

Bradyarrhythmias

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Basics

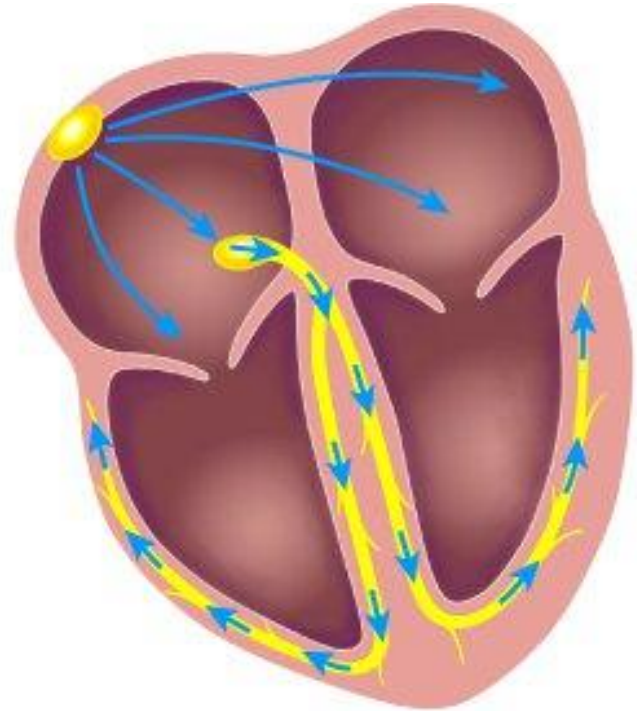
Arrhythmia/dysrhythmia = deviation from physiologic heart rhythm

Bradycardia $< 50/\text{min.}$

Tachycardia $> 100/\text{min.}$

Physiology of heart rhythm

- Origin of depolarization
 - sinoatrial (SA) node
- Transfer of depolarization
 - Conduction system
 - Atrial
 - Atrioventricular (AV) node
 - Intraventricular



Pathophysiology of heart rhythm

- Depolarization origination defect

- Sinoatrial (SA) node



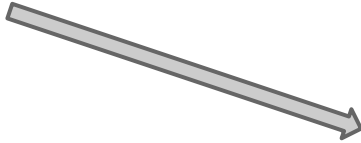
Sinus node
dysfunction

- Depolarization transfer defect

- In atrias
- AV node
- Intraventricular conduction system



AV blocks



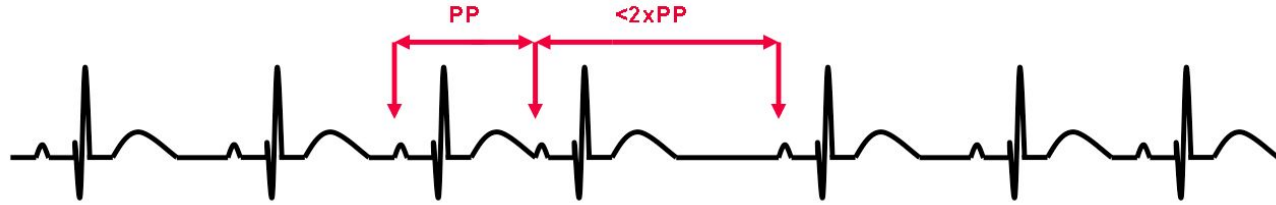
Intraventricular
conduction blocks

Sinus node dysfunction

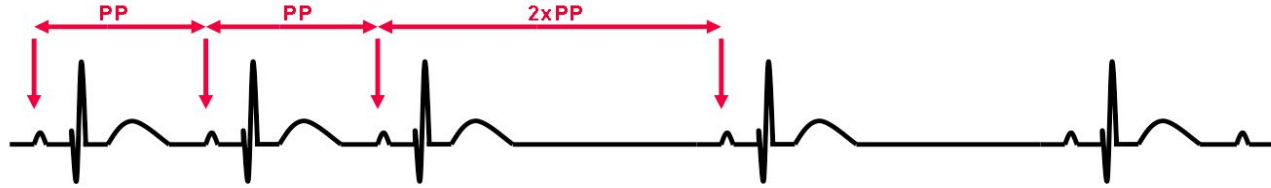
- many forms
 - sinus bradycardia
 - sinus arrest
 - sinoatrial (SA) blocks
 - brady - tachy form (switching between bradycardia and tachycardia)
 - chronotropní inkompetence
- If symptoms are present, we are talking about sick sinus syndrome (SSS)

ECG - SA blocks

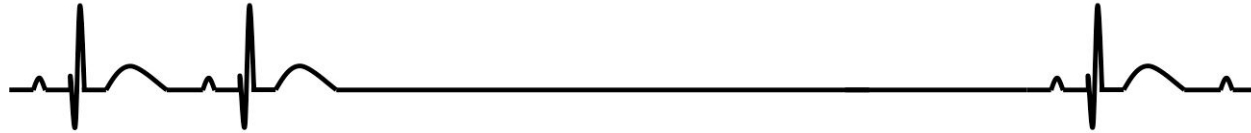
Grade II
type 1



Grade II
type 2



Grade III



Atrioventricular blocks

- **Grade I**
 - Prolonged AV conduction ($PR > 200\text{ms}$)
 - Every atrial depolarization is conducted to ventricles
- **Grade II**
 - Some of atrial depolarizations are conducted to ventricles but some are not
 - Type 1 - gradual prolongation of PR interval until one atrial depolarization is not conducted to ventricles. After that PR interval shortens again
 - Type 2 - to ventricles is conducted every 2nd, 3rd (n-th) atrial depolarization
- **Grade III**
 - Complete heart block between atrias and ventricles
- **Advanced heart block**
 - Several atrial depolarization are not conducted to ventricles

