

Acquired conduction disturbance in structurally normal heart in children

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Incidence

- Cardiac conduction disturbances detected in a pediatric population
 - 432,166 elementary and high school students
 - Prevalence of CCD increased with age : 0.48% → 0.97%
 - higher in males
 - Incomplete RBBB(0.32%), complete RBBB(0.11%), VPC(0.11%), WPW syndrome(0.067%)
 - Sensitivity of IRBBB in screening for ASD was 34.67%

Chiu et al. J Pediatr 2009; 152:85-89

Classification

- First AV Block
- Second AV Block
- Complete AV Block
- Intraventricular block
- Drug-induced long QT syndrome



Causes of acquired heart block

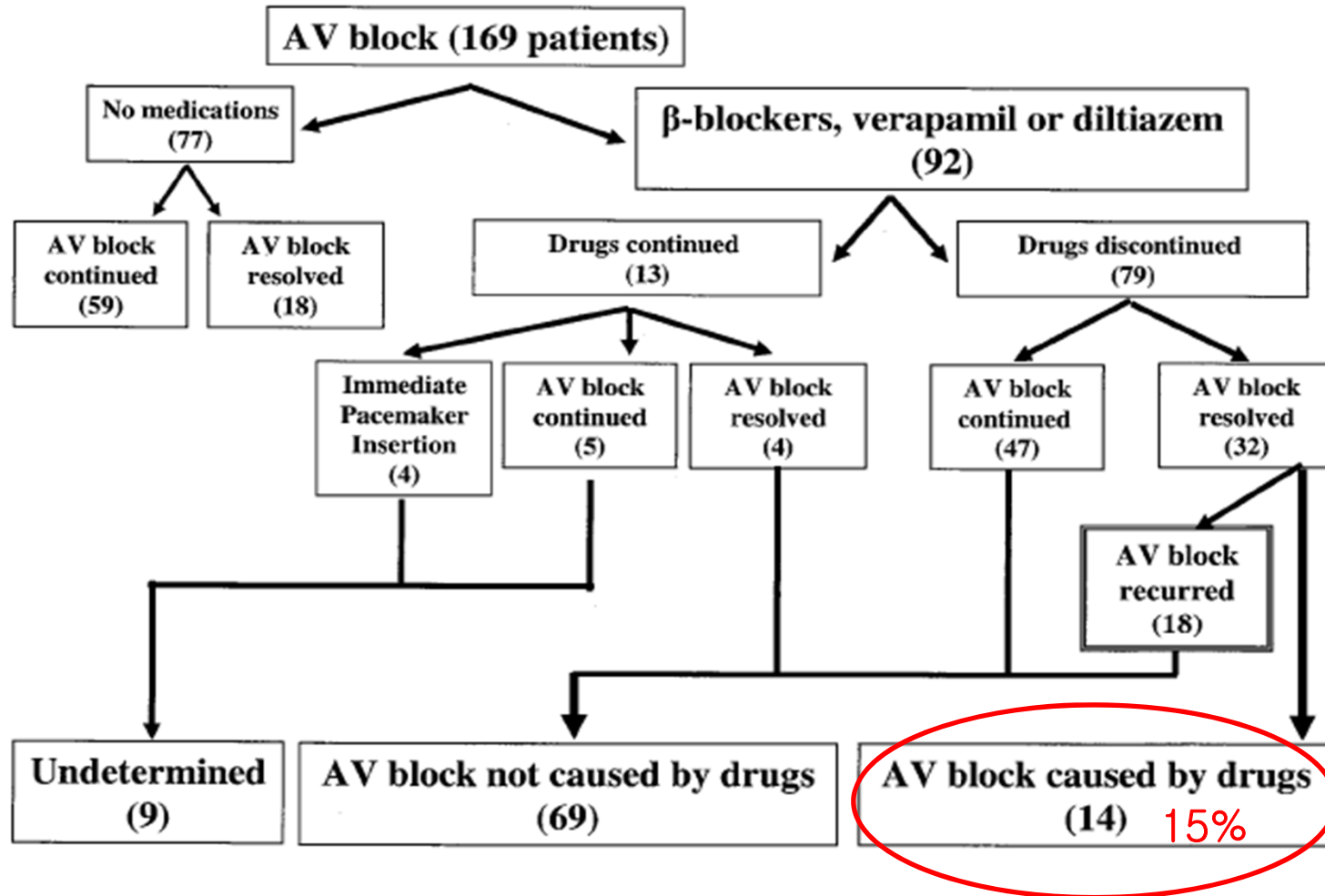
- medications
- myocardial inflammation
- Myopathy
- infection (Lyme disease, viral myocarditis, endocarditis)
- Hypothyroidism
- surgical trauma
- high levels of vagal tone
- Anorexia nervosa



