Organization of the Cardiovascular System
Blood Flow Through the Heart

- **PULMONARY CIRCUIT**
  - Superior vena cava
  - Right atrium
  - Tricuspid valve
  - Right pulmonary veins
  - Right ventricle
  - Papillary muscles
  - Inferior vena cava
  - Aorta
  - Right and left pulmonary arteries
  - Pulmonary semilunar valve
  - Left pulmonary veins
  - Left atrium
  - Bicuspid (mitral) valve
  - Chordae tendineae
  - Left ventricle
  - Interventricular septum

- **SYSTEMIC CIRCUIT**
Blood Flow Through the Heart
Myocardium

Left ventricle thicker than the right
Intercalated Disks

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Electrical System of the Heart

- Sinoatrial (SA) Node
- Anterior Internodal Tract
- Middle Internodal Tract
- Posterior Internodal Tract
- Atrioventricular (AV) Node
- Bachmann's Bundle
- Left Bundle Branch
- Right Bundle Branch
- Conduction (Purkinje) fibers

Control of the Heart
Control of the Heart

What part of the heart is referred to as the pacemaker of the heart?

What is the function of the A-V node?

What is the function of the Conduction (Purkinje) fibers?
Electrocardiogram

- SA node
- AV node
- Bundle branches
- Purkinje fibers

Atrial depolarization  Ventricle depolarization  Ventricle repolarization
Electrocardiogram

- **P wave**: Atrial depolarization
- **QRS complex**: Ventricular depolarization
- **T wave**: Ventricular repolarization
- **PR interval**: Time from P wave to QRS complex
- **QT interval**: Time from P wave to end of T wave
Electrocardiogram

- Superior vena cava
- SA node
- Right atrium
- AV node
- AV bundle
- Left atrium
- Bundle branches
- Purkinje fibers

- Atrial depolarization (P wave)
- Ventricular depolarization (QRS)
- Ventricular repolarization (T wave)
- PR interval
- QT interval
Autopsy Reveals Cause of Collier Death

By CHARLES ODUM
The Associated Press
Tuesday, November 1, 2005; 7:49 PM

DECATUR, Ga. -- Atlanta Hawks center Jason Collier died from a sudden heart rhythm disturbance caused by an abnormally enlarged heart, an autopsy showed.

He said tissue and blood samples had been sent to the Mayo Clinic and Harvard Medical School for further tests to determine whether Collier had hypertrophic cardiomyopathy, a congenital defect that can lead to an enlarged heart.

Sperry did not say that the Hawks or Rockets were negligent in clearing Collier to play in the NBA.

He said an enlarged heart can be very difficult to detect, especially due to Collier's size. But he said the player's heart "was above the accepted limits, even for a man of his size."

He said the organ was about one and a half times the size it should have been.
Maggie Dixon, Army Women's Basketball Coach, Is Dead at 28.

April 8, 2006

By FRANK LITSKY (NY Times)

Maggie Dixon, who coached the women's basketball team at Army to its first N.C.A.A. tournament last month, died Thursday at Westchester Medical Center in Valhalla, N.Y. She was 28.

Dr. Millard J. Hyland, the Westchester County medical examiner, performed an autopsy yesterday and said afterward that the cause of death was, in part, an enlarged heart with a mitral valve that was not shutting properly.

Jamie Dixon, Maggie's older brother and the men's basketball coach at Pittsburgh, said she collapsed Wednesday while having tea at a friend's home.

She was taken to the Keller Army Community Hospital at West Point and was airlifted to Westchester Medical Center. He said that she had an arrhythmic episode, an irregular heartbeat, and that she had no history of heart problems.

The Dixons were the first brother and sister to coach in the N.C.A.A. tournaments in the same year.

After five years as an assistant at DePaul, Maggie Dixon became the Army coach in late September, 11 days before the first practice. She inherited a team with players who take up to 24 credits a semester in subjects like engineering, physics and calculus and have limited time for sports.

Her team won the Patriot League regular-season championship for the first time. It then won the conference tournament, and its automatic N.C.A.A. Division I tournament berth, for the first time.

