

毛地黃
乙型阻斷劑
鈣離子阻斷劑

中毒之治療



台灣山區常見的美麗花朵



Foxglove 毛地黃 指頂花



名稱的由來

- 因為有著佈滿茸毛的莖葉及酷似地黃的葉片；又因為它來自遙遠的歐洲，所以又稱為「洋地黃」。
- 傳說有一個壞妖精將毛地黃的花朵送給狐狸，讓狐狸套在腳上，來避免覓食時發出腳步聲，因此毛地黃又有另一個名字叫「狐狸手套(Foxglove)」

簡介

- 毛地黃葉片含強心配醣體，是極佳的強心利尿劑。
 - Increase systolic contractility (positive inotropic property)
 - Decrease AV nodal conduction (negative chronotropic property)
- 有效劑量與中毒劑量非常接近，極易中毒
 - 噁心、嘔吐、心室顫動等症狀，嚴重時死亡。

含強心配醣體的植物

• 毛地黃	• 海檬果
• 洋地黃	• 玉竹
• 夾竹桃	• 馬利筋
• 鈴蘭	• 萬年青
• 紅海蔥	• 側金盞花



路邊野花不要採 北市街頭有毒植物64種

2010-07-26 中國時報【中廣新聞／林麗玉】

台北市議員簡余晏、陳建銘等人今天表示，台北市許多路樹、路花其實都有毒，例如南京東路、龍江路口，放置在公車道上的麒麟花其實有刺、也有毒，民眾千萬不能隨意碰觸，另外一款海檬果也含有劇毒，而台北市街頭種植的有毒植物種類竟多達64種，台北市公園處表示，會儘可能將有毒植物移至苗圃，避免民眾誤碰或誤食。

走在台北市路上，真的要小心不要隨意採路花、水果，台北市議員陳建銘、簡余晏、李慶鋒等人質疑，台北市街頭，一共有64種路樹、路花其實有劇毒。

市議員到南京東路、龍江路口會勘，發現這一帶公車專用道上的放置有麒麟花，這種麒麟花有刺，乳汁還有毒，如果有民眾誤食，可能會引發口喉、還有胃部不適，嚴重的話還會嘔吐、腹瀉。

(續)

甚至在台北火車站北一門側，有20-30株5、6公尺高的海檬果，市議員陳建銘說，這個海檬果植物的果實及植物汁液都有劇毒，如果民眾尤其小孩誤食，嚴重者還可能致死。

台北市公園處園藝工程隊隊長高民典回應，種植在南京東路、龍江路口的麒麟花，是捷運局擺飾的，後續會要求移到別處；至於公園處種植在台北市街頭的有毒植物，大約有4千株，會後續移到苗圃。

至於台北車站北一門附近的劇毒海檬果植物，台鐵已經設置有毒標誌，北市公園處也會後續協助台鐵移除，至於未來新種植的植物，不會再挑選有毒植物。

海檬果



含強心配醣體的動物

- 黑眶蟾蜍(*Bufo melanostictus* Schneider)
- 中華大蟾蜍(*Bufo gargarizans* Cantor)
 - 含有類強心配醣體的毒性(Bufagins)

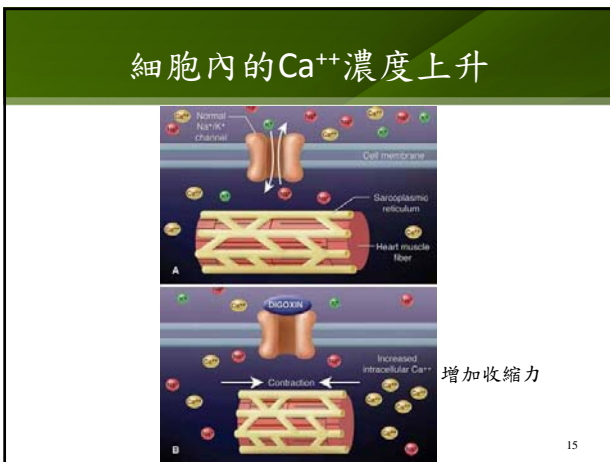
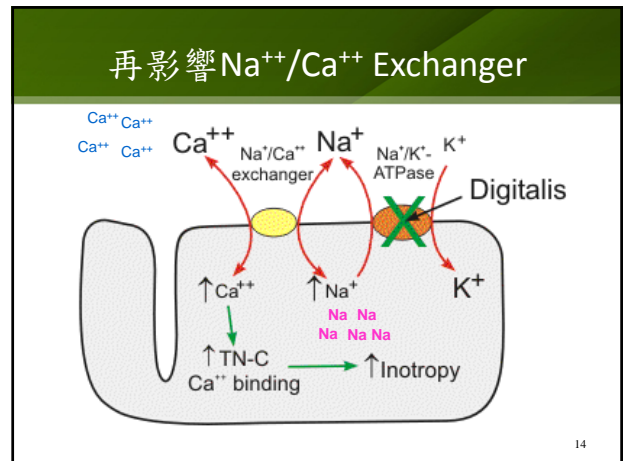
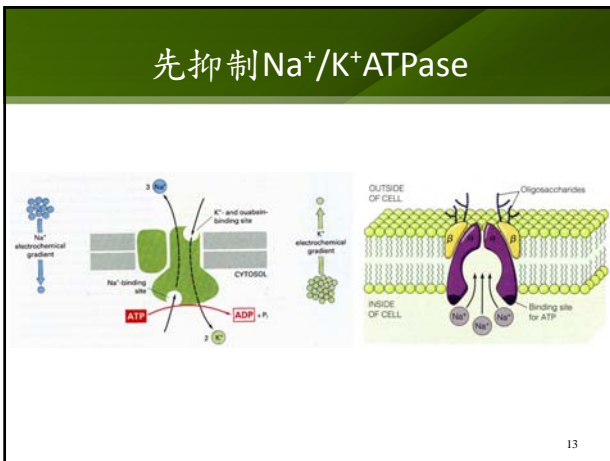