ECG - AV blocks

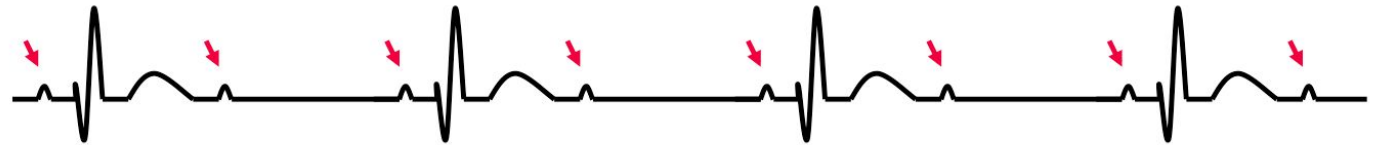
Grade I



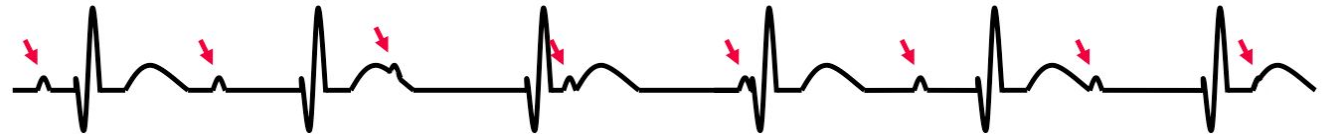
Grade II
type 1



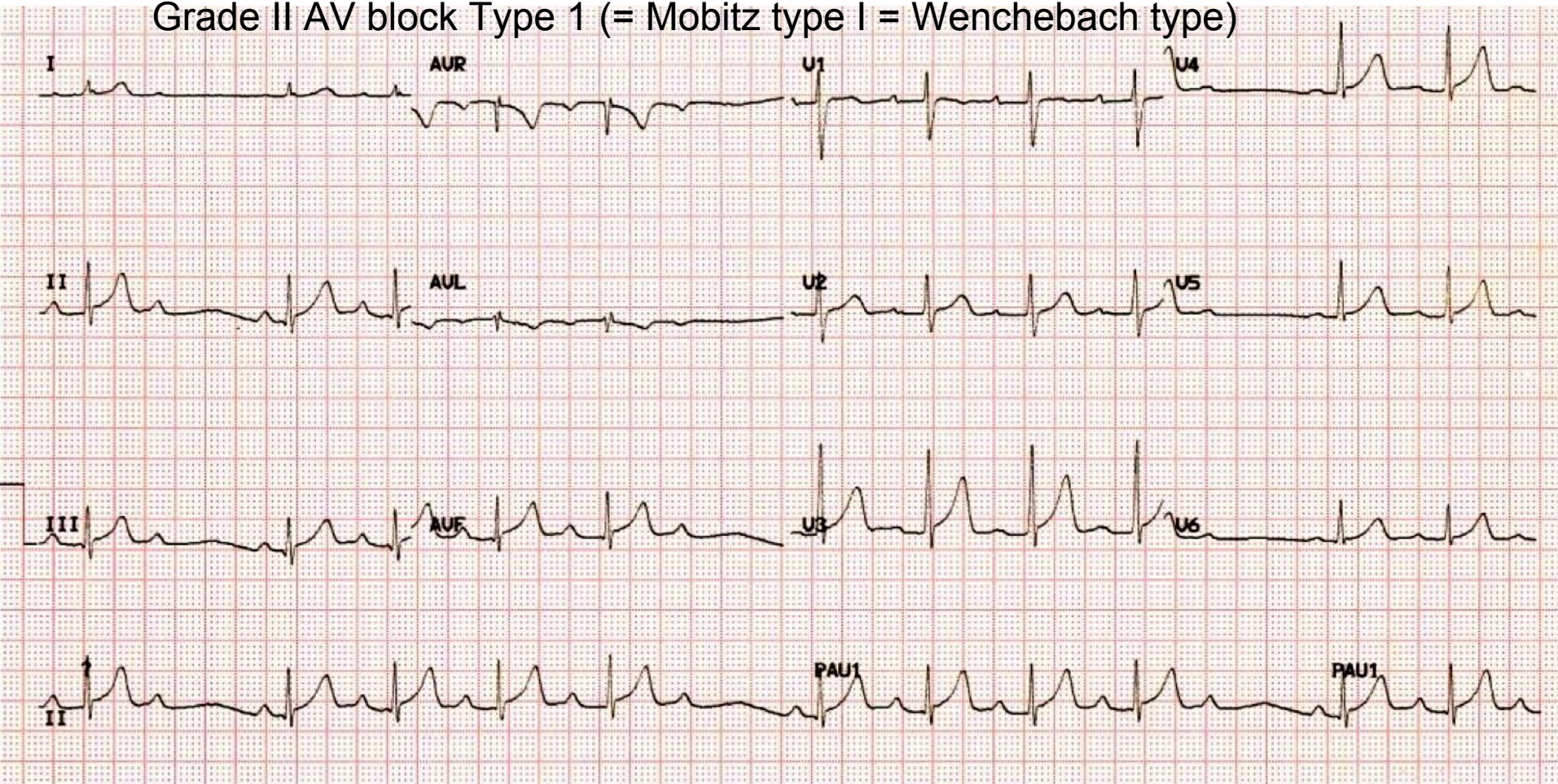
Grade II
type 2



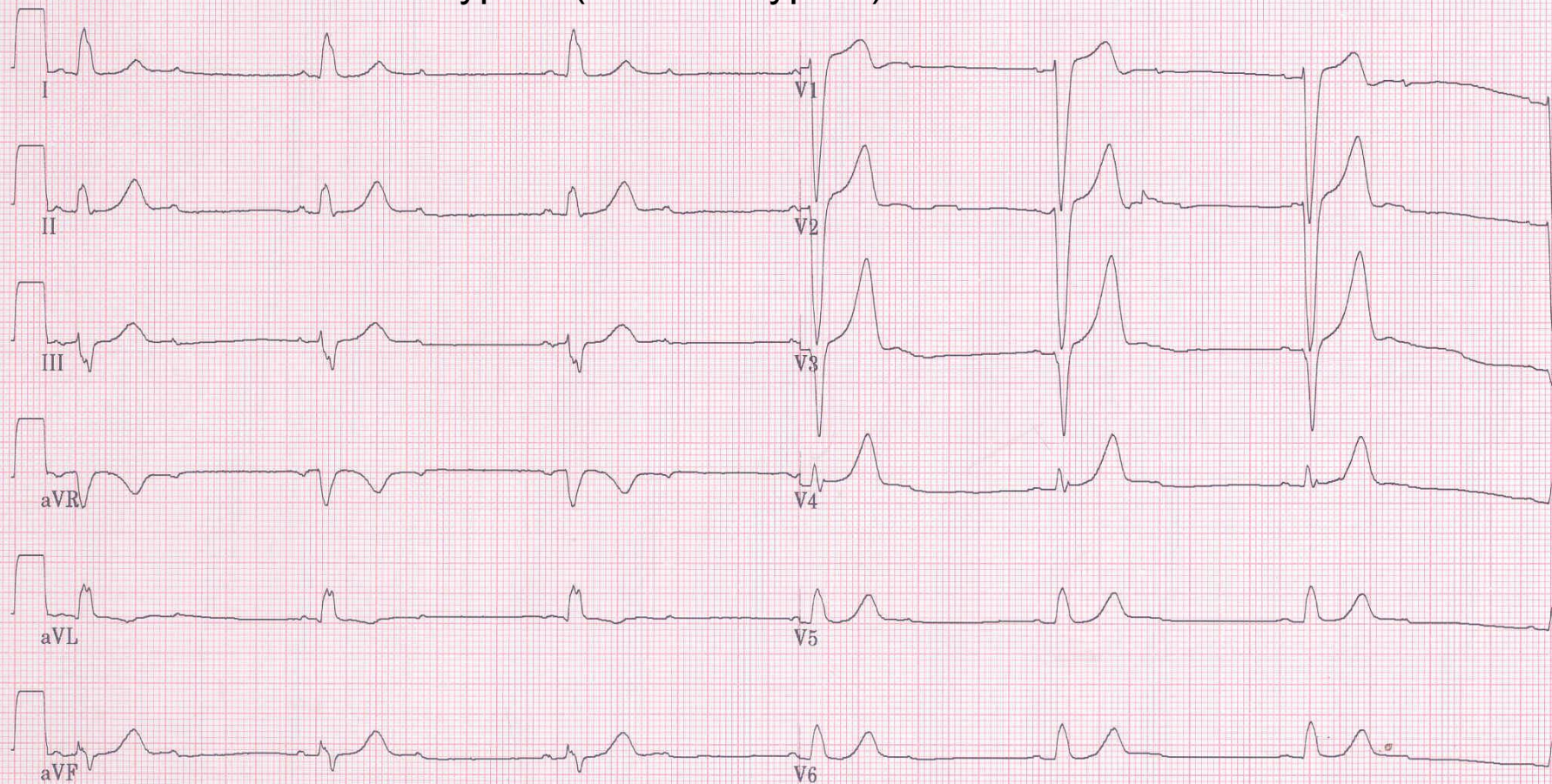
Grade III



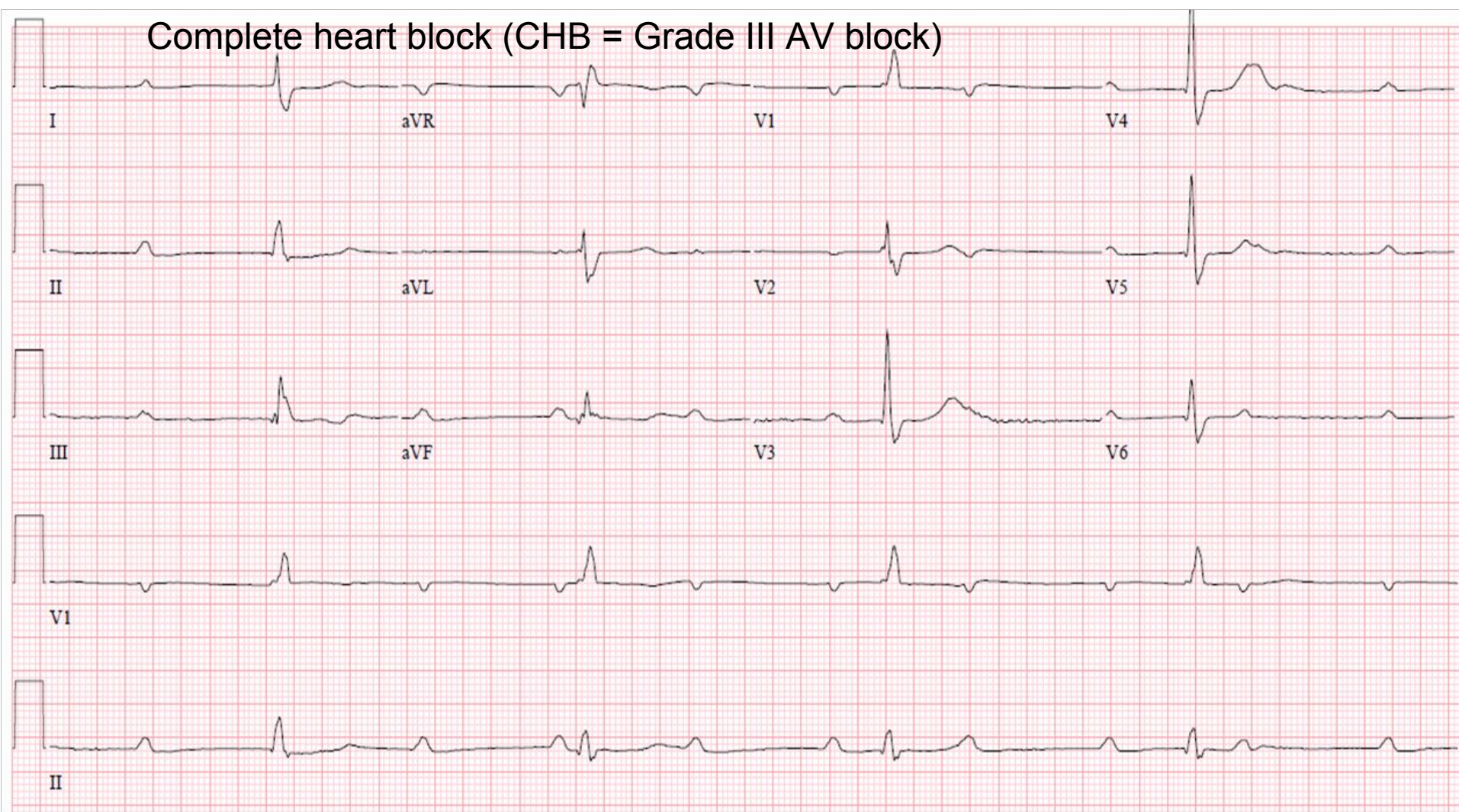
Grade II AV block Type 1 (= Mobitz type I = Wenchebach type)



