GYM NEPHROPATHY

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- **Regular physical activity reduces the risk factors for heart diseases and may decrease mortality.**

- **In addition, recent investigations have shown a positive relationship between regular physical activity levels and more gradual development of chronic renal failure .**

- **In the few last decades, the pattern of sports has changed.**

- **Athletes and bodybuilders, both professional and amateurs, are widely used Nonnutritional and nutritional supplements.**

- **Abuse of these supplements can cause kidney injury by different mechanisms.**

- **They are mainly used by males and to increase muscle mass and strength, speed recovery of the muscles, decrease fatigue, reduce muscle damage, decrease abdominal fat, and reform the body to a lean shape.**

Exercise-induced acute kidney injury

- Gym nephropathy, also known as exercise-induced AKI, is a condition characterized by the sudden onset of kidney dysfunction following intense physical activity or exercise and supplements use .

- While the exact mechanisms underlying gym, nephropathy are not fully understood, there are several renal endocrine aspects that may contribute to its development

- Prompt diagnosis and treatment of these renal complications are critical to prevent CKD.

- **Nonnutritional supplements used are anabolic-androgenic steroids (AAS), growth hormone, insulin-like growth factor, L-thyroxin, beta-2 agonists, anti-estrogens, beta-human chorionic gonadotropin, and erythropoietin.**

- **Nutritional supplements used are creatine, vitamins, protein, amino acids, glutamine, L-arginine, preworkout energy drinks, L-carnitine, liver albumin, and omega 3.**

Potential factors of gym nephropathy

- Gym nephropathy is a multifactorial condition, and these renal endocrine aspects may interact with other factors such as

- ✓individual susceptibility
- ✓pre-existing medical conditions
- ✓hydration status.

➢ **Recent studies show that exercise-induced AKI has two types;**

AKI with myoglobinuria(Rhabdomyolysis)

and

AKI without myoglobinuria.

➢AKI with myoglobinuria

- ➢Runner's Kidney is another condition that may be detected in athletics.
- ➢In marathon runners, myoglobinuria may result in acute tubular injury (runners' AKI), probably provoked by ischemia due to the toxic effect of myoglobin on renal tubular cells as well as vasospasm and tubular obstruction.

AkI without myoglobinuria

- It is characterized by abrupt renal failure in addition to severe loin pain and patchy renal ischemia after prolonged anaerobic exercises.

- In addition, there is no myoglobinuria, and creatine kinase levels are within the normal or marginal normal ranges.

- # Case of AKI without myoglobinuria

١.Dehydration and diuretic use

- Bodybuilders may engage in practices to reduce water retention and achieve a more defined muscle appearance.
- This can include excessive sweating, dehydration, and the use of diuretics.
- Dehydration can strain the kidneys and impact their function.

- **Diuretics, when misused or taken in excessive amounts, can also put additional stress on the kidneys.**

- **dehydration and running in high-temperature situations, particularly, in individuals who take NSAIDs before or after running Some athletes, mostly young males, experience AKI without myoglobinuria which is caused by renal vasoconstriction.**

Table 1 Summary of different supplements used by bodybuilders and their harmful effect on kidney

Supplements	Kidney injury secondary to abuse
Anabolic-androgenic steroids	Focal segmental glomerulosclerosis and global sclerosis
	Bile acid nephropathy
	Renal artery thrombosis
Creatine monohydrate	Generally safe, but cases of AKI had been reported
Vitamins	Hypercalcemia, nephrocalcinosis and renal stone
	Interstitial fibrosis and tubular atrophy with interstitial calcium deposits
Protein	Use is safe in individuals with normal kidney function
	Theoretical risks: glomerular hyperfiltration and hyperemia; acceleration of CKD; increased proteinuria; diuresis, natriuresis, and kaliuresis with associated blood pressure changes; increased risk for nephrolithiasis; and various metabolic alterations
Energy drinks	Cases of AKI had been reported

AKI, acute kidney injury; CKD, chronic kidney disease.

Anabolic-androgenic steroids(AAA)

- AAS are taken by athletes to improve performance, gain muscle, and lose body fat, but they may induce kidney injury through multiple pathways.

- The abuse of these substances is common and ongoing worldwide due to the social interest of increased muscle mass and strength, mainly in males.

- The other main reasons that athletes use these substances are their beneficial effects in speed recovery of muscles, decreasing fatigue, reducing muscle damage, helping in the lipolysis process, decreasing the abdominal fat, and reforming the body to a lean shape.