Drug-induced atrioventricular block

- AV block (diagnosed during therapy with antiarrhythmic medication) that resolved when the drug discontinued and never recurred during a follow-up period (≤ 3 wks)
- Beta-blockers, nondihydropyridine calcium channel antagonists (verapamil, diltiazem)

Drug-induced atrioventricular block : prognosis : benign ?



Infectious myocarditis – infectious agent

Bacteria	Virus	Parasites
<u>Diphtheria</u>	<u>Epstein-Barr virus</u>	Candidosis
<u>Cholera</u>	<u>Mumps</u>	Aspergillosis
Leptospirosis	Cytomegalovirus	Trichinosis
<u>Mycoplasma pneumoniae</u>	<u>Rubella</u>	Hydatidosis
<i>Rickettsia</i>	Poliomyelitis	<u>Toxoplasmosis</u>
<i>Streptococcus</i>	Parainfluenza	Paludism
Meningococcus	<u>Influenza</u>	Leishmaniosis
Listeriosis	<u>Varicella</u>	Bilharziosis
<i>Staphylococcus</i>	Herpes	<i>Trypanosoma gambiense</i>
Tuberculosis	measles	Cysticercosis
Syphilis	Arbovirosis	Opisthorchiasis
<i>Shigella</i>	<u>Hepatitis</u>	Paragonimiasis
<i>Salmonella</i>	HIV	
	<u>Coxsackie B</u>	
	Adenovirus	
	<u>Respiratory syncytial virus</u>	
	Hantaan virus	
	Enterovirus	

The underlined data are agents for which the implantation of a permanent pacemaker has been reported. (complete references available on request).

Infectious myocarditis

- Acquired AV block in children (even without myocardial systolic dysfunction) → r/o myocarditis
- Biopsy
 - Acute phase : injury of the conduction system, with mitochondrial inclusions, lymphocytes, mononuclear cells infiltrates, areas of inflammation and necrosis
 - Delayed phase : scar fibrosis

Batra et al. *Pediatr Cardiol* 2003;24:495-497

Infectious myocarditis

- Electrophysiologic investigations
 - Supra-hisian, intra-hisian, or infra-hisian block
 - Distal lesion : intraventricular block
- Treatment
 - Transient pacing (2/3; recovered at 1 week)
 - Permanent pacemaker
 - 20–30% of the cases

Batra et al. *Pediatr Cardiol* 2003;24:495–497



Infectious myocarditis

- Clinical course of CHB a/w acute myocarditis (40 patients)
 - Recovery : 67%
 - Average time for recovery : 3.3 ± 2.8 days
 - 1 week of presentation in nearly all cases
 - Temporary pacing : 95% of cases
 - Permanent pacemakers in 27% (after 1 week)
 - Immunosuppression?

Batra et al. *Pediatr Cardiol* 2003;24:495–497

Rheumatic fever

- Asymptomatic rhythm and conduction abnormalities in children with acute RF
 - 64 children, 24 hr electrocardiography
 - First-degree AVB : 21.9%
 - Not related to the presence of carditis
 - Mobitz type I AVB : 1(1.56%)
 - Rheumatic affection of atrioventricular conduction is proximal to the trifascicular system ?