Grade II AV block Type 2 (= Mobitz type II)



Complete heart block (CHB = Grade III AV block)

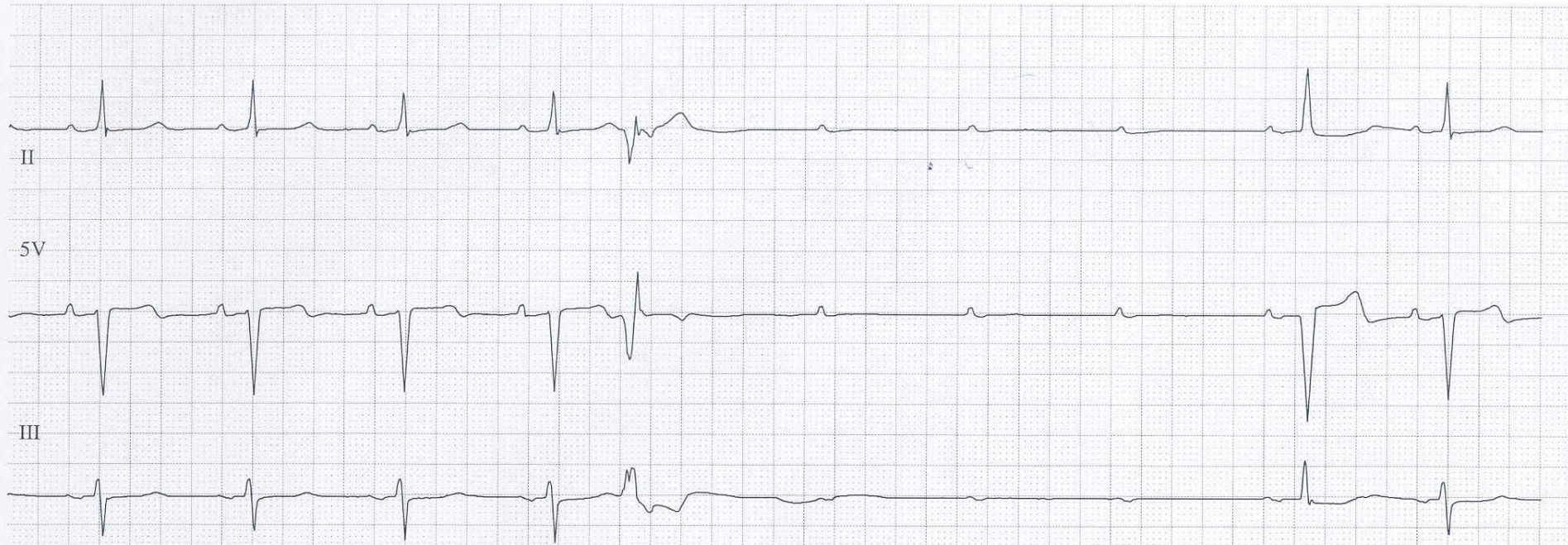


Advanced AV block

BKJ-5 BUKACOVA 999999999 6-NOV-2002 08:34

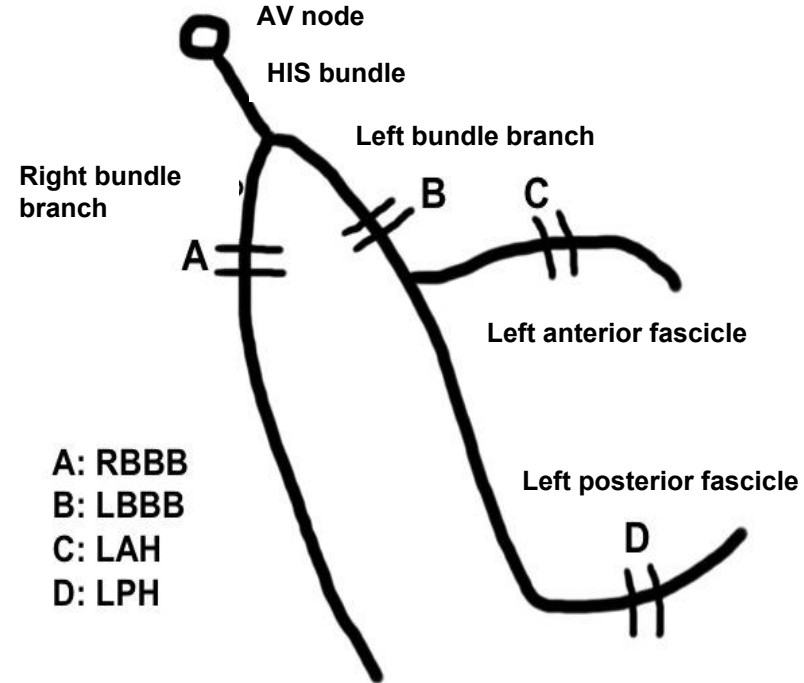
ALARM HISTORY *ASYSTOLE* .05-40Hz 06-NOV 04:11:43 HR 0 @25 MM/S

