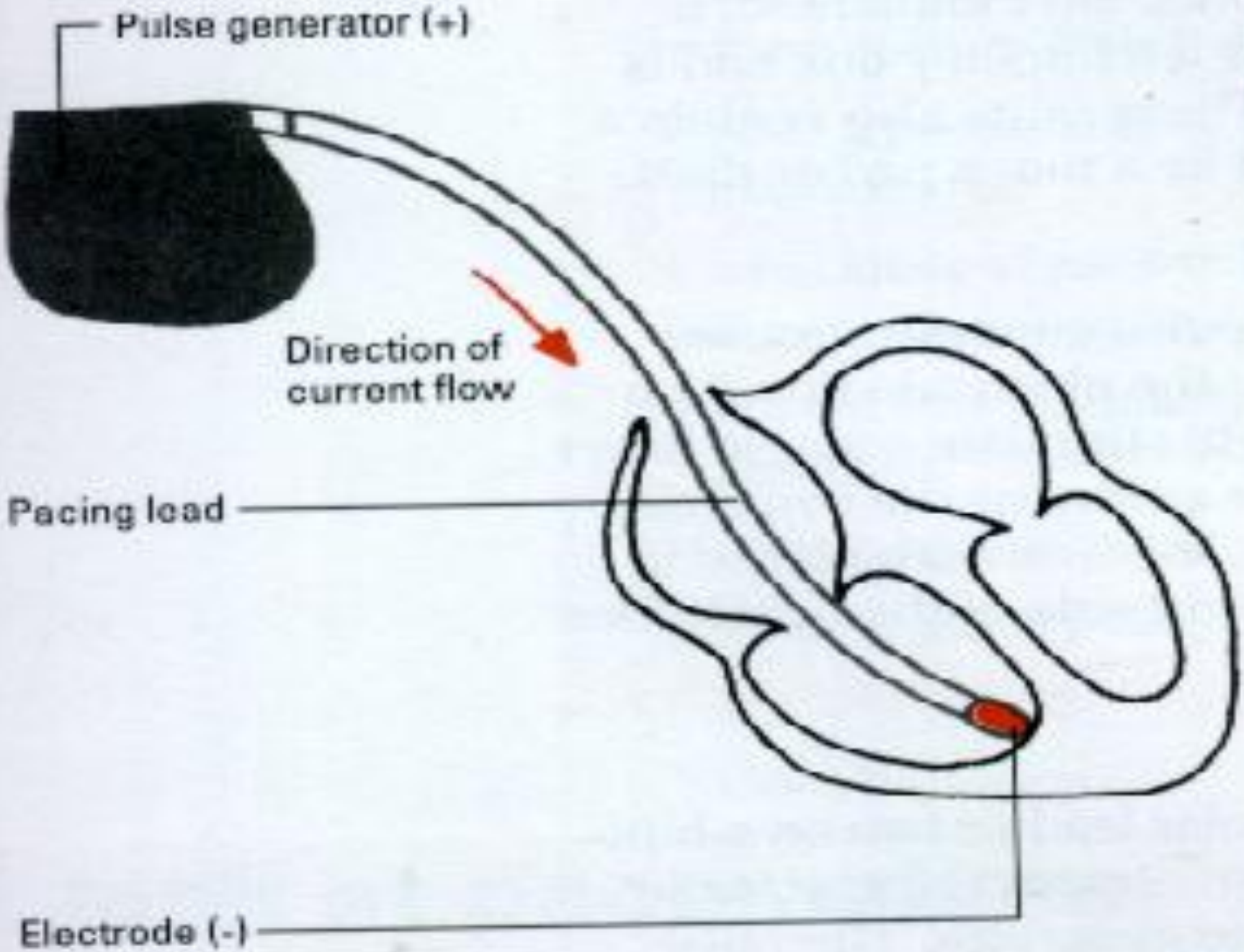
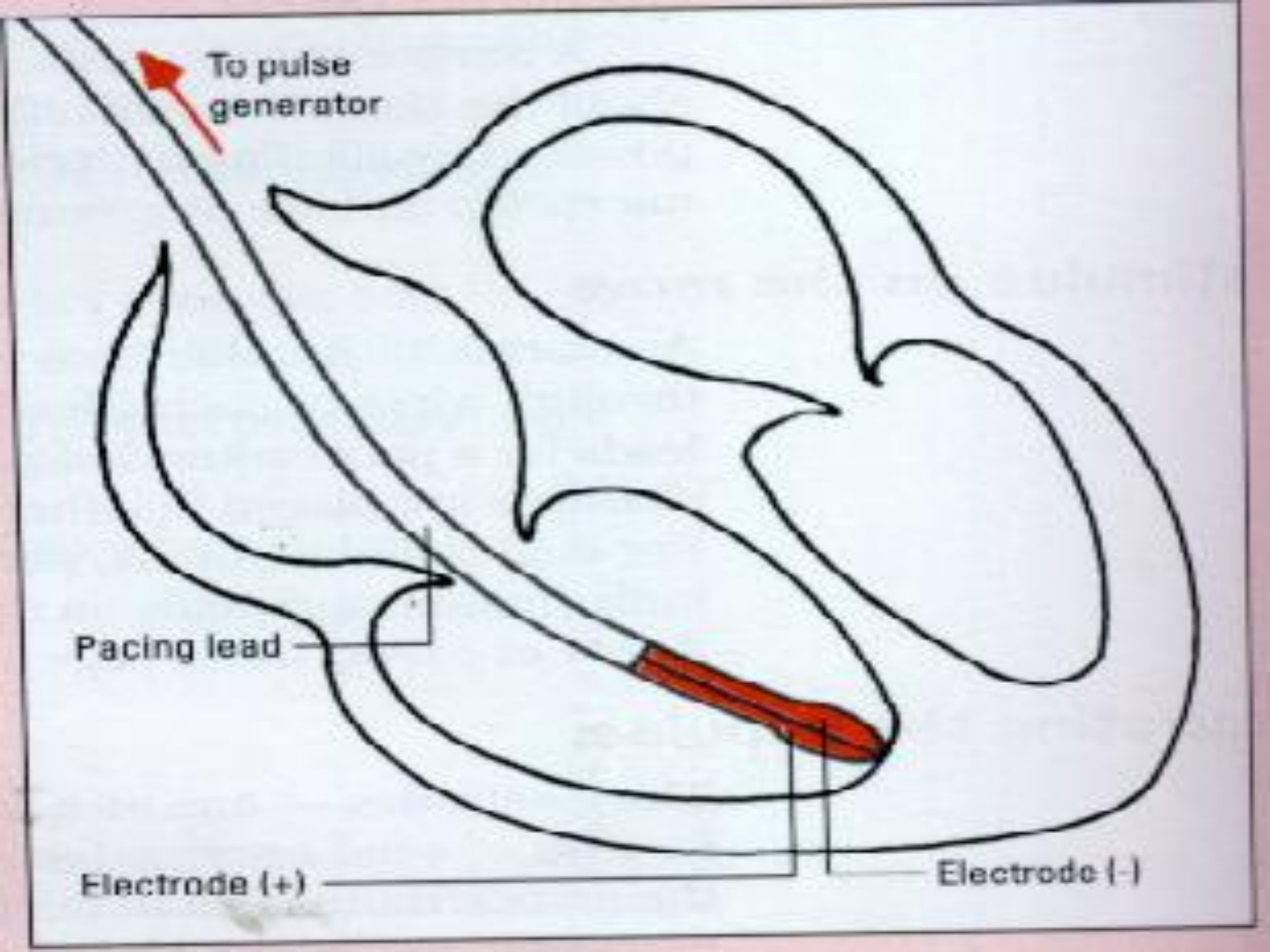
# Unipolar Pacemaker

