

Creatine Creating Muscles or Creating Malady in Indian Youth: Medicolegal Issues

Vivekanshu Verma¹, Jidhin Janardhan², Rana Abhyuday Singh³

Author Affiliation: ¹Associate Consultant, ²DNB Emergency 3rd Year Resident, Emergency and Trauma care, ³DNB Nephrology trainee, Department of Nephrology, Medanta Institute of Critical Care and Anesthesiology, Medanta-The Medicity, Gurugram, Haryana 122001, India.

Corresponding Author: Vivekanshu Verma, Associate consultant, Emergency and Trauma care, Medanta-The Medicity, Gurugram, Haryana 122001, India.

E-mail: vivekanshu@yahoo.co.in

Abstract

Most of Indian Urban Youth are keen of bulky bicep muscles, are getting misguided by online advertisements of "Creatine Creating Muscles". Supplement abuse is rampant in the fitness world. Enthusiasts often take them without proper clearance from medical professionals and often feel the consequences later, in the end of the month. Relevant scientific studies warns the Harmful Effects on kidneys of even healthy youth, associated with consuming creatine supplement for creating muscular body building alongwith physical workouts by weight lifting in Gymnasiums. The doctors get baffled to see otherwise healthy, young males hospitalised for an avoidable emergency, by regulating creatine use only after medical expert's supervision and monitoring.

Keywords: Creatine; Kidney injury; Body building; Creatinine; Dialysis.

How to cite this article:

Vivekanshu Verma, JidhinJanardhan, Rana Abhyuday Singh. Creatine Creating Muscles or Creating Malady in Indian Youth: Medicolegal Issues. J Forensic Chemistry Toxicol 2020;6(1):79–82.

Introduction

Increasing the body pool of creatine increases creatine concentration in serum and also urinary excretion rate.¹ The main metabolic waste product of creatine is Creatinine, which is metabolized further to form methylguanidme. Both creatinine and methylguanidine have been implied as kidney toxins.^{2,3}

Dehydration due to excessive sweating during gym workouts, lack of proper rehydration, along with consuming pain killers for muscle ache after workouts add further add to damage to kidneys.^{1,4,5}

Case Series

Two such cases of kidney injury associated with creatine abuse in healthy urban males doing Gym workouts have been reported in Medanta Hospital in Gurugram in past 6 months.

The first index case involved a young healthy male from Najafgarh in February 2019, unaware of his single functional kidney, experienced a sudden

shut down of kidney and a decrease in glomerular filtration rate, after abusing creatine powder for one month, for body building. An Urban Male, 26 yrs age, weighing 60 kg, well built, bulging biceps and back muscles, was brought by his father in midnight at our Hospital Emergency from Najafgarh Hospital with Complains of shortness of breath and altered behavior since 2 days. Admitted in Najafgarh hospital and treated as Anxiety disorder. No history of any knows Allergy.

ECG showed=Hyper-acute tall T waves suggesting Hyperkalemia

ABG: pH=6.88	Hb=7.3gm/dl (anemia)
PCO2=18.0	Wbc=16.48 x 10 ³
PO2= 49.2	RBC=2.39 million/cumm
HCO3= 3.3	Haemetocrit=24.1%
Hb = 7.4	Urea= 289 mg/dl(Critically High)
Na+ = 124	creatinine=20.60mg/dl(Critically High)
K+ = 6.15	Potassium : 6.1mmol/dl(Critically High)
Ca+2 = 0.79	Calcium=5.3mg/dl
Chloride = 116	CPK=1005 (Critically High)
Lactate = 1.02	CKMB mass=16.80 ng/ml (normal)

On detailed History by his father and friends: Reduced urine output since 2-3 days, No significant Past history, No love affair, No History Drug abuse, No Alcohol, Educated, Graduate, doing Business, no history of financial loss.

H/o Gymnasium: Body building exercise in his home town gymnasium recently

H/o intake of self-medication of Over the Counter Creatine powder approx. 120gm/day as nutrition supplement for Body building since last one month. No history of suspicious Events like trauma, assault.

- USG Abdomen- Solitary Shrunken kidney
- NCCT brain- WNL.

Management: Airway Secured by endotracheal intubation, Breathing supported by artificial ventilation, Inj. SODA BICARBONATE for correction of metabolic acidosis, antihyperkalemic measures in form Glucose, Insulin and Potassium infusion, Salbutamol nebulization, Calcium administration. Nephrologist advised urgent dialysis for supporting kidney functions. Patient was kept admitted for 7 days in ICU for repeated dialysis to filter out all the excess toxins and discharged in stable condition on biweekly dialysis dependent state.