Page 1

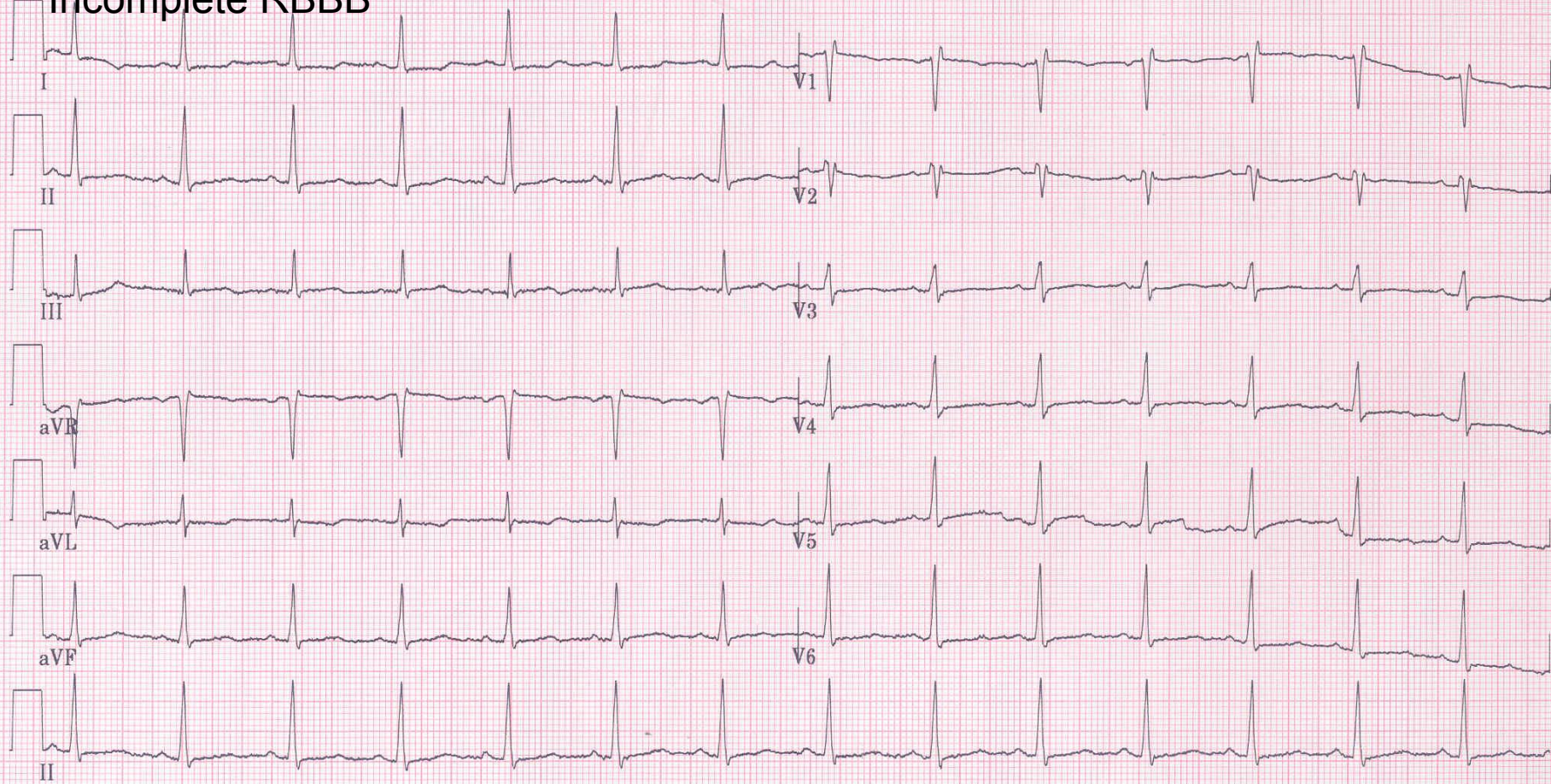


Intraventricular conduction defects

- Bundle branch blocks
 - Complete or incomplete
 - Left bundle branch block (LBBB)
 - Right bundle branch block (RBBB)
- Fascicular blocks (hemiblocks)
 - Left anterior hemiblock (LAH)
 - Left posterior hemiblock (LPH)
- Bifascicular block
 - RBBB + LAH
 - RBBB + LPH
- Trifascicular block
 - Bifascicular block + 1st grade AV block

