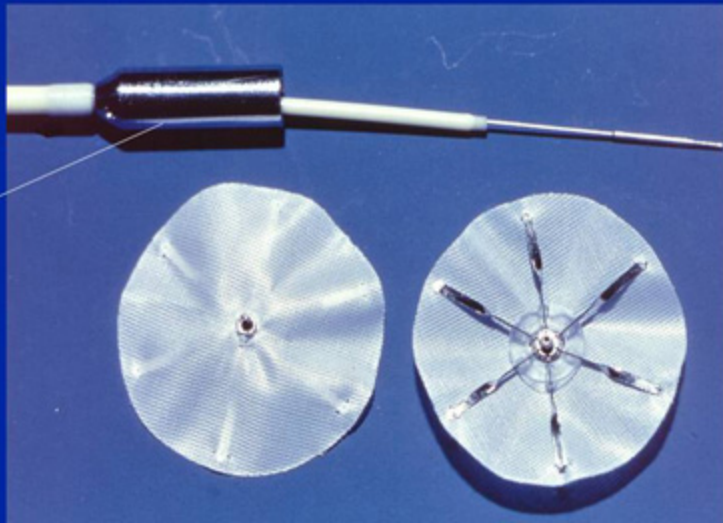


KING-MILLS ASD DEVICE - 1975

**DOUBLE
UMBRELLA**

**26 FRENCH (8.7 MM)
DIAMETER
DELIVERY POD**

**THE FIRST
INTRACARDIAC
CORRECTION**





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



RASHKIND "HOOKED" ASD DEVICE - 1977

**"FISH"
HOOKS**





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



CLAMSHELL ASD DEVICE - 1988



11 FRENCH
DELIVERY
POD





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



ASD OCCLUSION DEVICES WHICH HAVE *COME AND GONE FOR ASD OCCLUSION*

- **CLAMSHELL -- BARD**
- **CARDIOSEAL -- NITINOL MEDICAL**
- **ANGEL WINGS -- MICROVENA**
- **ASDOS – OSYPKA**
- **BUTTON DEVICE -- SIDERIS**



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



ATRIAL SEPTAL DEFECT OCCLUSION -- CURRENT STATUS

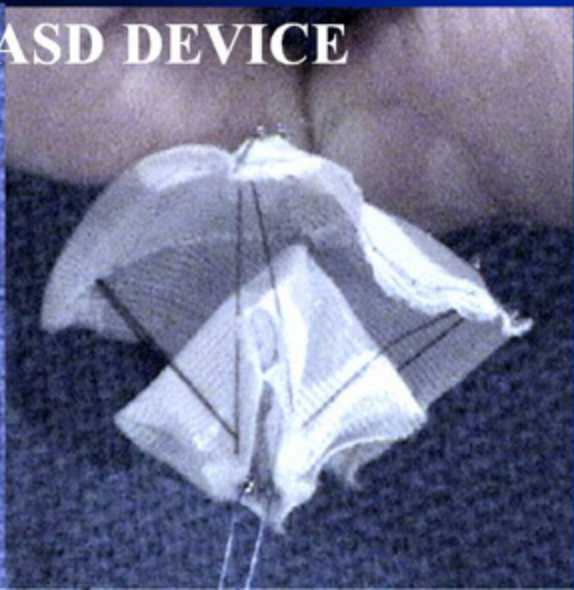
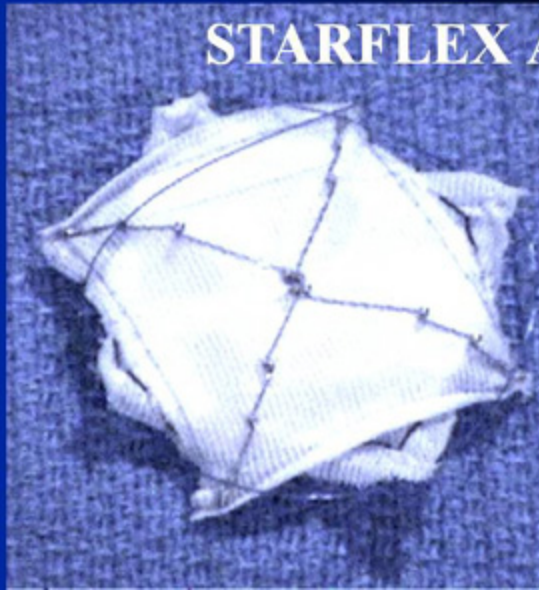
-- 2011 --