用途

- Pharmaceutical preparation
 - Deslanoside, Digoxin, Digitoxin, Powdered Digitalis
 - Typical doses (adult)
Digoxin: 0.5 mg po or 0.25 mg iv q6h to 1 mg total dose;
and then 0.125 to 0.25 mg daily for maintenance
- Unregulated topical aphrodisiacs
 - 印度神油

Pathophysiology

- Inhibits cardiac Na^+/K^+ ATPase pump
 - ↑ intracellular sodium
 - ↓ calcium excretion
 - ↑ intracellular calcium concentration
 - ↑ Contractility (Positive Inotrope)
- Increases vagal tone
Decreases baroreceptor sensitivity
 - ↓ myocardial and AVN conduction
 - ↓ heart rate (Negative Chronotrope)



為什麼會中毒呢?

- 多半是其他疾病，或者藥物交互作用造成
- 代謝變差：腎功能變差、或者老化
- 自殺（六歲以上）
- 兒童誤食。（小於一歲要考慮兒慮!）




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- ### Disease Interactions
- Renal failure decreases digitalis elimination.
 - Hepatic failure decreases digitoxin elimination.
 - Hypokalemia
 - Hypercalcemia
 - Hypomagnesemia
 - Hypoxia
 - COPD
 - Dehydration
 - Increased sympathetic nervous system activity
 - Hypothyroidism may exacerbate digitalis toxicity
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Drug Interactions

Increased Concentration of Arrhythmogenic Drug

Drug	Interacting Drug	Effect
Digoxin	Some antibiotics	Eliminating gut flora that metabolize digoxin
Digoxin	Amiodarone Quinidine Verapamil Cyclosporine Itraconazole Erythromycin	Increased digoxin bioavailability, reduced biliary and renal excretion due to P-glycoprotein inhibition Digoxin toxicity
Quinidine Cisapride Terfenadine, astemizole	Ketoconazole Itraconazole Erythromycin* Clarithromycin Some calcium channel blockers* Some HIV protease inhibitors (especially ritonavir)	Increased drug levels

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Drug Interactions

Decreased Concentration of Arrhythmogenic Drug

Drug	Interacting Drug	Effect
Digoxin	Antacids	Decreased digoxin effect due to decreased absorption
	Rifampin	Increased P-glycoprotein activity
Quinidine, mexiletine	Rifampin, barbiturates	Induced drug metabolism

結論是：交互作用極多，開藥之前要注意！
早年文獻上記載住院中病人使用毛地黃，有中毒現象的病人大約是9.5~30%

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中毒有什麼症狀？

- **Early signs are non-specific:** malaise and nausea
- As toxicity increases, interference with cardiac function predominates.
- Acute versus Chronic intoxication

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早期症狀並不明顯

<ul style="list-style-type: none"> ■ Vital signs <ul style="list-style-type: none"> ■ Bradycardia ■ Tachycardia ■ Hypotension ■ GI <ul style="list-style-type: none"> ■ Nausea ■ vomiting 	<ul style="list-style-type: none"> ■ Neurological <ul style="list-style-type: none"> ■ Headache ■ Weakness ■ Blurred vision ■ Colored visual halo ■ Drowsiness ■ Hallucinations ■ Confusion/delirium
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特別注意電解質