Karacan et al. Cardiology in the Young 2010;20:620–630



Kawasaki disease

- T wave change, prolonged PR, QT interval, complete heart block
- Most prevalent in the first month of disease
- Do not predict the type of echocardiographic abnormalities

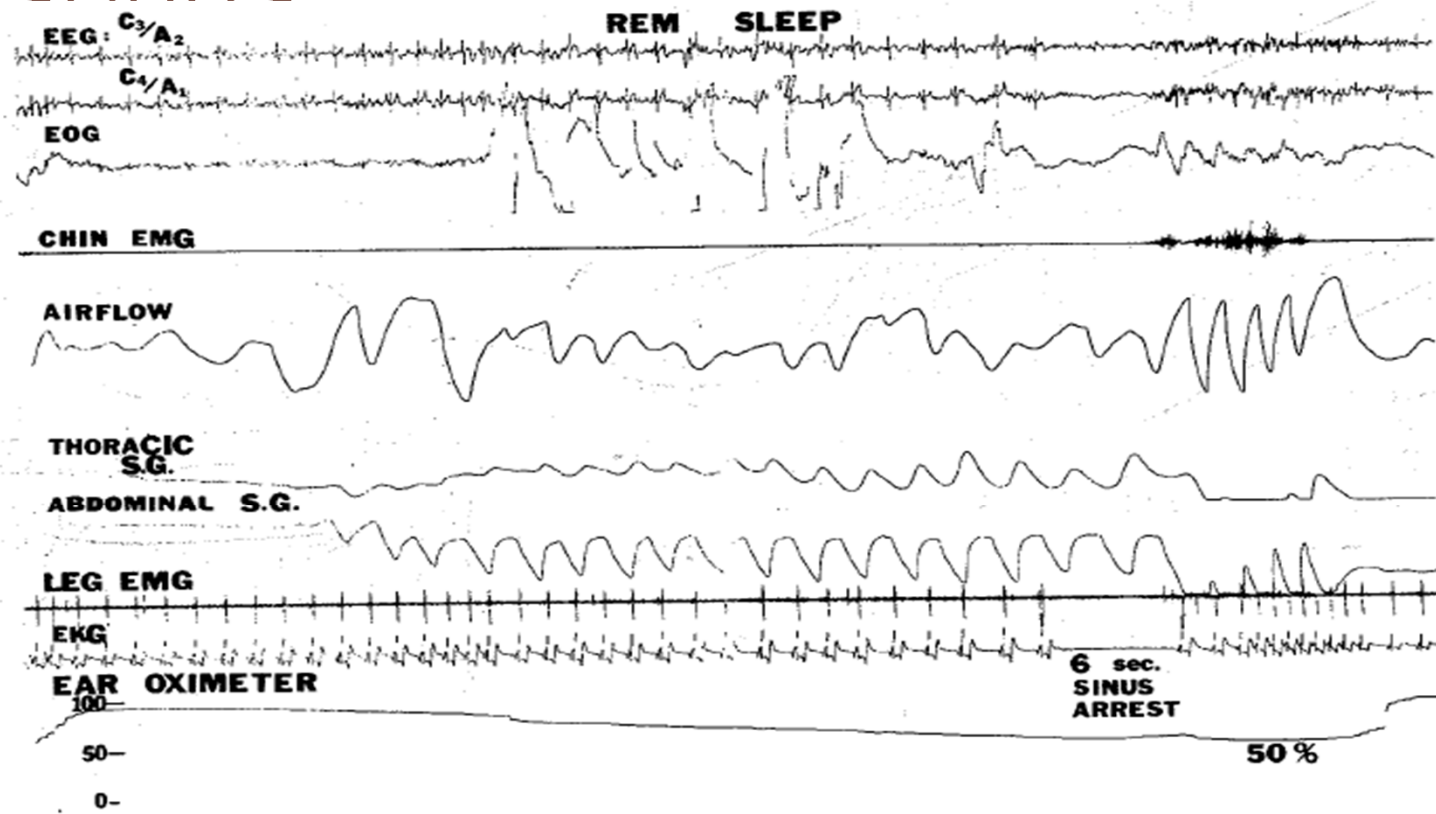
Duchenne's muscular dystrophy

- High incidence of ECG abnormalities in young pts with Duchenne's MD
 - 69 pts, aged \leq 18 yrs
 - Deep Q waves, low RV5 + SV1 (91.3% of pts)
 - Initial and primary sites of myocardial dystrophy : posterobasal and contiguous left ventricular wall as
 - Dystrophin gene deficiency