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



STARFLEX ASD DEVICE





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



HELIX ASD OCCLUDER





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



AMPLATZER ASD OCCLUDERS

FDA APPROVED IN THE U.S. IN 2002

FIRST FDA DEVICE APPROVAL IN 27 YEARS FOR CONGENITAL USE

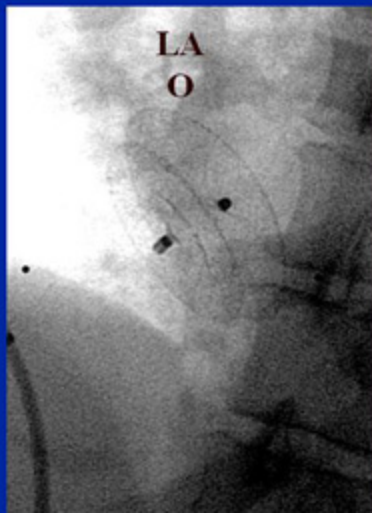
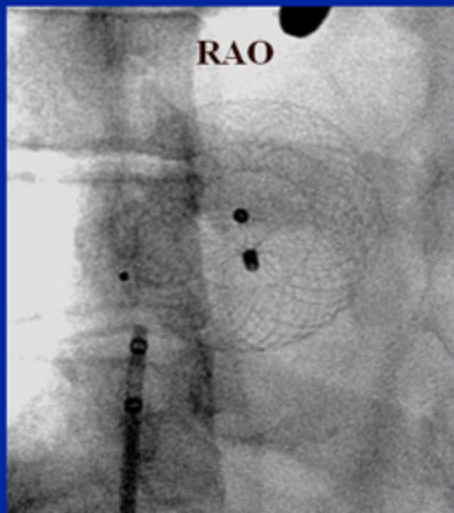




THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



AMPLATZER ASD OCCLUDER





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



ASD OCCLUSION -- 2011 STATUS

- HELEX ASD DEVICE – GORE
- AMPLATZER ASD DEVICE – AGA
- AMPLATZER CRIBRIFORM ASD OCCLUDER
- * “FRAMELESS” ASD DEVICE- - SIDERIS

* IN 2011 DEVICE NOT FDA APPROVED IN THE UNITED STATES

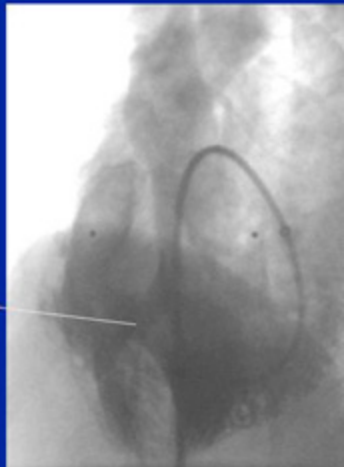
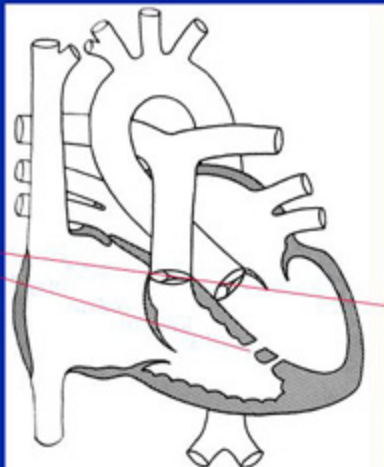


THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



CATHETER OCCLUSION OF VENTRICULAR SEPTAL DEFECTS (VSD)

INITIALLY
ONLY
SUITABLE
FOR:
MUSCULAR
VENTRICULAR
SEPTAL
DEFECTS





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



DEVELOPMENT OF CATHETER OCCLUSION OF VENTRICULAR SEPTAL DEFECTS (VSD)