- Lead has only one electrode that contacts the heart at its tip (+) pole
- The power source is the (-) pole
- Patient serves as the grounding source
- Patient's body fluids provide the return pathway for the electrical signal
- Electromagnetic interference occurs more often in unipolar leads


Pulse generator (+)
Direction of current flow
Pacing lead
Electrode (-)

# Bipolar Pacemaker

- If bipolar, there are two wires to the heart or one wire with two electrodes at its tip
- Provides a built-in ground lead
- Circuit is completed within the heart
- Provides more contact with the endocardium; needs lower current to pace
- Less chance for cautery interference


To pulse generator
Pacing lead
Electrode (+)
Electrode (-)

# Types

1. **Asynchronous/Fixed Rate**
2. **Synchronous/Demand**
3. **Single/Dual Chamber**
   - **Sequential (A & V)**
4. **Programmable/nonprogrammable**

# Asynchronous/Fixed Rate

- Does not synchronize with intrinsic HR
- Used safely in pts with no intrinsic ventricular activity
- If pt has vent. activity, it may compete with pt's own conduction system
- VT may result (R-on-T phenomenon)
- EX:  VOO, AOO, DOO

# Synchronous/Demand

**Contains two circuits**

* One forms impulses
* One acts as a sensor

**When activated by an R wave, sensing circuit either triggers or inhibits the pacing circuit**

**Called “Triggered” or “Inhibited” pacers**

**Most frequently used pacer**

- **Eliminates competition;**
- **Energy sparing**

# Examples of Demand Pacemakers

**DDI**

**VVI/VVT**

**AAI/AAT**

**Disadvantage: Pacemaker may be fooled by interference and may not fire**

# Dual Chamber: A-V Sequential

**Facilitates a normal sequence between atrial and ventricular contraction**

**Provides atrial kick + ventricular pacing**

**Atrial contraction assures more complete ventricular filling than the ventricular demand pacing unit**

**Increase CO 25-35% over ventricular pacing alone**

# A-V Sequential

**Disadvantage: More difficult to place**

**More expensive**

**Contraindication: Atrial fibrillation, SVT**

**Developed due to inadequacy of “pure atrial pacing”**

# Single Chamber

**Atrial**

**Ventricular**

# “Pure Atrial Pacing”

- Used when SA node is diseased or damaged but AV conduction system remains intact
- Provides atrial kick
- Atrial kick can add 15-30% to CO over a ventricular pacemaker
- Electrode in atrium: stimulus produces a P wave