- **Despite the various known side effects of androgenic-anabolic steroid (AAS) supplements, both elite and amateur athletes use AASs as they are interested in increasing the bulk of their muscles faster for various reasons, including aesthetic purposes.**

➢**AAS can induce endocrine system through multiple pathways such as :**

✓**stimulating renin–angiotensin– aldosterone system**

✓ **enhancing the production of endothelin**

✓**producing reactive oxygen species**

✓**overexpression of profibrotic and proapoptotic mediators**

✓**as well as inflammatory cytokines**

Types of kidney involvement caused by AAA:

- ✓FSGS
- ✓Bile cast nephropathy
- ✓Renal artery stenosis

- **The side effects of AAS are serious and include**
- ✓ **hypertension**
- ✓ **accelerated atherosclerosis**
- ✓ **reduced fertility**
- ✓ **liver toxicity**
- ✓ **suppression of the immune system.**

- **In addition, mood changes are common and vary from aggression and violence to different patterns of impulsive behaviors .**

1.Focal segmental glomerulosclerosis and global sclerosis

- **Prolonged use of AAS induces FSGS and global sclerosis.**
- **Additionally, excessive intake of salt and protein may cause glomerular hypertension and secondary FSGS.**

- de Francesco Daher et al showed that there is a subclinical kidney injury among AAS users, which was evident by monocyte chemoattractant protein-1 is higher in AAS users than nonusers.

- Although serum creatinine and cystatin C levels were within normal ranges, they showed a tendency to be higher in AAS users.

2.Bile acid nephropathy

- Drug-induced hepatotoxicity is a common cause of acute hepatic injury and may be associated with a cholestatic injury pattern.
- Renal dysfunction in the setting of cholestatic liver disease is multifactorial.
- Acute kidney injury (AKI) may develop secondary to hypoperfusion, from tubular bile cast obstruction and directly through tubular toxicity of bile acids.

3. Renal artery thrombosis

- AAS are responsible for a number of hemostatic defects, including

- ✓higher platelet number
- ✓enhanced platelet aggregation
- ✓ increased synthesis of procoagulant factors
- ✓ and impaired fibrinolysis.

Creatine supplementation

- Creatine supplementation has been recognized as one of the most efficient dietary supplements capable of increasing muscle strength and lean mass , as well as high-intensity exercise performance .

- The safety of consuming creatine supplements is controversial.

- **Although there is available evidence of the safety of creatine use, there are reports of creatine monohydrate induced kidney injury.**

- **While some studies suggest that creatine supplementation is safe even for a long period, others report that it has some side effects on various organs including the kidneys, liver, and gastrointestinal organs.**

1- Growth hormone and insulin-like growth factor

- Some individuals involved in bodybuilding may misuse growth hormone and insulin-like growth factor-1 (IGF-1) to enhance muscle growth.

- Additionally, excessive growth hormone and IGF-1 can cause enlargement of organs, including the kidneys, potentially affecting their function.

Vitamins

- Many bodybuilders abuse oral and injectable vitamins, which may cause acute kidney injury.

- A case series from Brazil consisted of 16 cases that used an excessive and prolonged intramuscular injection of veterinary supplements containing vitamins A, D, and E SO in conclusion, excessive use of veterinary vitamin supplements that contain high doses of vitamin A,D, and E is associated with AKI .

- Main signs and symptoms upon admission were nausea, vomiting, weight loss, epigastric pain, and headache.

High-protein diet

- **The International Society of Sports Nutrition's position stand on protein states that 'protein intakes of 1.4–2.0 g/kg/day for physically active individuals is not only safe but may improve the training adaptations to exercise training' .**

- **High protein improves the training adaptations to exercise with no harm as long as the renal functions are normal; however, the theoretical risks should be reviewed carefully with some individuals.**

- **High-protein consumption has been found, under various conditions, to lead to glomerular hyperfiltration and hyperemia; acceleration of CKD; increased proteinuria; diuresis, natriuresis, and kaliuresis with associated blood pressure changes; increased risk for nephrolithiasis; and various metabolic alterations**

- **Some trials are available to identify if significantly increasing protein intake would affect clinical markers of health (i.e. lipids and kidney function) as well as performance and body composition in young males with extensive resistance training experience**

- **Theoretical risks of high-protein diet Nevertheless, although there are no clear renal-related contraindications to high-protein diets in individuals with healthy kidney function, the theoretical risks should be reviewed carefully with some individuals.**

- **Available evidence that suggests the safety of high-protein diet in individuals with normal kidney function**

- **Pre-workout (energy drinks)**

- **Energy drink-induced renal failure has been reported infrequently.**

- **Red Bull contains caffeine, taurine, B vitamins, and simple sugars in a buffer solution.**

NSAID associated nephrotoxicity

- Acute overuse sport-related muscle injuries, such as strains and lacerations, injuries in adolescents and young adults are common.

