

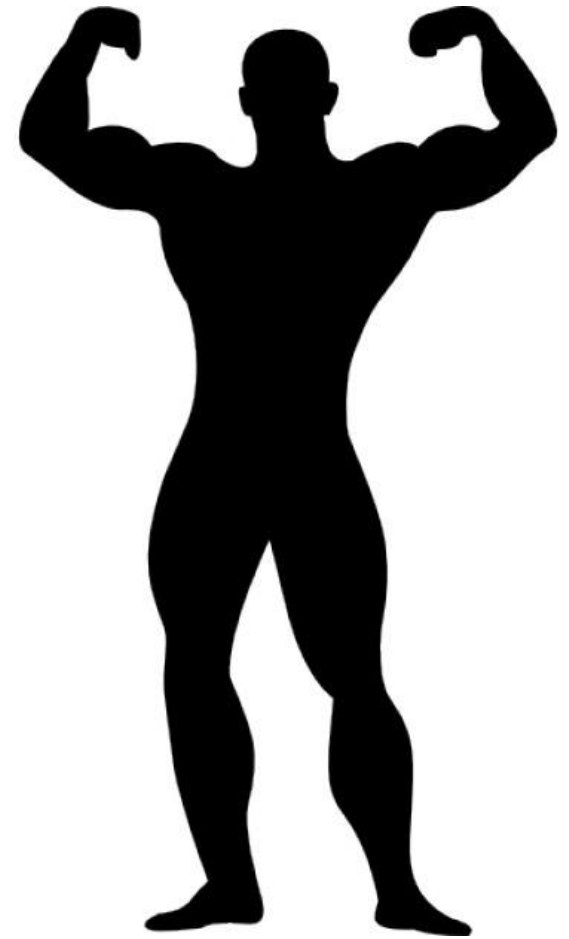
# Drugs for muscle: trifle or threat?

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# Patient 1

- M / 34
- Competitive body builder
- Presented with acute pulmonary edema in early morning
- Noted lowish H<sup>+</sup>stix 3.6 mmol/L
- Intubated and admitted to ICU



<http://clipartall.com>

# Patient 1

- Has been on multiple medications for bodybuilding
  - Testosterone enanthate, trenbolone, stanozolol, boldenone, nandrolone, methandienone
  - recombinant growth hormone
  - silymarin
  - tamoxifen
  - clenbuterol
  - diclofenac
  - silymarin
  - Humalog insulin
    - patient injected 1ml (100 units) subcutaneously the night before admission and skipped meal afterward

## Patient 2

- M / 28
- Bodybuilding coach
- Admitted for progressive lower limb weakness for 1 day
- Found to have severe hypokalemia
  - plasma potassium = 1.6 mmol/L (reference: 3.5 – 5.1)
  - ECG: presence of U wave

## Patient 2

- In preparation of body-building competition about 2 weeks before,
  - took > 12 litre of water per day, high protein diet
  - took “spironolactone” 4 tablets per day to “lower his sodium”
  - then high carbohydrate loading
  - Felt very thirsty and hungry after competition, then ate huge amounts of snacks and high carbohydrate food
- Took various supplements and claimed to feel excited
- On melatonin for insomnia

## Patient 2

- Urine sample detected
  - mycophenolate mofetil
  - diltiazem
  - naphazoline
  - rhein, emodin, aloe-emodin and physcion (*anthraquinones with laxative effect, chronic use may cause hypokalemia*)
- Hypokalemia contributed by:
  - electrolyte shift due to large carbohydrate load leading to hyperinsulinemia
  - prior intake of high dose spironolactone and then withdrawal leading to increased mineralocorticoid activity

# Other cases recorded by HATS (1)

Case	Sex/Age	Substances used	Brief Clinical Problems
2010-1	M/38	Dihydroepiandrosterone beta-sitosterol Gingko Theobromine minerals (Mg, Zn) vitamins (B, C, E) Pyridoxine riboflavin caffeine	<ul style="list-style-type: none"><li>• Presented with renal failure (plasma creatinine 2500), proteinuria, hypertension</li><li>• Required hemodialysis</li><li>• Renal biopsy: Focal segmental glomerulosclerosis (FSGS).</li><li>• Had cadaveric kidney transplantation</li></ul>
2010-2	M/46	Glutamate powder Nectar Whey protein Amino 222 Soft gel	<ul style="list-style-type: none"><li>• Presented with jaundice and deranged liver function: ALT 104, ALP 298, bili 444.</li><li>• Liver biopsy: canalicular cholestasis</li></ul>