- Fluids and electrolytes
 - Hyperkalemia (acute overdose)
 - Hypokalemia (chronic toxic or diuretics use)

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電解質異常

- **Hyperkalemia** (in acute overdose): **predictor of outcome!!!**
- **Hypokalemia:** predispose to cardiac toxicity
- **Hypercalcemia** and **hypomagnesemia:** predispose to dysrhythmia
- Renal insufficiency: impair digoxin clearance
- Hepatic dysfunction increases digoxin levels

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造成心臟的症狀往往極嚴重

- Cardiovascular
 - Bradycardia
 - Atrioventricular block
 - Paroxysmal atrial tachycardia with block
 - Intraventricular conduction delay
 - Ventricular dysrhythmias
 - Congestive heart failure

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鑑別診斷

- Toxic causes of nausea, hypotension, and bradycardia:
 - 誤食cardiotoxic plants, β -receptor or calcium blockers, and type 1 anti-dysrhythmic agents.
- Nontoxic causes:
 - AGE, small bowel obstruction, myocardial ischemia, hyperkalemia or other electrolyte abnormalities

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怎麼確認病人中毒？抽血嗎？

- Serum digoxin levels
 - Digoxin therapeutic range 0.5 to 2 ng/mL
 - Digitoxin therapeutic range 18 to 22 ng/mL
 - Hypokalemia can precipitate toxicity at therapeutic range of digoxin or digitoxin

血中濃度正常並不表示病人沒有中毒！
中毒的時候血中濃度有可能正常！

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會影響濃度的因素

- 最佳抽血時刻：上次服用藥物後六小時
 - Redistributions: 6小時以上才是血清最低點
- 使用digoxin immune Fab antibodies治療
- Digoxin-like immunoreactive substance (DLIS)

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心電圖是最重要的檢查

- ECG
 - Nearly every possible dysrhythmia
 - Exception: sinus tachycardia; atrial flutter; PSVT
 - Prolonged PR ; shortened QTc ; sagging ST depression (scooped out)
 - Characteristic
 - Sinus bradycardia
 - Atrial or junctional tachycardia with High grade AVB
 - AV block (AF with fixed RR intervals or complete AVB)
 - Bidirectional VT
 - PAT with 2:1 block

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毛地黃中毒典型的心電圖變化

- Odd shaped ST-depression.
- T-wave flat, negative or biphasic
- Short QT interval
- Increased U-wave amplitude
- Prolonged PR-interval
- Brady-arrhythmias:
 - Sinus bradycardia
 - AV block. Including complete AV block and Wenckebach.
- Tachy-arrhythmias:
 - Junctional tachycardia
 - Atrial tachycardia
 - Ventricular ectopia, bigeminy, monomorphic ventricular tachycardia, bidirectional ventricular tachycardia



When to suspect Digoxin toxicity ?

- 心電圖懷疑
- 無法解釋的bradycardia
- Nonspecific GI or neurologic complaints
 - 特別是有心臟病病史的病人身上
- 不明原因的高血鉀
- 有造成慢性中毒的危險因子
 - 電解質異常
 - 肝腎功能異常
 - 藥物交互作用

治療

- ABC
- 除污
 - Emesis: not recommended
 - Gastric lavage: not recommended
 - or pre-treat with atropine
 - Activated charcoal(10:1)
- Antidote: Fab (Digoxin specific polyclonal antibody fragments)

治療的重點

- 支持性療法
- 治療致命的心律不整
- 決定是否投予Digoxin immune Fab

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治療心律不整

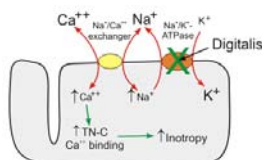
- Atropine + TCP for bradycardia
- Phenytoin: 可加速AV node傳導，digoxin 造成的 ventricular dysrhythmia 的首選!
- Lidocaine for ventricular dysrhythmia
- Replacement of K & Mg
- Electrocardioversion: 易造成 refractory Vf
 - 10~25J(start at low energy!!)
- **Contraindication: agents decrease AV conduction (class Ia ,Ic,II,IV antidysrhythmics)**

Replacement of potassium

- Hypokalemia will worsen digoxin toxicity and may require replacement
- Replace potassium if $K < 4$ and there are ventricular dysrhythmia
- If there is AV block do not replace potassium unless $K < 3$

陷阱

- 急性毛地黃中毒容易造成高血鉀
- 治療高血鉀的方式：
 - Burinex
 - Glucose / Insulin
 - Bicarbonate
 - Potassium-binding resin
 - Calcium chloride / Calcium gluconate
 - 都能用嗎?