# Problems with Atrial Pacing

- Electrode difficult to secure in atrium
- Tends to float
- Inability to achieve consistent atrial "demand" function

# Ventricular Pacemakers

**If electrode is placed in right ventricle, stimulus produces a left BBB pattern**

**If electrode is placed in left ventricle, stimulus produces a right BBB pattern**

# Programmability

- Capacity to noninvasively alter one of several aspects of the function of a pacer
- Desirable since pacer requirements for a person change over time
- Most common programmed areas
  - Rate
  - Output
- AV delay in dual chamber pacers
- R wave sensitivity
- Advantage: can overcome interference caused by electrocautery

# 3-Letter or 5-Letter Code

- Devised to simplify the naming of pacemaker generators

# First letter

**Indicates the chamber being paced**

- **A: Atrium**
- **V: Ventricle**
- **D: Dual (Both A and V)**
- **O: None**

# Second Letter

**Indicates the chamber being sensed**

- **A: Atrium**
- **V: Ventricle**
- **D: Dual (Both A and V)**
- **O: Asynchronous or does not apply**

# Third Letter

**Indicates the generator's response to a sensed signal/R wave**

- **I: Inhibited**
- **T: Triggered**
- **D: Dual (T & I)**
- **O: Asynchronous/ does not apply**

# Fourth Letter

**Indicates programming information**

- **O: No programming**
- **P: Programming only for output and/or rate**
- **M: Multiprogrammable**
- **C: Communicating**
- **R: Rate modulation**

# Fifth Letter

**This letter indicates tachyarrhythmia functions**

- **B: Bursts**
- **N: Normal rate competition**
- **S: Scanning**
- **E: External**
- **O: None**

**Table 4-4.** *Generic Code for Identification and Description of Pacemaker Function*

| First Letter | Second Letter | Third Letter | Fourth Letter | Fifth Letter |
|---|---|---|---|---|
| Cardiac chamber paced | Cardiac chamber in which electrical activity is sensed | Response of generator to sensed R wave and P wave | Programmable functions of the generator | Antitachycardia functions of the generator |
| V—Ventricle | V—Ventricle | T—Triggering | P—Programmable (rate and/or output only) | B—Bursts |
| A—Atrium | A—Atrium | I—Inhibited | M—Multiprogrammable | N—Normal rate competition[a] |
| D—Dual (atrium and ventricle) | D—Dual | D—Dual | C—Communicating[b] | S—Scanning |
| | O—None (asynchronous) | O—None (asynchronous) | O—None (fixed function) | E—External |

[a] *Stimuli delivered at normal*

# Types of Pulse Generators

| Letter Number [a] | | | Description |
|---|---|---|---|
| I | II | III | |
| A | O | O | Asynchronous (fixed rate) atrial pacing |
| V | O | O | Asynchronous (fixed rate) ventricular pacing |
| A | A | I | Noncompetitive (demand) atrial pacing, electrical output inhibited by intrinsic atrial depolarization (P wave) |
| V | V | I | Noncompetitive (demand) ventricular pacing, electrical output inhibited by intrinsic ventricular depolarization (R wave) |
| A | A | T | Triggered atrial pacing, electrical output triggered by intrinsic atrial depolarization (P wave) |
| V | V | T | Triggered ventricular pacing, electrical output triggered by intrinsic ventricular depolarization (R wave) |
| D | V | I | Paces (sequential) in atrium and ventricle, does not sense P waves, does sense R waves |
| D | D | D | Paces and senses in atrium and ventricle |
| V | D | D | Paces in ventricle, senses in atrium and ventricle, synchronized with atrial activity and paces ventricle after a preset atrioventricular interval |

# Examples

**AOO**

- **A: Atrium is paced**
- **O: No chamber is sensed**
- **O: Asynchronous/does not apply**

**VOO**

- **V: Ventricle is paced**
- **O: No chamber is sensed**
- **O: Asynchronous/does not apply**

# Examples

**VVI**

- **V: Ventricle is the paced chamber**
- **V: Ventricle is the sensed chamber**
- **I: Inhibited response to a sensed signal**

**Thus, a synchronous generator that paces and senses in the ventricle**

**Inhibited if a sinus or escape beat occurs**

**Called a “demand” pacer**

# Examples

## DVI

**D: Both atrium and ventricle are paced**

**V: Ventricle is sensed**

**I: Response is inhibited to a sensed ventricular signal**

**For A-V sequential pacing in which atria and ventricles are paced. If a ventricular signal, generator won't fire**

**Overridden by intrinsic HR if faster**

# Examples

**DDD**

- Greatest flexibility in programming
- Best approximates normal cardiac response to exercise

**DOO**

- Most apparent potential for serious ventricular arrhythmias

**VAT**

- Ventricular paced, atrial sensed
- Should have an atrial refractory period programmed in to prevent risk of arrhythmias induced by PACs from ectopic or retrograde conduction
- AV interval is usually 150-250 milliseconds