Takami et al. *Pediatr Neurol* 2008;39:399–403

Arrhythmia & obstructive sleep

apnoea



HOLTER EKG



Arrhythmia & obstructive sleep apnea

- a/w the number of apneic episodes and the severity of hypoxemia
- Nocturnal arrhythmia : 50% of pts
- Nonsustained VT, sinus arrest, second-degree AVB, PVC
- Prolonged apnea and hypoxemia → diving reflex → cardiac vagal activation → bradycardia, AVB and

Arrhythmia & obstructive sleep apnea

TABLE II Cardiac Arrhythmia or Conduction Abnormality in 50 Patients With Sleep Apnea Syndrome Before and After Tracheostomy

Cardiac Arrhythmia or Conduction Abnormality	Before Tracheostomy		After Tracheostomy	
	Awake	Asleep	Awake	Asleep
Sinus arrest 4 to 13 s	0	15	0	0
Second-degree atrioventricular block				
Mobitz type I	0	5	0	0
Mobitz type II	0	10	0	0
Ventricular tachycardia	0	8	0	0
Atrial flutter	0	2	0	0
Atrial fibrillation	0	8	0	0
Extreme sinus bradycardia	0	2	0	0
Frequent premature ventricular contractions				

Obesity

- Cardiac conduction system involvement in sudden death of obese young people
 - 7 patients, 5 obese and 2 mild to moderately obese
 - 6~32 years of age
 - 3 patients : OSA
 - Pathology

Obesity

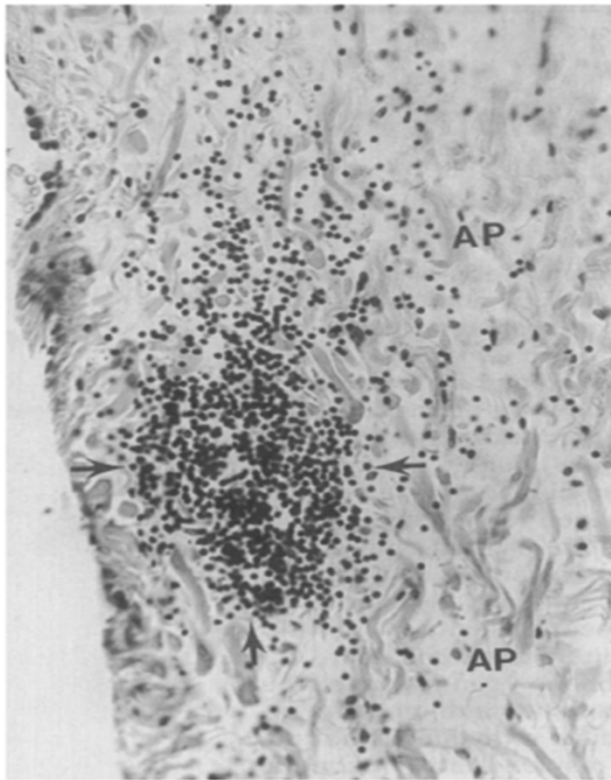


Fig. 1. Patient 1. Focal accumulation of mononuclear cells in approaches to SA node. *AP*, Approaches to the SA node. *Arrows* point to accumulation of mononuclear cells. (Hematoxylin-eosin stain—; original magnification $\times 200$.)