Disease Interactions

- Renal failure decreases digitalis elimination.
- Hepatic failure decreases digitoxin elimination.
- Hypokalemia
- **Hypercalcemia**
- Hypomagnesemia
- Hypoxia
- COPD
- Dehydration
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- Hypothyroidism may exacerbate digitalis toxicity

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何時使用Antidotes?

- Indications of Digoxin Immune Fab Antibodies
 - CV instability: hemodynamic instability and life-threatening arrhythmias ascribed to digitalis toxicity
 - Rapid progression of toxicity (CV or GI)
 - Serum $K^+ \geq 5.5$ mEq/L in acute overdose
 - Plasma digoxin > 10ng/mL
 - Ingestion of > 10mg in adults or > 4mg in children
 - Cardiac arrest of short duration



Digoxin-specific Fab antibody fragment

- 兩家藥廠
- Digibind: GlaxoSmithKline
- DigiFab: Savage Laboratories
- 未知食入劑量，且病患狀況嚴重時：
 - 可以先使用5~10 vials
 - 後續的劑量：
 - Number of vials = serum digoxin level(ng/mL) x BW / 100

Digibind

- 從綿羊身上對Digoxin的IgG分離出來
- 使用Fab後血中Digoxin濃度會極速上升
 - 和抗體結合的Digoxin(inactive)會上升10~20倍
 - Free digoxin (active)下降至零
 - 和抗體結合後的Digoxin由腎臟排除
 - 對於腎臟功能不佳的患者，有可能在十幾天後在次中毒。

病患動向

- Discharge Criteria and Instructions
 - 急診患者
 - 無症狀的患者：Digoxin濃度正常、ECG正常、電解質正常。經過腸胃道除污及留觀12小時之後，可以考慮出院。
 - 住院患者
 - 腸胃道除污後，對心臟的影響已消失

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β -Adrenergic Blockers intoxication



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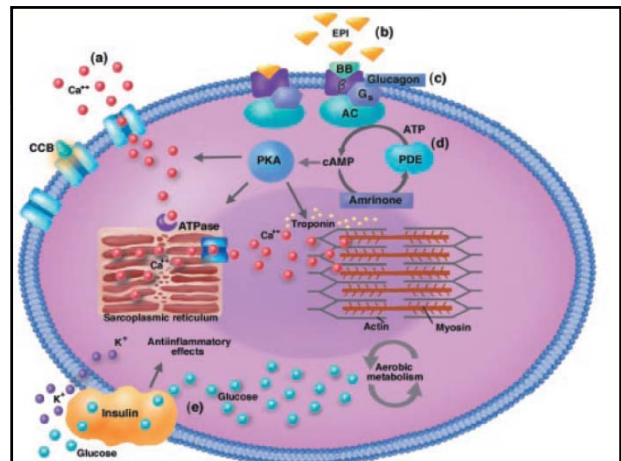
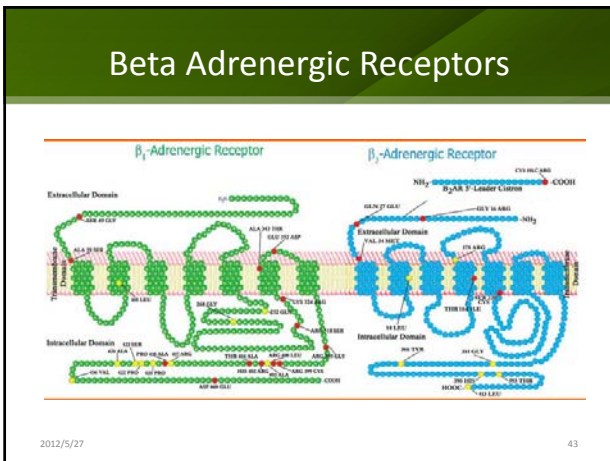
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用途

- Beta-blockers最常用來治療：
 - Hypertension
 - Angina
 - Myocardial infarction
 - Cardiac dysrhythmias
 - Cardiomyopathy
 - Migraine headache
 - Thyrotoxicosis
 - Topical use in glaucoma

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- ### β-blocker分類
- 簡單口訣：一心二肺
 - β1: 心肌、腎臟、眼
 - β2: 平滑肌、骨骼肌、肝、胰、脂肪
 - β3: 脂肪
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- ### 藥理特性
- **Cardioselective (β1) vs. Nonselective**
 - 較不易有bronchospasm, vasoconstriction, hypoglycemia
 - **Intrinsic Sympathomimetic Activity (ISA)**
 - pindolol and acebutolol
 - protective in overdoses：較不會有竇性心跳緩慢
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- ### 藥理特性
- **Membrane-Stabilizing Activity (MSA)**
 - MSA blocks sodium channels → wide QRS interval and potential dysrhythmias and impaired cardiac conduction → fatality
 - Acebutolol, propranolol, labetalol, and pindolol
 - **Lipid solubility**
 - 藥物容易過BBB
 - Higher in propranolol ; lower in atenolol and nadolol
 - CNS effects: 嗜睡, 昏迷, 抽筋
 - **QTc prolongation**
 - Sotalol: Independent class III antiarrhythmic activity