- Treatment with NSAIDs is common; however, it may lead to renal impairment.

- The imbalance between renal vasoconstriction and vasodilation may lead to renal failures such as interstitial nephritis and NSAID-associated nephrotoxicity .

endocrine aspects:

1. **Renin-angiotensin-aldosterone system (RAAS) Activation**
2. **Catecholamine release**
3. **Inflammatory response**

Renin-angiotensin-aldosterone system (RAAS) Activation

- Intense exercise can lead to activation of the RAAS, which plays a crucial role in regulating blood pressure and fluid balance.
- The release of renin from the kidneys stimulates the production of angiotensin II, a potent vasoconstrictor that increases blood pressure.
- Angiotensin II also stimulates the release of aldosterone from the adrenal glands, promoting sodium and water reabsorption in the kidneys. Excessive activation of the RAAS can lead to vasoconstriction and reduced renal blood flow, potentially contributing to kidney injury .

Catecholamine release

- During intense exercise, there is an increased release of catecholamines such as epinephrine and norepinephrine from the adrenal glands.
- These hormones help mobilize energy reserves and increase cardiac output.
- Excessive catecholamine release can cause vasoconstriction in the renal arteries, reducing renal blood flow and oxygen delivery to the kidneys.

Inflammatory response

- Intense exercise can trigger an inflammatory response in various tissues, including the kidneys.
- Inflammatory mediators such as cytokines and chemokines can directly damage renal cells and impair kidney function.
- Exercise induced oxidative stress is another factor that can affect renal endocrine function in gym nephropathy.
- Intense physical activity leads to an increased production of reactive oxygen species (ROS) in the body.ROS can directly damage renal cells and impair their function.

Fluid and electrolyte imbalance

Hypercalcemia and nephrocalcinosis

- Treatment of vitamin D insufficiency may affect muscle performance .

- There have been reports of vitamin D intoxication in bodybuilding individuals resulting in renal dysfunction by causing hypercalcemia and nephrocalcinosis.

- Excessive milk intake with anabolic agents could provoke milk- induced hypercalcemia, nephrocalcinosis, and interstitial injury in bodybuilders, especially in those who drink milk instead of water to receive more protein.

Hyperuricemia in athletes

- There is a risk of hyperuricemia due to excessive intake of anti-oxidant supplements or a high-purine diet.

- Hyperuricemia has deleterious effects on kidney morphology including tubular damage and interstitial nephritis.

Exercise-associated hyponatremia

- **Exercise-associated hyponatremia in athletes Endurance athletes, such as marathons runners, may experience exercise-associated hyponatremia (EAH) which is characterized by a plasma sodium level less than 135 mmol/liter.**

- **The pathogenesis of EAH is complex and multifactorial.**

- **It has been reported that stimulation of arginine vasopressin has a major role, especially in circumstances with unbalanced water intake.**
- **Other influential factors include renal impairment and sweat sodium loss.**
- **During heavy exercise, athletes experience dehydration with a decrease in body mass.**

- **To avoid dehydration, they take large amounts of water which may result in EAH and lead to severe hyponatremia.**

- **Most athletes with EAH that have a serum sodium level between 128-134 mmol/L, usually have mild symptoms such as dizziness, nausea, and vomiting, or no symptoms at all.**

- **Those that have a serum sodium level less than 126 mmol/L usually have severe symptoms including neurological features (such as confusion, cerebral edema, or seizures), pulmonary edema, or even death .**

Exertional heat-related illnesses

- Prolonged exercise may lead to exertional heat-related illnesses (EHRIs), especially in hot and humid environments.

- Heatstroke is the most life-threatening condition of EHRIs and is associated with extensive inflammatory reactions that may result in multiple organ failures including renal failure.

- Some supplements are associated with EHRIS including stimulant drugs, such as amphetamines and methylphenidate, alcohol, or some illicit drugs such as cocaine, heroin, and phencyclidine .

- Tank you for attenuation