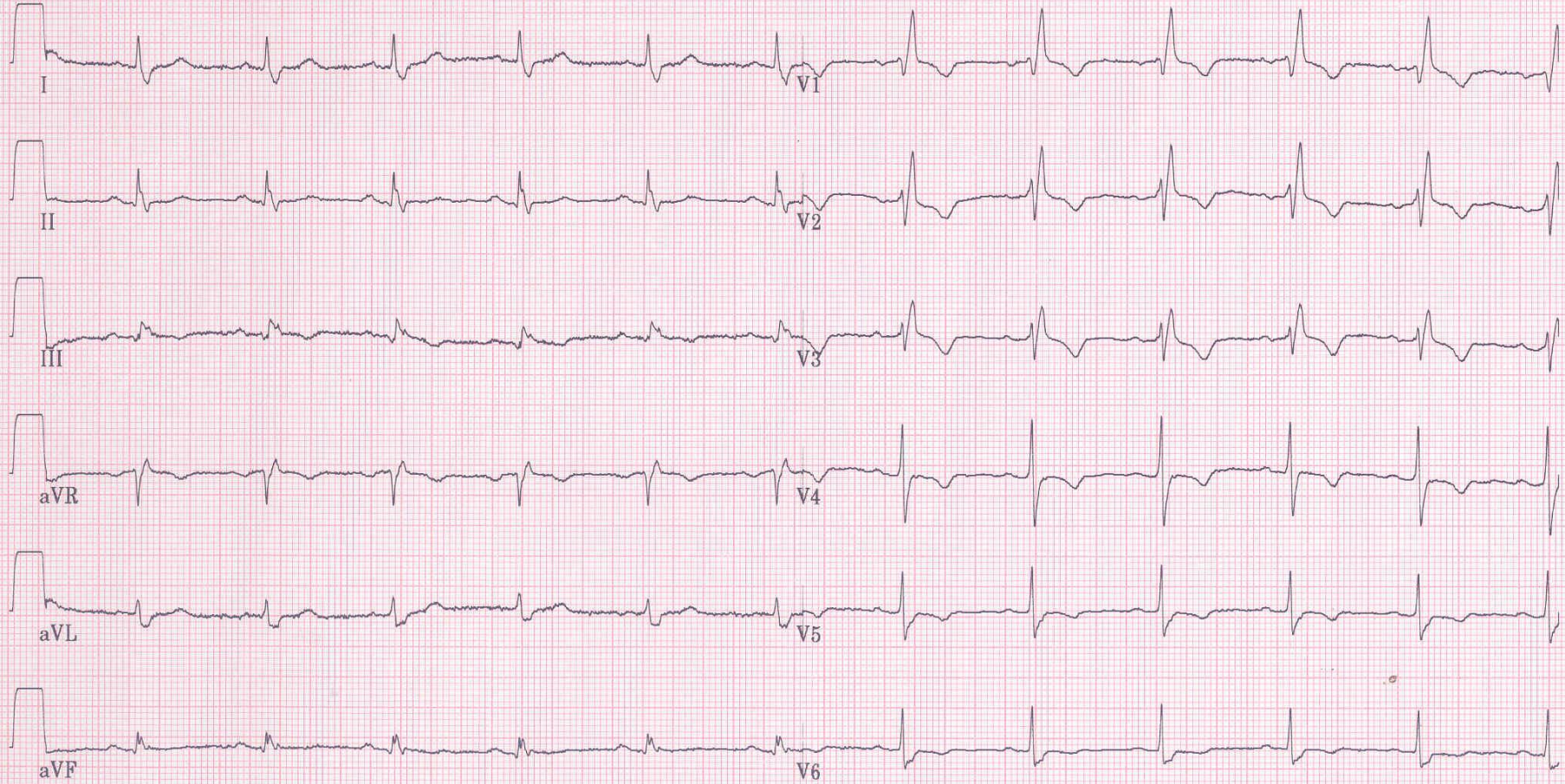


Incomplete RBBB



RBBB

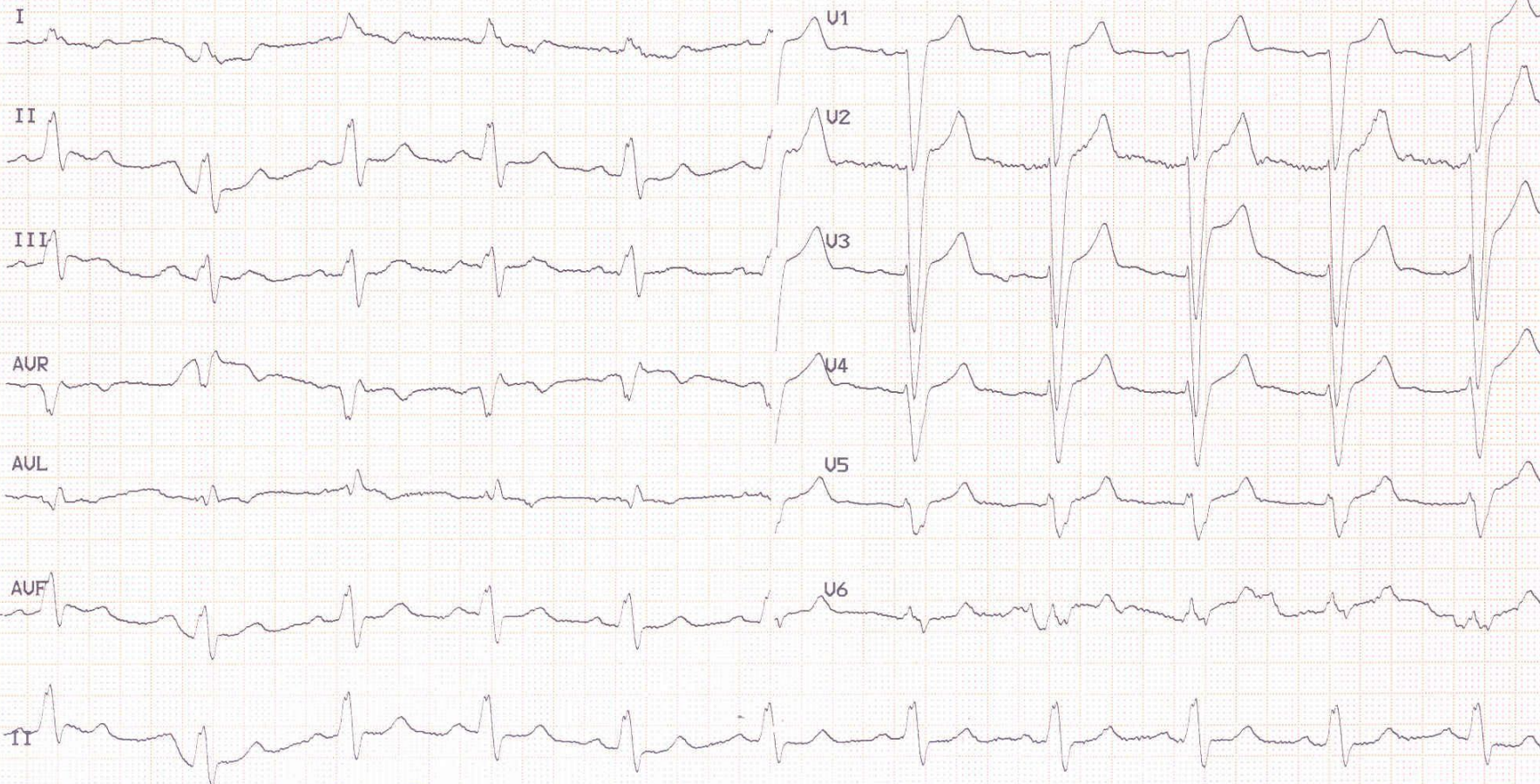
Unconfirmed



LBBB

aVF

Nepotvrzená zpráva.



2.7.2014

905

01. Led. 1970

00:00:00

25mm/s

10mm/mV

ADS

50Hz

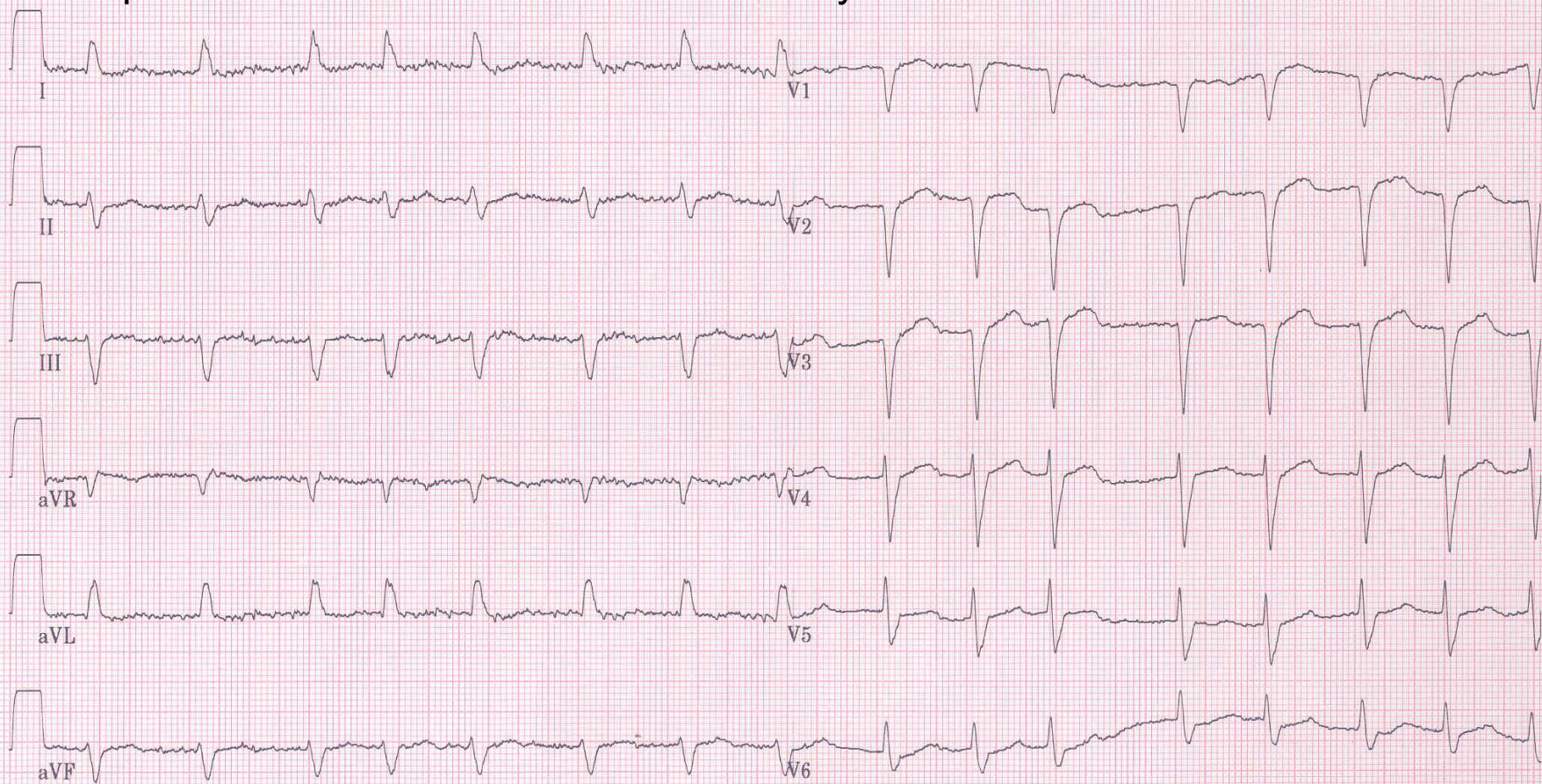
0.08 - 40Hz

6_F1_R

Automatický U5.2 12i (1)

12SL@U231

Nonspecific intraventricular conduction delay



Etiology

- Structural defect

- Myocardial infarction, myocarditis, cardiac storage diseases, heart tumors, sarcoidosis
- Iatrogenic (alcohol septal ablation, cardiac valve surgery/implantation, heart surgery, catheter ablation)
- Idiopathic (degeneration, fibrosis)

- Functional defect

- Mineral dysbalance, pharmacotherapy, hypothermia, autonomic nervous system dysfunction

Clinical manifestation

- Transient bradycardia or asystole
 - Syncope
 - Adams-Stokes syndrome = syncope with convulsions (event. loss of sphincter tone - loss of urine, feces)
 - Dizziness
 - Feeling of instability
- Permanent bradycardia
 - Fatigue, weakness, bradypsychia
 - Heart failure