## Other cases recorded by HATS (2)

Case	Sex/Age	Substances used	Brief Clinical Problems
2016-1	M/38	“TREN, MAST, Eq, Te, Tp, Win” ? = trenbolone, drostanolone, masteron, Equipoise (boldenone), Winstrol (Stanozolol), testosterone propionate Thyroxine, Growth hormone	<ul style="list-style-type: none"><li>• Heart failure</li><li>• Dilated cardiomyopathy</li></ul>



# Muscle growth

- Bodybuilders use three main strategies to maximize muscle hypertrophy:
  - Strength **training** through weights or elastic/hydraulic resistance
  - Specialized **nutrition**, incorporating extra protein and supplements when necessary
  - Adequate **rest**, including sleep and recuperation between workouts
- ***“Eat clean, train hard, sleep well”.***

# Use of performance-enhancing substances in bodybuilders

- Multiple substance use
  - Up to 80% amateur bodybuilders in the United State use anabolic-androgenic steroids (AAS)
  - 19.7% of them used 6-7 substances
  - A case used 26 types of supplement

- In a UK study, about 70% health club users had used AAS within the previous 1 year

Table 1  
Drugs, other than AAS, currently used by AAS-using respondents (*n*=96)

Type of drug	% Use
Ephedrine	44
Growth hormone	24
Tamoxifen	22
Clenbuterol	21
Insulin	14
Human chorionic gonadatrophin	11
Diuretics	10
Thyroid hormone	10

# Adverse effects of Anabolic Androgenic Steroids

System	Adverse effects
Cardiovascular	↑ risk of thrombosis, myocardial infarction, stroke ↑ low-density-lipoprotein (LDL) cholesterol, ↓ high-density-lipoprotein (HDL) cholesterol cardiomyopathy, heart failure, sudden cardiac death
Liver	cholestasis, peliosis (blood filled cystic lesion in liver) adenoma, hepatocellular carcinoma
Kidney	Focal segmental glomerulosclerosis, renal failure
Reproductive	testicular atrophy, infertility, erectile dysfunction, ♂ gynaecomastia amenorrhoea, infertility, breast atrophy, dysphonia, deepening ♀ of voice
Psychiatric	irritability, depression, aggressiveness, self-aggressiveness, suicidal thought
Skin	acne, alopecia, hirsutism

# Other drugs used by bodybuilders

Drug name	Drug class	Purpose	Adverse effects
Humalog	Insulin	↑ muscle mass ↓ catabolism in muscle and liver	Hypoglycaemia
Human growth hormone	Growth hormone	↑ lean body mass and ↓ fat mass	Carpal tunnel syndrome, pseudotumor cerebri, cardiovascular disease, hyperlipidemia, insulin resistance
Clenbuterol	beta-adrenergic agonist	↑ lean muscle mass	Hypertension, Increased heart rate, palpitations, insomnia, tremors, etc.
Tamoxifen	Estrogen antagonist	Prevent and treat gynaecomastia Ergogenic agent in women	Thromboembolic events, endometrial cancers, bone density loss, sexual dissatisfaction

# Other drugs used by bodybuilders

Drug name	Drug class	Purpose	Adverse effects
Gamma-hydroxybutyrate	GABA <sub>B</sub> and GHB receptor agonist	↑ growth hormone↓ fat, muscle building	Impaired consciousness in overdose
Letrozole	Oral non-steroidal aromatase inhibitor	Prevent gynaecomastia	Sweating, arthralgia, fatigue
Frusemide Spironolotone	Diuretic	Dry up the body before competition to look better and control body weight	Electrolyte disturbances
Ephedrine	Adrenergic agonist	Stimulant, enhance exercise performance	Rhabdomyolysis, sympathomimetic effects
Caffeine	Methylxanthine		

# Source of knowledge

- In a survey conducted in Poland:

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Sources of knowledge of dietary supplementation	Answers [%]
Magazines	42
Coach or dietician	35
Friends	31
The Internet	28
Professional literature	17

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# How may bodybuilders present

- Rhabdomyolysis
- Hypoglycaemia
- Heart failure
- Sudden cardiac death
- Electrolyte disturbances
- Liver derangement
- Renal failure
- Neuropsychiatric symptoms
- ....

# Acknowledgement

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**Thank you**

The End