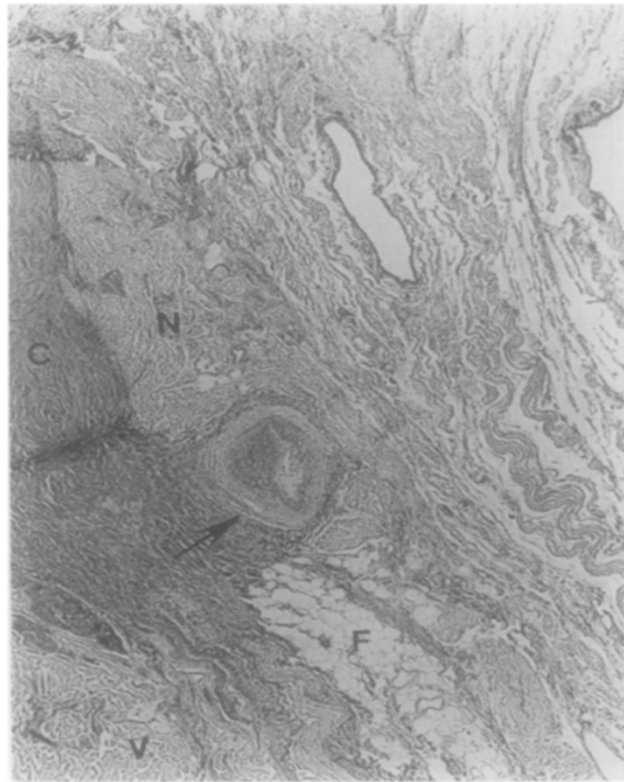


Fig. 6. Patient 3. Arteriolosclerosis of AV node with fatty infiltration in adjacent ventricular septum. *N*, AV node; *C*, central fibrous body; *F*, fat in central fibrous body and ventricular septum; *V*, ventricular septum. *Arrow* points to

Obesity

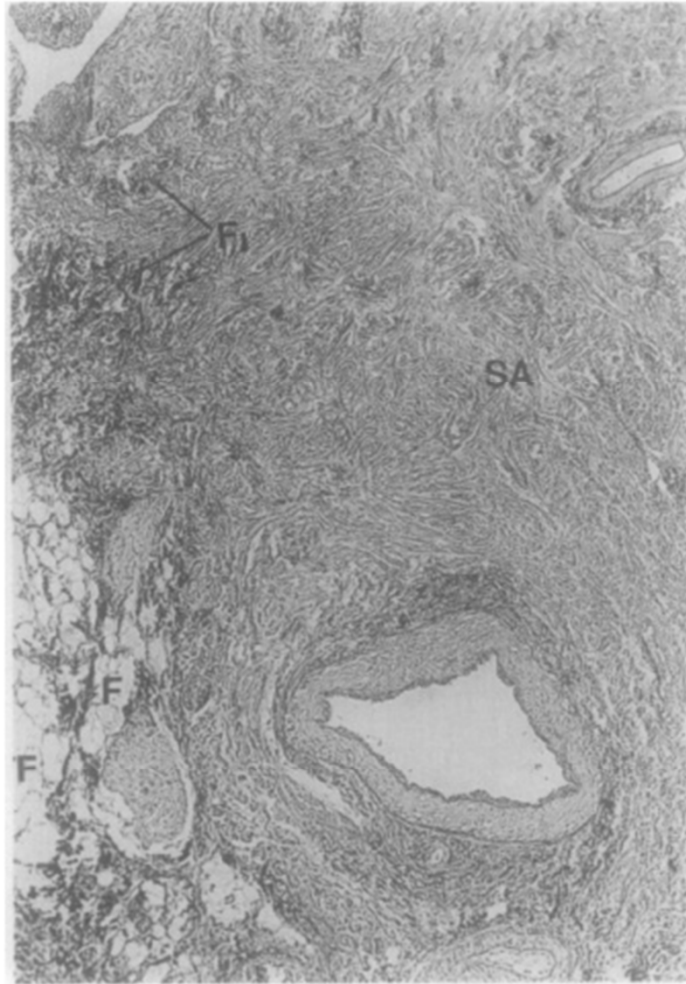


Fig. 5. Patient 3. Remnant of SA node with fibrosis and fatty infiltration. SA, Sinoatrial node; F, fat; FI, fibrosis. (Hematoxylin-eosin stain; original magnification $\times 40$.)