Pharmacological Properties

Agent	β-selective	Partial agonist	Membrane-Stabilizing Activity	Lipophilic
Acebutolol	Yes	Yes	Yes	Weak
Atenolol	Yes	No	No	Weak
Esmolol	Yes	No	No	Weak
Labetolol	No	No	No	Moderate
Metoprolol	Yes	No	Weak	Moderate
Nadolol	No	No	No	Weak
Oxprenolol	No	Yes	Yes	Moderate
Pindolol	No	Yes	Yes	Moderate
Propranolol	No	No	Yes	High
Sotalol	No	No	No	Weak
Timolol	No	No	No	Weak

Propranolol

- 最常造成嚴重中毒症狀的beta-blocker
 - nonselective
 - membrane-stabilizing effects: CNS depression, **seizures**, and prolongation of the QRS complex



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Epidemiology

- 中毒不常見，且多半是輕度到中度中毒。
- 致死的原因常因合併其他藥物或食入超大量
 - 合併CCB或digitalis中毒會加重bradycardia, dysrhythmias & hypotension
 - 合併Anti-hypertensives會加重低血壓
- 若沒有合併其他藥物中毒，有membrane-stabilizing activity者較易造成嚴重症狀。

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中毒原因

- 誤食
- 自殺 (六歲以上)
- 兒虐事件 (小於一歲)

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危險因子

- Reactive airway disease
- Elderly patients / underlying CV disease
- Children: Seizures and hypoglycemia
 - esp. propranolol

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Symptoms and Signs (1)

- Hypotension
- Bradycardia
 - Tachycardia, while unusual, has been reported with practolol, pindolol, and sotalol
- Life-threatening dysrhythmias (severe)
 - Bronchospasm
- Seizures
- Hypoglycemia

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Symptoms and Signs (2)

- Vital signs
 - Bradycardia
 - Hypotension
- Pulmonary
 - Bronchospasm is possible.
 - Respiratory depression
 - Severe: Pulmonary edema and ARDS

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Symptoms and Signs (3)

- Cardiovascular
 - Bradycardia
 - AV block
 - Intraventricular conduction delay
 - Ventricular dysrhythmias
 - CHF
- Neurological
 - Seizure (Propranolol)
 - CNS depression
 - Coma may complicate profound hypotension

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Symptoms and Signs (4)

- Endocrine
 - Hypoglycemia, **usually in children and diabetics** after propranolol overdose

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檢查

- Essential tests
 - ECG
 - Continuous monitoring
 - Serum electrolytes (including Ca), glucose, BUN, creatinine to detect other causes of dysrhythmias or causes of drug accumulation

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Treatment - Decontamination

- In-hospital
 - Gastric lavage: <1 hour 或有嚴重症狀時
 - One dose of activated charcoal (1-2 g/Kg)
 - Whole bowel irrigation

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Treatment

- Treatment focuses on
 - Supportive care
 - Appropriate airway management
- Drugs

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Treatment algorithm (1)

ABCDE, 兩條大條IV, monitor, glucose check, activated charcoal

Fluid bolus (NS)

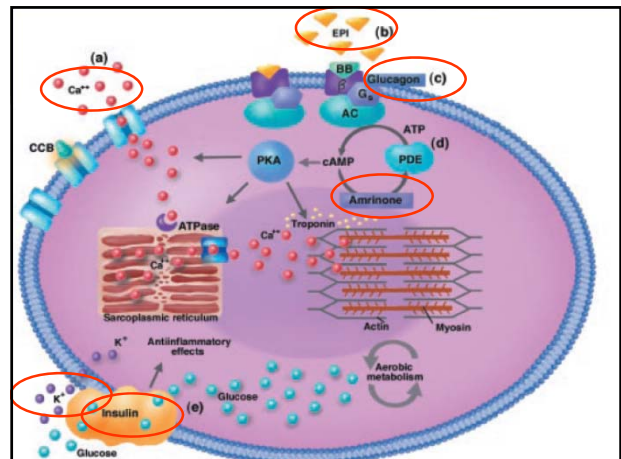
- 10 ~ 20 mL/Kg 0.9% saline

Atropine trial for symptomatic bradycardia

- 0.5mg IV, up to 3mg

Treatment algorithm (2)