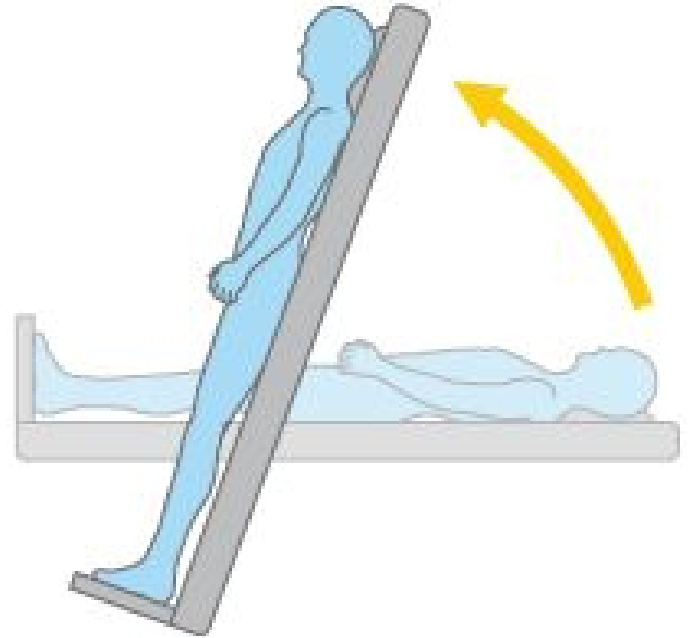
Diagnose

- ECG
- Long term ECG monitoring
 - Holterovská monitoration (24 h. to 7 days)
 - Telemetry
 - Loop recorder (external or implantable)
- Stress ECG
 - dg. chronotropic incompetence
- Head up tilt table test
- Carotid sinus massage
- Electrophysiology study (EPS)



Head up tilt test (HUT)

- Examination on tilt table
- 60 degrees
- Duration of 45 minutes
- Diagnosis of neurocardiogenic syncope



Carotid sinus massage

- Manual compression of carotid sinus (on neck in place with carotid pulsations)
- Leads to increased parasympathetic tone
- Diagnosis of Carotid sinus syndrome
 - More than 3 sec asystole during carotid sinus massage

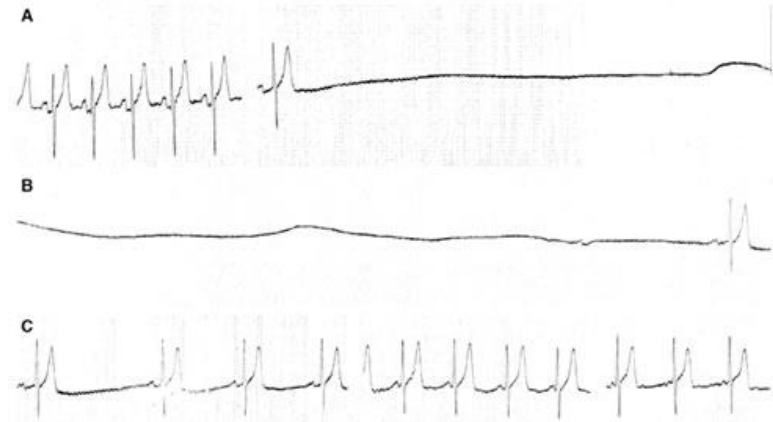
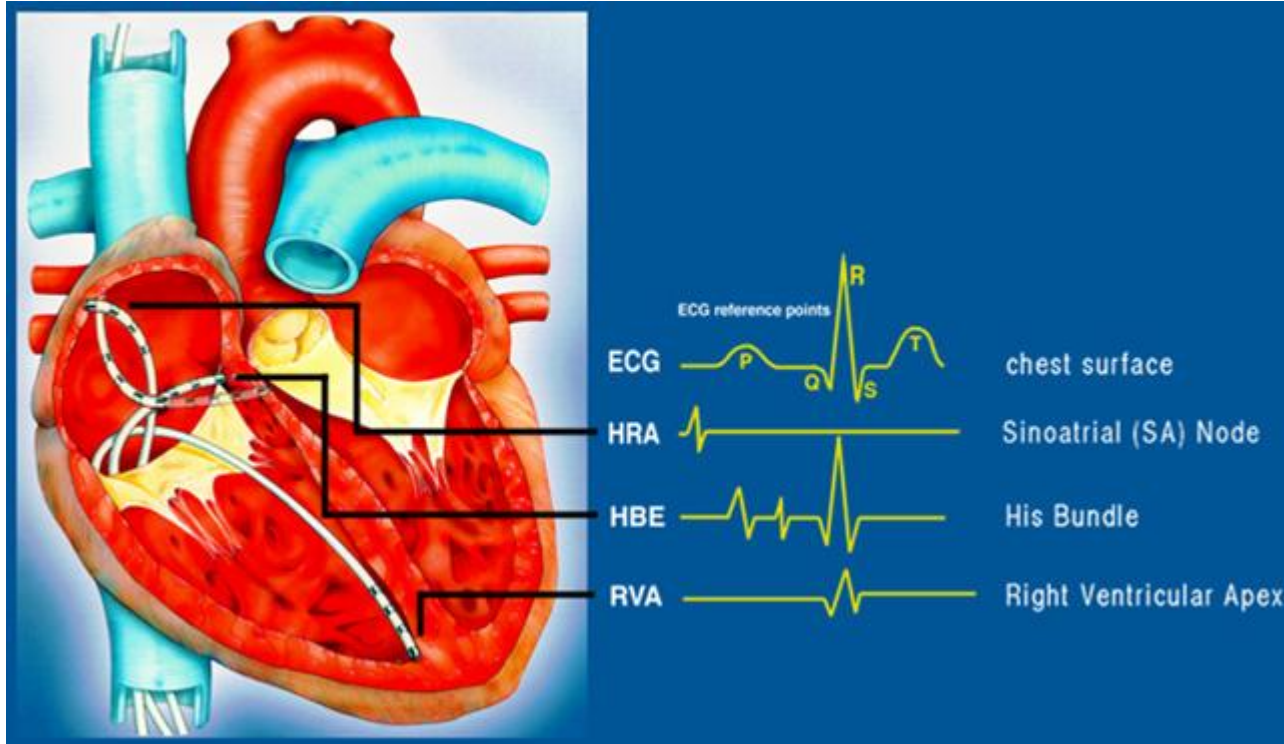


Figure 1. (A, B) Electrocardiograms showing an asystolic pause lasting 18 seconds associated with loss of consciousness. (C) Restoration of sinus rhythm followed by regaining consciousness.

Electrophysiology study

- Invasive catheter procedure
- Introducing of electrophysiology catheters into heart chambers
- Electrical stimulation and intracardiac signals registration
- Very often indicated for bradyarrhythmias diagnosis
 - Capacity of His bundle conduction (Bifascicular block)
 - Sinus node function (Sick sinus syndrome)
 - Low sensitivity (60%)

Electrophysiology study



Prognosis

- Potentially malignant
 - 2nd grade AV block II., type 2
 - Complete heart block with wide QRS
 - Advanced AV block
- Benign
 - sick sinus syndrome
 - 2nd grade AV block, type 1
 - Complete heart block with narrow QRS and heart rate > 40 bpm)
 - Intraventricular conduction defect without AV block

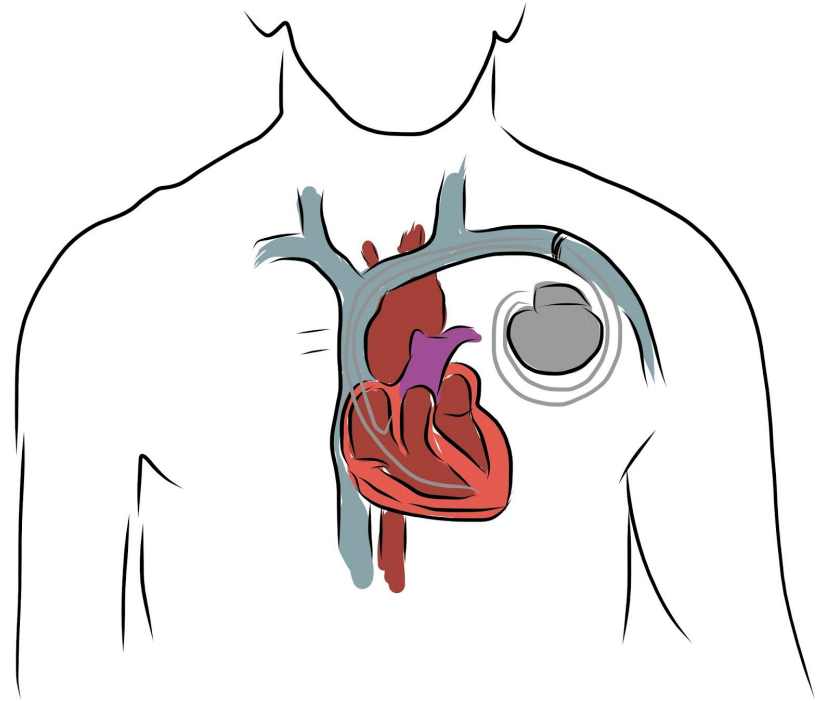
Therapy

- Pharmacotherapy
 - Only in acute phase
 - Catecholamines - adrenaline, isoprenaline
 - Atropine
- Cardiac pacing
 - Temporary in acute phase
 - Permanent