1985 - RASHKIND PDA DEVICE

1987 - CLAMSHELL "ASD" DEVICE

1989 - CARDIOSEAL "VSD" DEVICE

2000 - *AMPLATZER MUSCULAR VSD DEVICE

2003 - AMPLATZER PERIMEMBRANOUS VSD DEVICE

2004 - SIDERIS "FRAMELESS" PATCH -INVESTIGATIONAL

***2011-DEVICES APPROVED IN U.S.--FOR MUSCULAR VSD ONLY**



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



OCCLUSION OF MISCELLANEOUS ABNORMAL VASCULAR STRUCTURES - 2011

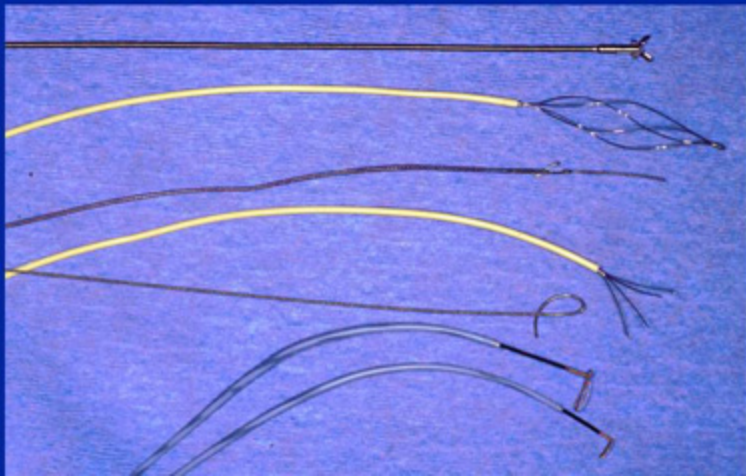
- **OCCLUSION OF SYSTEMIC TO PULMONARY COMMUNICATIONS**
 - COILS
 - PLUGS
- **OCCLUSION OF ARTERIAL-VENOUS FISTULAE**
 - COILS
 - FOAM
 - PLUGS
- **DEVICE OCCLUSION OF MISC COMMUNICATIONS**
 - ASD DEVICES
 - GIANTURCO GRIFKA BAG
 - AMPLATZER VASCULAR PLUGS I, II & III



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



**NEITHER OPENING NOR CLOSING OF STRUCTURES -
- RETRIEVAL OF FOREIGN BODIES – 2011 --**





THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



HOW FAR HAVE WE COME? -- ESTABLISHED PROCEDURES:

- **OCCLUSION OF ABNORMAL OPENINGS**
 - PDA OCCLUSION
 - ASD AND PFO OCCLUSION
 - VSD OCCLUSION (MUSCULAR)
 - MISC VASCULAR OCCLUSION (COLLATERALS, SHUNTS, FISTULAE)
- **DILATION OF NARROWED/STENOTIC STRUCTURES**
 - OPENING VALVES (ALL FOUR CARDIAC VALVES)
 - VESSEL DILATION (PULMONARY ARTERIES, SYSTEMIC VEINS, SYSTEMIC ARTERIES)
 - TRANSCATHETER VALVE IMPLANTS
- **INTRAVASCULAR STENTS** PERMANENT SUPPORT OF DILATED VESSELS (ALL VESSELS WHICH CAN BE DILATED PLUS PDA & COLLATERALS)
- **OPENING OF TOTALLY OCCLUDED STRUCTURES** (ATRIAL SEPTUM, PULMONARY VALVES, SYSTEMIC VEINS AND ARTERIES)
- **CATHETER RETRIEVAL OF INTRAVASCULAR FOREIGN BODIES**



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



WHERE ARE WE GOING?

- **OCCLUSIONS: NEW DEVICES** - (FRAMELESS, REABSORBABLE, PERIMEMBRANOUS VSDS)
- **OPENING STRUCTURES: NEW STENTS** - (COVERED, "OPEN", REABSORBABLE, MORE FLEXIBLE, DIFFERENT APPLICATIONS)
- **PERCUTANEOUS VALVES: MORE REFINED** - (STILL TO BE DEVELOPED, NEWER MATERIALS, SMALLER DELIVERY AND DIFFERENT APPLICATIONS)
- **HYBRID PROCEDURES:** (HYPOPLASTS, STENTS, VSDS, PERVENTRICULAR VALVES)



THE EVOLUTION OF ENDOVASCULAR REPAIR OF CONGENITAL HEART DISEASE



FUTURE OF CONGENITAL ENDOVASCULAR THERAPEUTICS



THE SKY IS THE LIMIT