- Glucagon
- Epinephrine
- Isoproterenol
- Other inotropic: Dopamine, Norepinephrine
- Amrinone
- Cardiac pacing
- IABP



Treatment - Glucagon (1mg/vial)

- **Antidotes – 1st line treatment**
 - Indication: β -blocker induced bradycardia and hypotension
 - Bolus therapy
 - IV bolus of **0.05~0.15mg/Kg** (3-10 mg in an adult)
 - 2nd bolus in 10~15 mins
 - Effect: within 1~3 mins, peak: 5~7 mins
 - Maintenance infusions:
 - **1 to 20 mg/h**, titrated to effect
 - pediatric dose 0.07mg/kg/hour

Glucagon 副作用

- 禁忌症
 - 對glucagon過敏
- 潛在副作用
 - 噁心想吐(因為esophageal sphincter relaxation)
 - 高血糖
 - 溶劑造成的症狀(due to phenol diluent)
 - 如果需要用高劑量，改用saline泡
 - Phenol: thrombophlebitis, seizures, hypotension, or dysrhythmias

Adjunctive Treatment

- Calcium chloride
- High-dose insulin-dextrose therapy
- Amrinone
- Sodium bicarbonate
- Magnesium Sulfate

Adjunctive Treatment

- Overdoses un-responsive to drug therapy
 - Cardiac pacing for refractory bradycardia
 - IABP for refractory shock
 - Hemodialysis Increases elimination of
 - Acebutolol
 - Atenolol
 - Nadolol
 - Sotalol

Discharge Criteria and Instructions

- From the ER
 - Asymptomatic patients (other than mild bradycardia) taking immediate-release formula may be discharged following GI decontamination. **6 hours of observation**, and psychiatric consultation, if needed
 - **Sotalol a long halflife, observe for 24hrs**
- From the hospital
 - Following GI decontamination, resolution of cardiac effects, and psychiatric consultation, if needed

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Pitfalls

- **Diagnosis**
 - Ophthalmic drops can cause severe toxicity, esp. in the elderly.
 - Sustained-release products may not be symptomatic for several hours after overdose.

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Pitfalls

- **Treatment**
 - Multiple modes of treatment (pressors, glucagon, isoprotrenolol, etc.) are often needed simultaneously in patients with severe effects.

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Calcium Channel Blockers Intoxication



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Classes of Calcium Channel Blockers (CCB)

- **Dihydropyridine (DHP)**
 - Amlodipine (Norvasc)
 - Felodipine (Plendil)
 - Nicardipine (Cardene, Carden SR)
 - Nifedipine (Procardia, Adalat)
 - Nimodipine (Nimotop)
 - Nisoldipine (Sular)
 - Nitrendipine (Cardif, Nitrepin)
 - Lacidipine (Motens)
 - Lercanidipine (Zanidip)
- **Phenylalkylamine**
 - Verapamil (Calan, Isoptin)
 - Gallopamil (D600)
- **Benzothiazepine**
 - Diltiazem (Cardizem)

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Introduction

- CCB are medications used to treat
 - Hypertension
 - Some cardiac dysrhythmias (such as termination of SVT and rate control of AF)

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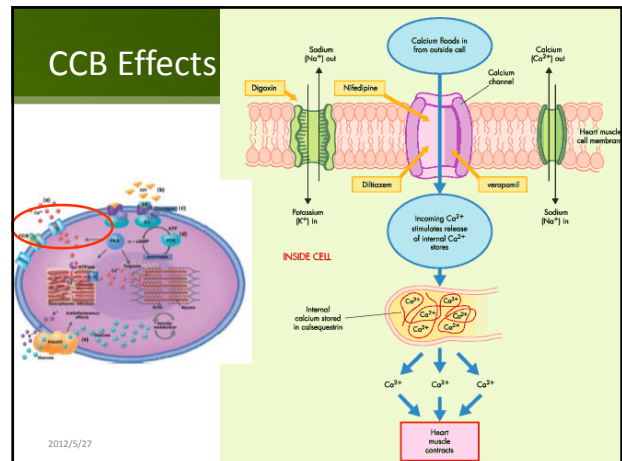
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Toxic Dose

Agents	Lowest dose	Mean Toxic Dose
Verapamil	720mg	16mg/kg
Diltiazem	420mg	5.7mg/kg
Nifedipine	50mg	8mg/kg

Ingestion of 1g or more of verapamil, nifedipine, or diltiazem can produce serious toxicity and possible death in an adult.