Margaret Mary Dixon was born May 9, 1977, in North Hollywood, Calif., and grew up there. At the University of San Diego, the 5-foot-11 Dixon won four varsity letters in basketball and was the captain her senior year. She graduated with a degree in history in 1999. In May 2000, she was cut by the Los Angeles Sparks of the Women's National Basketball Association and later talked her way into an assistant's job at DePaul.
Control of the Heart
Control of the Heart

Parasympathetic:
- Constricts pupil
- Stimulates salivation
- Inhibits heart
- Constricts bronchi
- Stimulates digestive activity
- Stimulates gallbladder
- Contracts bladder
- Relaxes rectum

Sympathetic:
- Dilates pupil
- Inhibits salivation
- Relaxes bronchi
- Accelerates heart
- Inhibits digestive activity
- Stimulates glucose release by liver
- Secretion of epinephrine and norepinephrine from kidney
- Relaxes bladder
- Contracts rectum
Control of the Heart

- Medulla oblongata
- Nervous stimulation
  - Sympathetic nervous system
  - Parasympathetic nervous system
- Hormonal regulation
  - Epinephrine and Norepinephrine
Heart Rate

- Tachycardia
- Bradycardia

Normal Heartbeat

Fast Heartbeat

Slow Heartbeat
Stroke Volume

Stroke volume (SV) is the amount of blood pumped by each ventricle with each heartbeat, averaging 70 ml per beat in the adult at rest. Stroke volume represents the difference between end diastolic volume (EDV) and end systolic volume (ESV).

Cardiac Output = Heart Rate x Stroke Volume

\[
CO = HR \times SV
\]
Stroke Volume

- End diastolic volume
- End systolic volume
Control of Stroke Volume

- Preload
- Contractility
- Afterload
EDV & Preload

Preload EQUALS End Diastolic Volume

Stretch
Contractility

Sympathetic stimulation
Afterload

is

End-systolic Wall Stress
or
Resistance

Resistance
Afterload
Control of Stroke Volume

- Stroke volume
- End diastolic volume ("preload")
- Contractility
- Total peripheral resistance ("afterload")
Cardiac Output

Cardiac Output = ___________ x ___________

Example:

HR of 72 beats/minute x SV of 70 mL/beat

Therefore, Q = 72 x 70 or 5,040 mL/min (or 5.04 Liters/min)
Cardiac Output

CARDIAC OUTPUT

HEART RATE

STROKE VOLUME

PRELOAD

CONTRACTILITY

AFTERLOAD

DIASTOLIC FILLING

FIBER STRETCH

CONTRACTILE FORCE

ARTERIAL PRESSURE

VENTRICULAR SIZE
a-v O2 Difference

15 ml of O2 per 100 ml of blood

20 ml of O2 per 100 ml of blood

a-v O2 difference = 5 ml of O2 per 100 ml
The Vascular System
Arteries

Vessel Characteristics

- Connective Tissue
- Smooth Muscle
- Endothelium

Muscular and Elastic, Thick walled

Muscular, Little connective tissue

Endothelial layer, no muscle

Thin walls with some smooth muscle

Thin walled with smooth muscle, flacid
Arterioles

- Smooth muscle sphincters
Capillaries
Veins

*One-way values*

Figure 23-19 Portion of a femoral vein opened, to show the valves. The direction of flow is upward.
Coronary Blood Flow

3 major coronary arteries
Autopsy cites heart disease in 49er's death

Denver's medical examiner says Thomas Herrion, 23, had significant blockage in his right coronary artery.

San Francisco 49ers offensive lineman Thomas Herrion died last month from heart disease, the Denver medical examiner's office said. Herrion, who collapsed in the team's locker room after an Aug. 20 exhibition game in Denver, had significant blockage in his right coronary artery, the city's health department said in a news release.

Herrion, 23, also had a slightly enlarged heart, the release said. A drug screen performed on Herrion's blood and urine found only atropine, a drug that was administered by medical personnel trying to resuscitate him.

49ers spokesman Aaron Salkin said in a telephone interview that the team's medical personnel hoped to review the coroner's report later today. Salkin said, to his knowledge, Herrion's annual physical examinations never detected any heart problems.

Herrion, a second-year player from Utah, collapsed shortly after 49ers coach Mike Nolan finished a locker-room speech to the team after a 26-21 exhibition loss in Denver. The 6-foot-3, 330-pound lineman had been on the field for the 49ers' final series, a 14-play, 91-yard touchdown drive.

"It really squashes all the speculation regarding his death," Frederick Lyles, Herrion's agent, said of the report. "They appear to be very thorough in their analysis. Hopefully, now people really get off the idea that these guys are overweight, or that drugs or steroids were involved in any way."

From Register news services
Blood Pressure

- Systolic
- Diastolic

80
Diastole

120
Systole
NOTE: Blood flows from a high to a low pressure
The Blood

- Plasma
- Red blood cells (erythrocytes)
- Hematocrit (42% in this example)