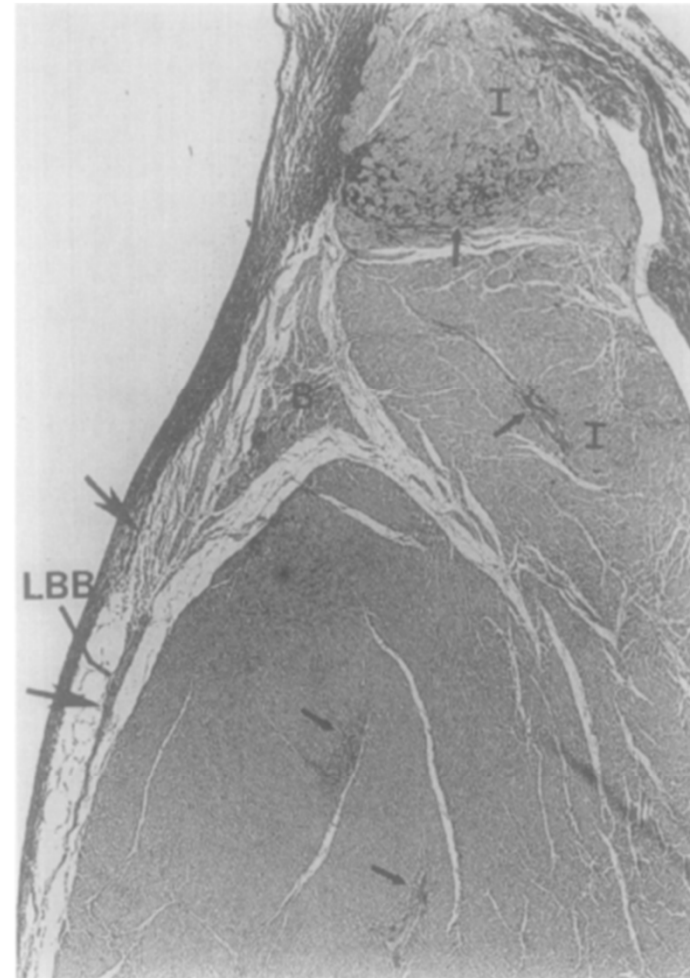


Fig. 2. Patient 1. Right ventricular infundibular muscle pressing on branching bundle, with focal fibrosis of branching septum. I, Infundibular septal bulge pressing on the branching bundle; B, branching bundle; LBB, mid part of left bundle branch. Arrows point to fibrosis. Weigert-van Gieson stain; original magnification $\times 24$.)



Obesity

- Pathologic findings of conduction system were more marked in patients with obesity of long-standing duration and a history of obstructive sleep apnea
- May produce arrhythmias that may be silent in nature but may form a milieu for an arrhythmic event that end fatality during an altered physiologic state

Bharati et al. Am Heart J 1995;129:273-81

Anorexia nervosa


- Bradycardia, hypotension, prolonged QTc
- Kanbur, et al. 2009
 - 12 yr old girl
 - Second-degree AV block (Mobitz type I)
 - Intrinsic or complication of AN ?

Kanbur et al. Int J Eat Disord 2009;42:575–578



QTc

- Predisposing factors to QT prolongation
 - Age, female gender, LVH, heart failure, myocardial ischemia, hypertension, DM, increased thyroid hormone concentration, elevated serum cholesterol, high BMI, slow HR, electrolyte abnormalities (hypokalemia, hypomagnesemia), drugs



Long QT syndrome – medications

- Class IA and III antiarrhythmics
- Antibiotics (macrolides and quinolones)
- Antidepressants (tricyclics and selective serotonin reuptake inhibitors)
- Antipsychotics (haloperidol and phenothiazines)
- Antiemetics (ondansetron and prochlorperazine)

LQTS – medication

- Mechanism

- Inhibition of the KCNH2–encoded HERG potassium channel → prolongation of the action potential duration and a prolonged QT interval
- 10% : quiescent LQTS–susceptibility mutations
- Risk factors : advanced age, female gender, hypokalemia, bradycardia, hypomagnesemia

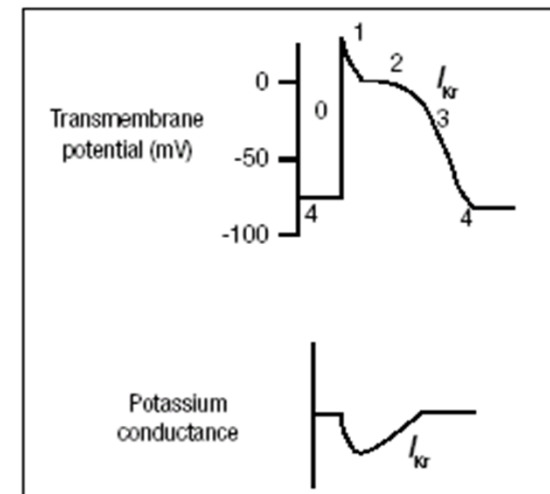


Figure 5. Cardiac action potential. Phase 3 depolarization is mediated by I_{kr} , the delayed rectifier potassium current. Almost all of the drugs that cause LQTS block this current.

Ayad et al. Proc (Bayl Univ Med Cent) 2010;23(3):250–255