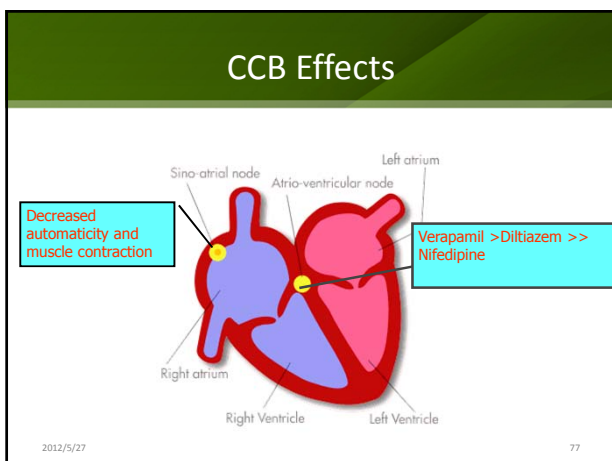
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- ### Pathophysiology
- Inhibits voltage-dependent calcium channel (cardiomyocytes)**
 - ↓ Entry of extracellular calcium
 - ↓ Contractility
 - Inhibits voltage-dependent calcium channel (AV node)**
 - ↓ Entry of extracellular calcium
 - ↓ Conduction (Negative inotropic)
 - Inhibits voltage-dependent calcium channel (arterial smooth muscle cells)**
 - ↓ Entry of extracellular calcium
 - ↑ Arterial relaxation (Vasodilation)
 - Little effects on venous beds
- Hypotension
Reflex Tachycardia
- Hypotension
Bradycardia
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簡單比較

	BP	HR	AVN conduction	Heart contractility
Verapamil	↓	↓	↓↓↓	↓↓
Diltiazem	↓	↓	↓↓	↓
Nifedipine	↓↓	± or ↓	±	±



- ### Epidemiology
- 中毒仍不常見，就算中毒也是輕症為主
 - 造成死亡的案例，病人多半合併其他藥物中毒或者食入巨量藥物
 - 近年來因為大量使用，中毒數量漸增，幾乎佔了心血管藥物中毒的一半
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Drug and Disease Interactions

- 肝
 - Hepatic disease decreases CCB elimination.
- **Coingestion** of β -blockers, digitalis, or class I anti-arrhythmics may worsen bradycardia, dysrhythmias, and hypotension.
- Coingestion of other anti-hypertensives may worsen hypotension.

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中毒機轉

- **Symptoms and Signs**
 - CCB suppresses cardiac function to varying degrees in overdose.
 - Verapamil and diltiazem are more effective than nifedipine at suppressing SA and AV node firing.
 - Overdose with any of these agents may result in **hypotension** and **bradycardia**.

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Diagnosis

- **Symptoms and Signs**
 - Vital signs
 - **Bradycardia**
 - **Hypotension**
 - Cardiovascular
 - Severe bradycardia
 - Atrioventricular block
 - Intraventricular conduction delay
 - Ventricular dysrhythmia
 - Congestive heart failure

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Diagnosis

- **Symptoms and Signs**
 - Pulmonary
 - Respiratory depression may develop in patients with hemodynamic instability.
 - Pulmonary edema and ARDS may develop after severe overdose.

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Diagnosis

- **Symptoms and Signs -- Uncommon**
 - Gastrointestinal
 - Nausea
 - Vomiting
 - Ileus
 - Neurological
 - CNS depression
 - Syncope
 - Seizure
 - Come may complicate profound hypotension

意識相對清楚

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中毒的診斷

- 臨床診斷
 - 詢問病史、病人用藥情形
- 12 lead ECG
- ECG monitor

鑑別診斷

- Hypothermia
- Acute coronary syndrome
- Hyperkalemia
- Cardiac glycoside toxicity
- β -Blocker toxicity
- Types Ia, Ic antidysrhythmic toxicity
- Central α 2-adrenergic agonist (e.g., clonidine) toxicity

治療

- Supportive treatment!!
- Critical: Calcium chloride
- Seizure: Valium
- Unstable BP + Bradycardia:
 - Calcium chloride + Atropine + Isoproterenol
- Pacing
- 透析無效

Treatment

- Treatment focuses on
 - Continuous monitoring, EKG q1~2h
 - Treatment of dysrhythmias and hypotension
- **Dose** (*type, amount, preparation*) and **time** of exposure should be determined for all substances involved.