Case No. 1, unaware about his solitary functional kidney consumed excessive Creatine supplements by self, and did lots of vigorous exercise without proper hydration, developed kidney injury,

remained only a step away from dying, but timely intervention saved his life but necessitated life-long dialysis. His Kidneys were damaged irreversibly and they will never return to their normal functioning in spite of best of medical care.

The second case reported in June 2018, involved acute kidney injury in a healthy young male wrestler after creatine abuse. A professional state level wrestler was hospitalized in Medanta for dark coloured urine associated with high dose of Creatine after long term regular use for 2 months for muscle gain, requiring urgent dialysis. Further examination revealed that the reason behind the severe condition of a seemingly healthy person was the health supplements he had been taking for the last four months on the advice of his gym trainer. Patient recovered luckily and was able to participate in his tournament, as his kidney function resolved upon discontinuance of the creatine use.

In February 2019, another case of limb vessel blockage associated with creatine abuse in a healthy urban male from Mathura, was hospitalized in Medanta with pain and discoloration of right lower limb associated with high dose of Creatine after long term regular use along with Gym exercise since one year. On investigation, his limb vessels were choked, causing gangrene of lower limbs, and in order to save his life, vascular surgeon had to amputate of both lower limbs. Patient was discharged after 26 days of hospitalisation in stable condition with limb prosthesis to let him walk with support.



Discussion

Similarly, recent cases on the change in renal function associated with creatine use have been reported in international medical journals.

Herlitz LC, et al. (2016) reported a case series involving 10 healthy bodybuilders abusing steroids and creatine > 10gm/day, who developed focal segmental glomerulosclerosis resulting an elevation in serum creatinine and a decrease in glomerular filtration rate.⁶

The second case reported by Koshy, K.M., et al. (1999) involved the development of acute interstitial nephritis in a healthy young man. A professional baseball player was hospitalized for renal dysfunction.⁷

Another case reported by Robinson S.J., et al. (2000) of acute quadriceps compartment syndrome and rhabdomyolysis in a weight lifter using high-dose creatine supplementation.⁸

Almukhtar, S.E., et al. (2015) reported a case series of Four bodybuilders who injected anabolic steroids and ingested commercial protein creatine (15 g/day) products presented with high serum creatinine levels. Renal biopsies revealed acute tubular necrosis. Four weeks after discontinuing injections and supplements, serum creatinine was in the normal range.⁹

The findings highlight a risk for acute and potentially chronic kidney injury among young men abusing anabolic steroids and using excessive amounts of Creatine supplements.

So, All Commercial containers with creatine supplements should bear a warning label advising against use of these products by any person diagnosed with, or at risk for renal dysfunction.

Some relevant case studies on animals fed on creatine, were found significant: A mouse study has reported on oral creatine after a single high dose of 50 mg/kg, is metabolized to methylamine, which is further metabolized to formaldehyde. Formaldehyde is responsible for crosslinking proteins (e.g. Lysine residues) in vivo and chronic methylene administration has been reported to cause oxidative damage in rats.¹⁰

In similar animal studies, for autosomal dominant polycystic renal disease has shown that oral supplementation of creatine salts resulted in greater cyst growth and renal impairment.^{11,12}

But, to promote and market the commercial

products of creatine supplements, the manufacturers have supported the Creatine drug trials to get favourable position statements and their employees have published some studies in favour of nil side effects of Creatine on kidney (Kreidir et al. 2017), which can't be relied blindly as co-authors of these articles had Conflict of interest, and authors have received externally-funded grants from creatine industry to conduct research on creatine, and last but not the least is that, some co-authors were already hired in advisory board by companies that sells creatine.¹³

Recommended Dose of Creatine: Taking dosages greater than 2 g/day is potentially harmful to the kidneys. Creatine is sold in a powder or liquid form in dosages by Gym Trainers, sometimes greater than 10 g/day, without any written prescription.¹⁴

So Safety of Creatine use and risk of kidney injury in youth is pertinent, and more requires double blind clinical trials, to save the lives of youth seeking body building supplements, especially for professional games and tournaments. Not surprisingly, there is a high prevalence of doping (77.8%) among competitive bodybuilders.¹⁵

Some of the psychological research studies bodybuilding without focusing on the "obsession with muscle." Schneider et al. (2016) explained the drive for muscularity in their study.¹⁶

Recent Canadian study by Boychuk, et al (2016) reported that Creatine supplementation does not alter neuromuscular recovery after eccentric exercise.¹⁷

Conclusion

The consensus of Medical Experts conclude that creatine in high dose, if consumed for long term, can adversely affects renal function in healthy individuals doing lots of aerobic exercises, causing excessive water loss due to sweating resulting in dehydration.