Cardiac pacing

= stimulation of heart contraction by electric impulse

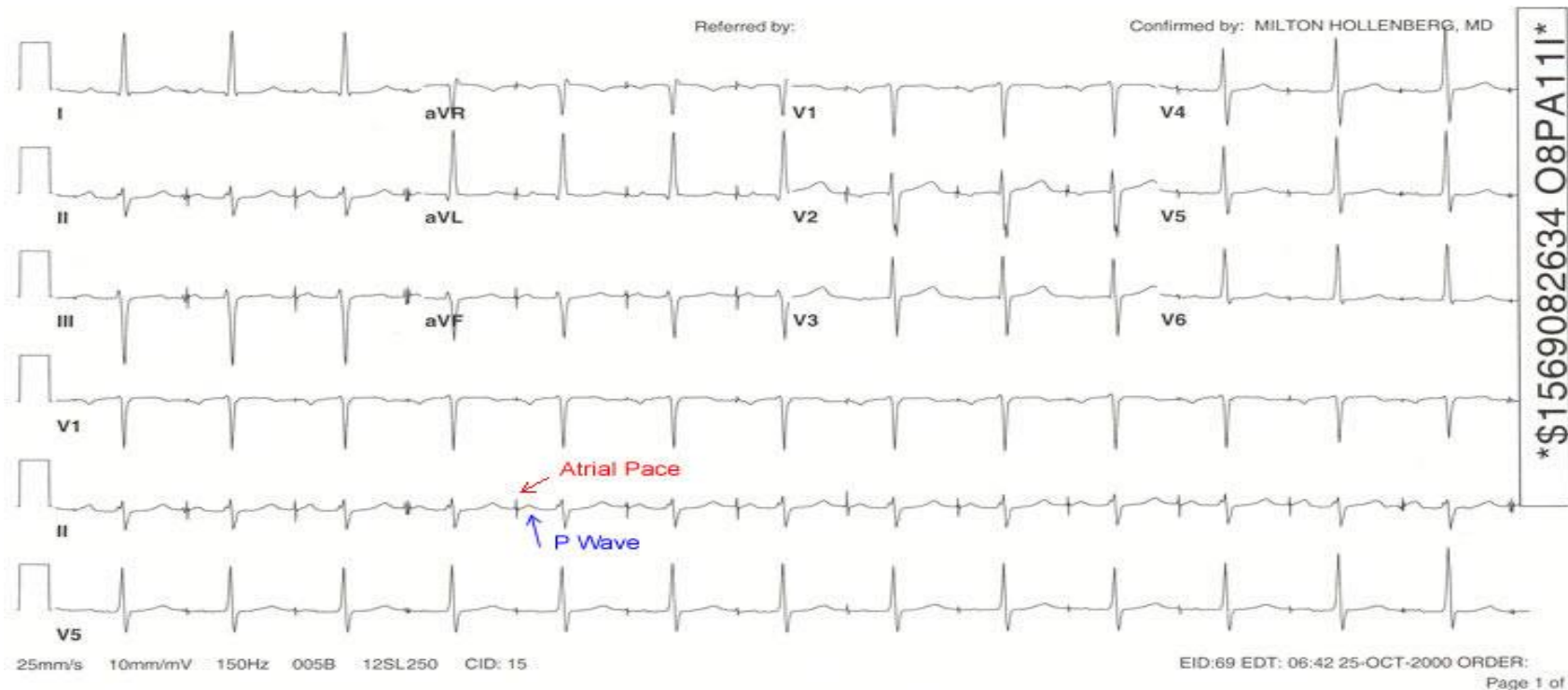
- Electric impulses are conducted to heart by pacing electrode
- Pacemaker + electrode = pacing system



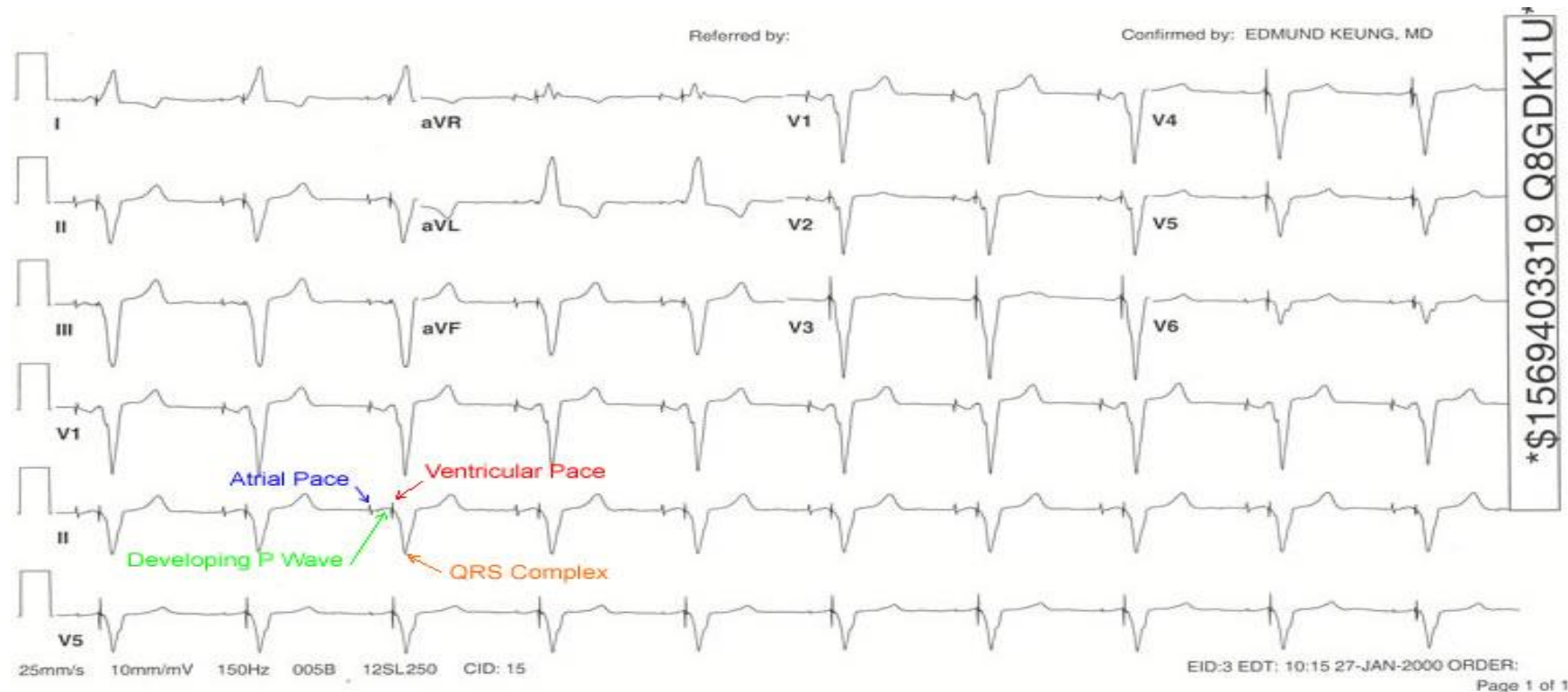
Types of pacing

- According to duration
 - Temporary (approximately days)
 - Permanent
- According to paced chambers
 - Single chamber pacing (only right ventricle or right atrium paced)
 - Dual chamber pacing (right ventricle and right atrium pacing)
 - Biventricular pacing (simultaneous right ventricle and left ventricle pacing)