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Treatment

- **Directing Patient Course**
 - Admission consideration
 - Asymptomatic
 - Observation or Monitor bed
 - 6hr for immediate-release CCB
 - 24~36hr for sustained release or long-acting preparations
 - Intensive care setting is indicated in
 - Symptomatic patients
 - Sustained release preparation

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Treatment - Decontamination

- **In-hospital**
 - Gastric lavage: <1 hour 或有嚴重症狀時
 - Vagal stimulation with NG placement, pretreat with atropine
 - One dose of activated charcoal (1-2 g/Kg)
 - Whole bowel irrigation

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嚴重中毒時

Calcium gluconate or calcium chloride 10 mL of 10% (0.15 mL/kg) over 5 min^{a,b}

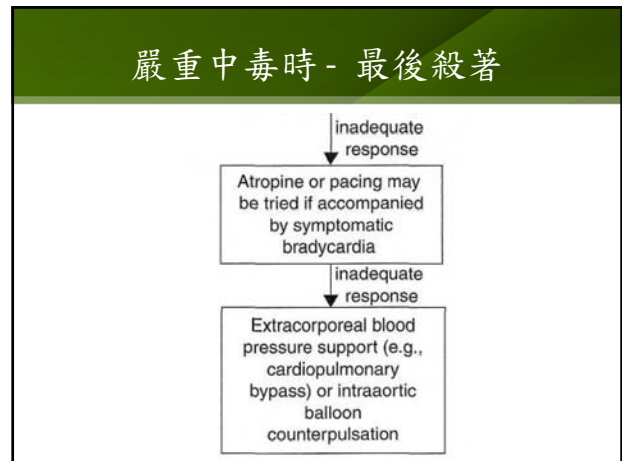
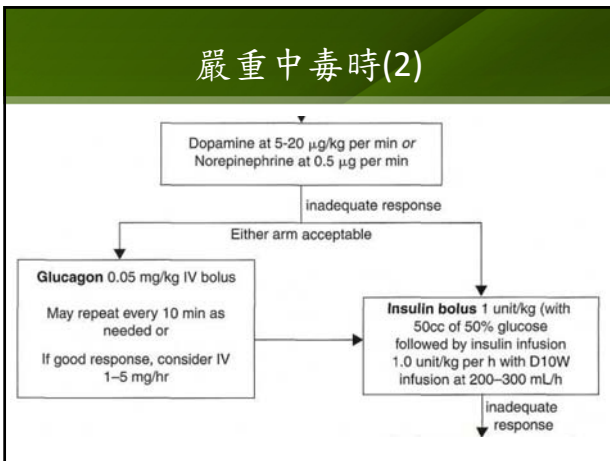
May repeat every 10 min as needed; measure ionized calcium after three boluses (30 mL) of CaCl₂; do not exceed 3.0 mM

inadequate response

Dopamine at 5-20 μ g/kg per min or Norepinephrine at 0.5 μ g per min

inadequate response

Either arm acceptable



Hyperinsulin/euglycemia (HIET)

- **Adjunctive Treatment**
 - Refractory hypotension or bradycardia after atropine, calcium and vasopressors: **Insulin**
 - Check blood glucose and K
 - Bolus therapy:
 - Regular insulin 1U/kg IV
 - Dextrose 25-50 grams IV; repeat for hypoglycemia
 - Maintenance infusions:
 - Insulin 0.5~1 U/kg/hr IV + D10W 250cc for 1hr, then
 - Insulin 0.1~1u/kg/hr + D10W 250 cc/hr; achieve euglycemia
 - Insulin infusion may be tapered off once signs of cardiotoxicity begin to resolve.

Treatment - Glucagon

- **Adjunctive Treatment**
 - Refractory hypotension or bradycardia after atropine, calcium and vasopressors: **glucagon**
 - 3-10 mg for an adult (0.05mg/Kg bolus q10m up to 0.15mg/kg), followed by an infusion of 0.075~0.15mg/kg/h, titrated to effect
 - If large doses are given, saline should be used to reconstitute the drug.
 - Hospital pharmacies often stock insufficient amounts of glucagon.

Follow-Up

- **Discharge Criteria and Instructions**
 - From the ER
 - Asymptomatic patients may be discharged following GI decontamination. **6 hours of observation**, and psychiatric consultation, if needed
 - **24-hour observation for sustained release preparation**
 - From the hospital
 - Following GI decontamination, resolution of cardiac effects, and psychiatric consultation, if needed

Pitfalls

- **Diagnosis**
 - Sustained-release products may not be symptomatic for several hours after overdose.

Pitfalls

■ Treatment

- Multiple modes of treatment are often needed simultaneously in patients with severe effects.
- Elderly patients may be intolerant of even mild hypotension.

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Summary

- Diltiazem and verapamil are the most cardiotoxic of the CCBs
- Aggressive GI decontamination
- Administration of **IV calcium, glucagon, catecholamines, insulin/glucose** may be necessary
- IABP, ECMO are options for severely poisoned.

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問題?

