

## **BAB 6**

### **KESIMPULAN DAN SARAN**

#### **6.1 KESIMPULAN**

Berdasarkan hasil penelitian mengenai Pengaruh Pemberian Steroid Androgenik Anabolik (*Sustanon 250*) Terhadap Jumlah Sel Osteoblas Pada Femur Tikus Putih galur Wistar, didapatkan kesimpulan sebagai berikut :

1. Gambaran histologi jumlah sel osteoblas pada tikus putih galur Wistar yang diberikan perlakuan Sustanon 250 yaitu terdapat perbedaan jumlah sel osteoblas pada kelompok kontrol dan kelompok perlakuan yang diberikan Sustanon 250 3, 5, dan 10 mg/kgbb.
2. Peningkatan jumlah osteoblas secara signifikan terjadi pada pemberian kelompok perlakuan Sustanon 250 dosis 3, 5 dan 10 mg/kgbb.

#### **6.2 SARAN**

Berdasarkan hasil yang diperoleh pada penelitian ini, beberapa saran apabila ingin dilanjutkan berbagai penelitian lain yaitu :

1. Dapat dilakukan pemeriksaan kepadatan tulang untuk penelian lebih lanjut.
2. Rentang dosis Sustanon 250 yang digunakan untuk perlakuan hewan coba perlu dihitung kembali dan dapat ditingkatkan untuk melihat dosis paling efektif untuk meningkatkan jumlah osteoblas.
3. Jumlah sampel penelitian dapat ditingkatkan dan disarankan pemilihan umur hewan coba yang lebih muda, yaitu sekitar 3 bulan.

4. Dapat dilakukan pada hewan coba yang berbeda untuk penelitian lebih lanjut.

## DAFTAR PUSTAKA

1. Baron DA., Martini DM., Magdi SA. *Doping In Sports And Its Spread To At-Risk Populations: An International Review*. J World Psy Assoc [Internet]. 2007 Jun; 6(2); 118; 120. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2219897/>
2. Bisher, ASAB. *The Physiological Effects on Hormones levels and Kidneys Functions Induced by The Anabolic Androgenic Drug (Sustanon) in Male Guinea Pigs*. Am J of Applied Sci [Internet]. 2009; 6(6); 1036-1037. Diunduh dari: <http://thescipub.com/html/10.3844/ajassp.2009.1036.1042>
3. Pițigoi G, Păunescu C, Mitrea N, Baconi D, Păunescu M, Burcea C, Arsene AI. *New Approaches Regarding The Dynamics Of The Doping Pharmacologic Agents In Sports*. Farmacia [Internet]. 2012; 111;115. Diunduh dari: <http://www.revistafarmacia.ro/201201/art.12.pitigoi%20111-119.pdf>
4. World Anti-Doping Agency. 2006 prohibited substances list. [www.wada-ama.org](http://www.wada-ama.org).
5. Evans NA. *Current Concepts in Anabolic-Androgenic Steroids*. Am J of Sports Med [Internet]. 2004; 32; 534; 535-536. Diunduh dari: <http://ajs.sagepub.com/cgi/content/abstract/32/2/534>
6. Guyton AC, Hall JE, editor. *Fisiologi Kedokteran*. Jakarta: EGC; 2008. p.1055, 1056-1058.
7. Wills, S. *Drugs of Abuse. 2nd Ed*. Published by Pharmaceutical Press, London, U.K.SBN-10: 0853695822. 2005
8. Hartgens, F. and H. Kuipers. *Effects Of Androgenic-Anabolic Steroids In Athletes*. J. Sport Med [Internet]. 2004; 34: 513-522. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pubmed/15248788>
9. Beotra, A. *Drug Abuse In Sport. Published Control Center Of Sports Authority Of India*. New Delhi, India. 2005.
10. Clarkson, P.M. and H.S. Thompson. *Drugs And Sport: Research Findings And Limitations*. J Sport Med [Internet]. 1997; 24: 366-384. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pubmed/9421862>