Creatine use in individuals with the history of pre-existing renal disease or an increased risk should be restricted from the use of creatine, and every person seeking bodybuilding should undergo preventive health check-up including kidney function tests, urine tests and ultrasound of kidneys. And individuals consuming Creatine supplement should be monitored regularly with Creatine phosphokinase assay, Blood gas and electrolytes tested under medical supervision, to avoid acute kidney injury.

Conflict of Interest: Nil

References

1. N Pritchard, P Kalra, Renal dysfunction accompanying oral creatine supplements, *The Lancet* 1998;352:233–234.
2. P Yu, Y Deng, Potential cytotoxic effect of chronic administration of creatine, a nutrition supplement to augment athletic performance, *Medical hypotheses*, 54 (2000) 726–728.
3. M.S. Juhn, M. Tarnopolsky, Potential Side Effects of Oral Creatine Supplementation: A Critical Review, *Clinical Journal of Sport Medicine*, 8(1998)298-304.
4. J.R. Poortmans, M. Francaux, Adverse effects of creatine supplementation, *Sports Medicine*, 30 (2000)155–170.
5. Rawson, E.S., Clarkson, P.M. Creatine Supplementation: The Athlete's Friend or Foe?, *International SportMed Journal*,1(2000) 1–5.
6. Herlitz LC, Markowitz GS, Farris AB, et al. Development of focal segmental glomerulosclerosis after anabolic steroid abuse. *J Am SocNephrol*. 2010;21(1):163–172. doi:10.1681/ASN.2009040450
7. K.M. Koshy, E. Griswold, E.E. Schneeberger, Interstitial nephritis in a patient taking creatine, *The New England Journal of Medicine*, 340 (1999) 814–815.
8. S.J. Robinson, Acute quadriceps compartment syndrome and rhabdomyolysis in a weight lifter using high-dose creatine supplementation, *The Journal of the American Board of Family Practice*, 13 (2000) 134–137.
9. Almkhatar, S.E., et al. Acute kidney injury associated with androgenic steroids and nutritional supplements in bodybuilders. *Clinical Kidney Journal*, Volume 8, Issue 4, August 2015, Pages 415–419.
10. J.W. Edmunds, S. Jayapalan, N.M. DiMarco, H. Saboorian, H.M. Aukema, Creatine supplementation increases renal disease progression in Han: SPRD-cy rats, *American Journal of Kidney Diseases*, 37 (2001) 73–78.
11. R.d.P. Vieira, R.F. Franya, C.R.F.d. Carvalho, M. Dolhnikoff, W. Ribeiro, R.A.B.L. Martins, Efeitos da suplementação oral com creatina sobre o metabolismo e a morfologia hepática em ratos, *Revista Brasileira de Medicina do Esporte*, 14 (2008) 38–41.
12. N.C.d.V. Baracho, L.P.d. Castro, N.d.C. Borges, P.B. Laira, Study of renal and hepatic toxicity in rats supplemented with creatine, *Acta Cirúrgica Brasileira*, 30 (2015) 313–318.
13. Kreider RB, Kalman DS, Antonio J, Ziegenfuss TN, Wildman R, Collins R, Candow DG, Kleiner SM, Almada AL, Lopez HL (2017-06-13). "International Society of Sports Nutrition position stand: safety and efficacy of creatine supplementation in exercise, sport, and medicine". *Journal of the International Society of Sports Nutrition*. 14:18.
14. Coquet R, Roussel P, Ohl F. Understanding the Paths to Appearance- and Performance-Enhancing Drug Use in Bodybuilding. *Front Psychol* 2018;9:1431.
15. Schneider C, Rollitz L, Voracek M, Hennig-Fast K. Biological, Psychological, and Sociocultural Factors Contributing to the Drive for Muscularity in Weight-Training Men. *Front Psychol*. 2016 Dec 21;7:1992.
16. Acute kidney injury associated with androgenic steroids and nutritional supplements in bodybuilders
17. Boychuk KE, Lanovaz JL et al. Creatine supplementation does not alter neuromuscular recovery after eccentric exercise. *Muscle Nerve*. 2016 Sep;54(3):487-95.