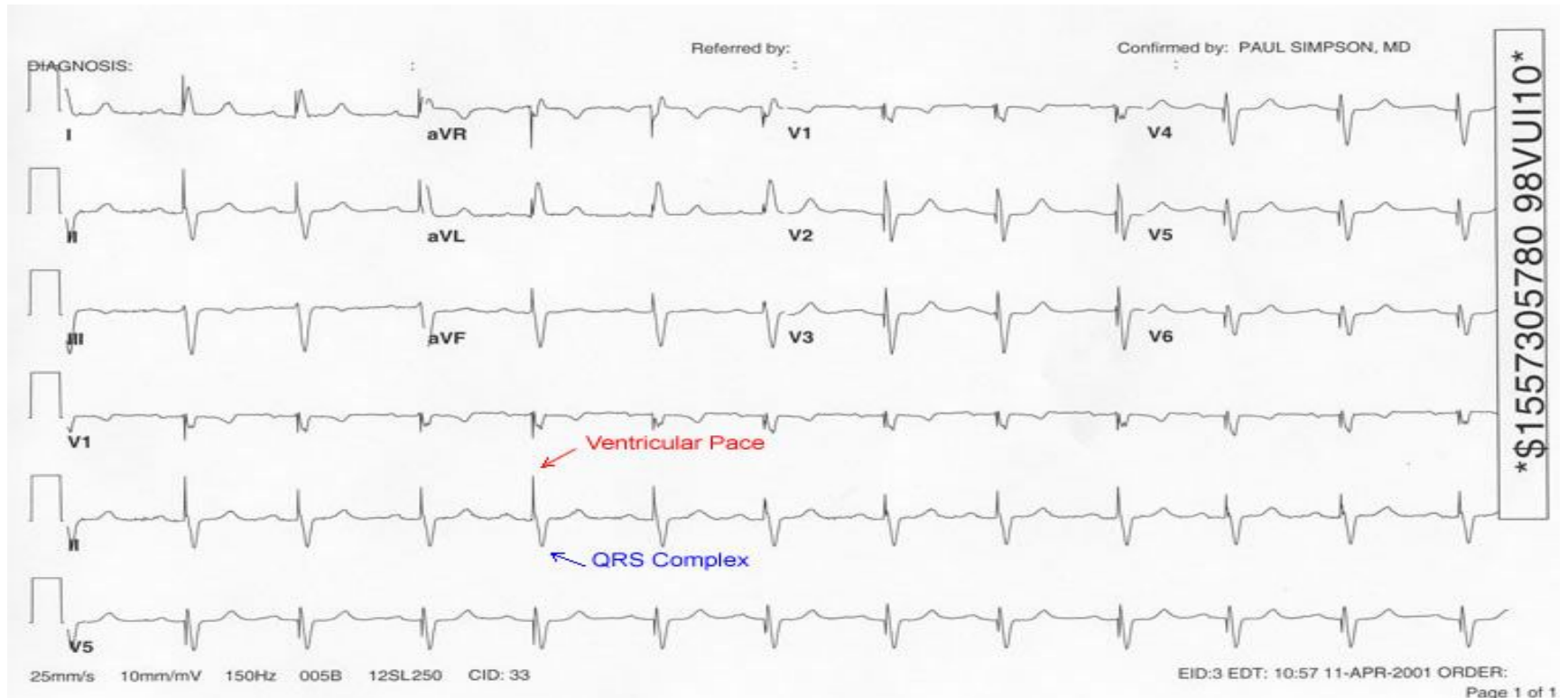
ECG - atrial pacing



ECG – AV sequential pacing

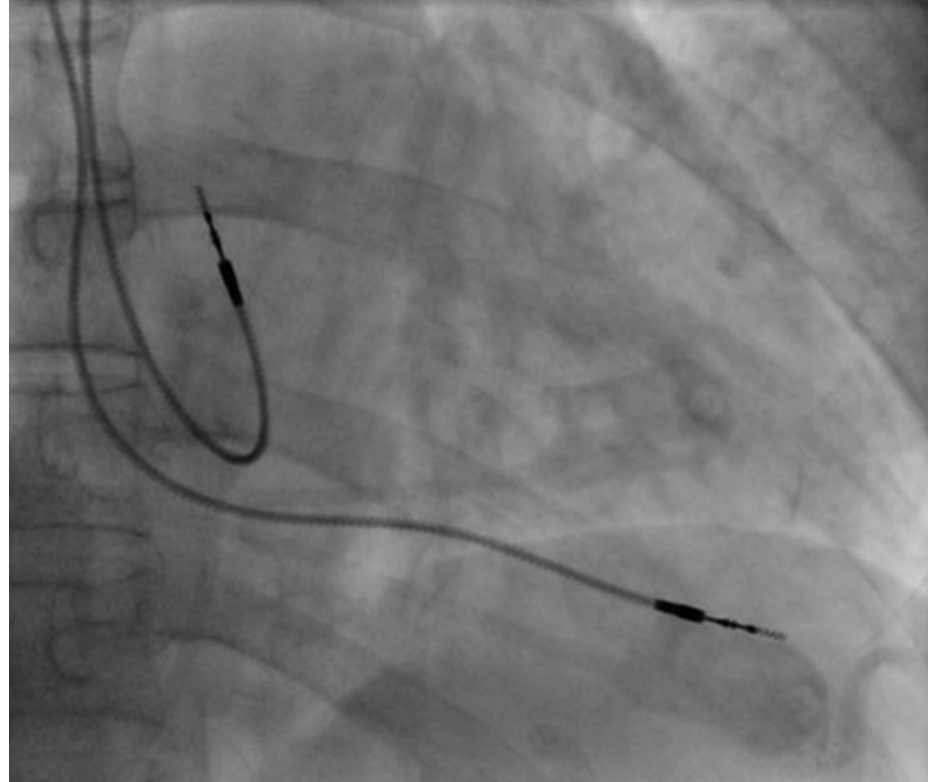


ECG – atrial triggered ventricular pacing



Pacemaker implantation

- Skin incision, subcutaneous pocket preparation
 - Subclavicular region on left or right side
- Pacing electrode implantation
 - Endovasal (v. subclavia puncture)
 - Epimyocardial (surgery)
- Pacemaker connection
- Wound suture





Pacing modes

DDD VOO AAIR DDI
VDD DDDR VVI



Paced chamber	Sensed chamber	Response to sensing	Rate adaptive pacing
A = atrium	A = atrium	T = triggered	R = rate adaptive
V = ventricle	V = ventricle	I = inhibition	
D = dual (atrium and ventricle)	D = dual (atrium and ventricle)	D = dual (inhibition and triggering)	

Pacemaker implantation indications

- Benign arrhythmias only in symptomatic patients
 - Sick sinus syndrome
 - 2nd grade AV block, type 1
- Potentially malignant arrhythmias regardless of symptoms
 - 2nd grade AV block, type 2
 - Advanced AV block
 - Complete heart block
- Always exclude transient cause
 - (mineral dysbalance, pharmacotherapy, Lyme carditis)

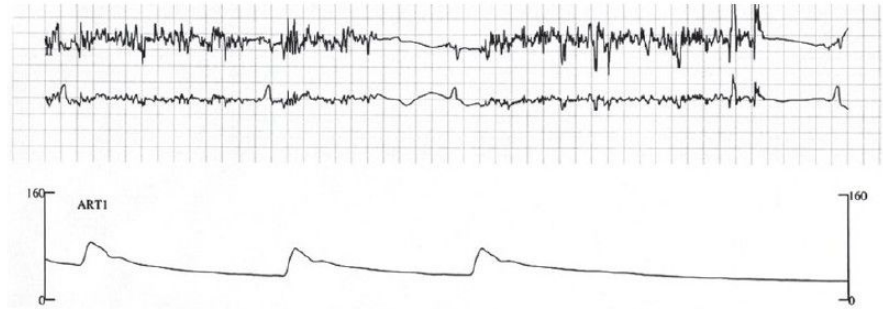
Patient care after pacemaker implantation

- Pacemaker clinic, outpatient
- Pacemaker check-up each 6 to 12 months
 - Battery capacity
 - Pacing threshold
 - Arrhythmias in device memory
- Battery longevity approx. 8-12 years
 - If battery depleted, reimplantation of whole pacemaker, pacing electrodes are leaving in situ

Electromagnetic interference (EMI)

= interference of pacing functions with electromagnetic field

- Pacing inhibition
- Inadequate pacing



● Risk of EMI

- MRI examination
- Electrocautery during surgical procedures
- Arc welding
- Strong magnets (transformer stations)
- Electrotherapy