11. Socas, L., M. Zumbado, A. Romos, J. Hernandez and L. Boada. *Hepatocellular Adenomas Associated With Anabolic Androgenic Steroids Abuse In Body Builders: A Report Of Two Cases And A Review Of The Literature*. Br. J Sport Med [Internet]. 2005; 39: 27-41. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pubmed/15849280>
12. Fitch, K.D. *Androgenic-Anabolic Steroids And The Olympic Games*. Asian J Androl [Internet]. 2008; 10: 384-390. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pubmed/18385900>
13. Tahtamouni L, N. Mustafa, A. AlMuthana, I. Hassan, M. Abdalla and S. Yasin. *Prevalence And Risk Factors For anabolic Androgenic Steroids Abuse Among Jordanian Collegiate Students And Athletes*. Eurp. J. Public Health [Internet]. 2008; 18: 661-665. Diunduh dari: DOI: 10.1093/eurpub/ckn062
14. Monaghan, L., 2001. *Bodybuilding, Drugs and Risk*. 1st Edn., Routledge New York, USA., ISBN: 10: 041522683X, pp: 232.
15. Ryan, C. and L. Richard. *Abuse Of Supraphysiologic Doses Of Anabolic Steroids*. Southern Med. J [Internet]. 2005; 98: 555.
16. Evans NA. *Gym & Tonic: A Profile Of 100 Male Steroid Users*. Br J Sports Med [Internet]. 1997;31:54-58.
17. Pope HG, Katz DL. *Psychiatric And Medical Effects Of Anabolic Androgenic Steroid Use: A Controlled Study Of 160 Athletes*. Arch Gen Psychiatry [Internet]. 1994; 51:375-382.
18. Mescher AL. *Junqueira's Basic Histology Text And Atlas*. 13<sup>th</sup> Ed. USA: McGraw-Hill. 2013 p. 138, 139,140-143, 148, 152-154.
19. Waugh A, Grant A. *Ross and Wilson Anatomy and Physiology in Health and Illness*. 9<sup>th</sup> Ed. Spain: Elsevier. 2001. p. 389,390.
20. Tortora GJ, Derrickson B. *Principles of Anatomy and Physiology*. 13<sup>th</sup> Ed. USA: John Wiley & Sons, Inc. 2012. p. 185,186.
21. Brunton LL, Parker KL, editors. *Goodman & Gilman's Manual Pharmacology and Therapeutics*. USA: McGraw-Hill. 2008. p. 1012-1013, 1015-1016.

22. Karila T. *Adverse Effects Of Anabolic Androgenic Steroids On The Cardiovascular, Metabolic And Reproductive Systems Of Anabolic Substance Abusers* [dissertation]. [Helsinki]: University of Helsinki. 2003. 70p.
23. Nieschlag E, Behre HM, Nieschlag S. *Testosterone: Action, Deficiency, Substitution*. New York: Cambridge University Press. 2012. p. 184-185, 517,518.
24. Wade N. *Anabolic Steroids: Doctors Denounce Them, But Athletes Aren't Listening*. Science [Internet]. 1972; 176: 1399–1403
25. Mauras N, Hayes V, Welch S, et al. *Testosterone Deficiency In Young Men: Marked Alterations In Whole Body Protein Kinetics, Strength, And Adiposity*. J Clin Endocrinol Metab [Internet]. 1998; 83:1886-1892.
26. Bhasin S, Storer TW, Berman N, et al. *The Effects Of Supraphysiological Doses Of Testosterone On Muscle Size And Strength In Normal Men*. N Eng J Med [Internet]. 1996; 335:1-7.
27. Brodsky IG, Balagopal P, Nair KS. *Effects Of Testosterone Replacement On Muscle Mass And Muscle Protein Synthesis In Hypogonadal Men: A Clinical Research Center Study*. J Clin Endocrinol Metab [Internet]. 1996; 81:3469-3475.
28. Katznelson L, Finkelstein JS, Schoenfeld DA, et al. *Increase In Bone Density And Lean Body Mass During Testosterone Administration In Men With Acquired Hypogonadism*. J Clin Endocrinol Metab [Internet]. 1996; 81:4358-4365.
29. Snyder PJ, Peachey H, Berlin JA, et al. *Effects Of Testosterone Replacement In Hypogonadal Men*. J Clin Endocrinol Metab [Internet]. 2000; 85:2670-2677.
30. Wang C, Swerdloff RS, Iranmanesh A, et al. *Transdermal Testosterone Gel Improves Sexual Function, Mood, Muscle Strength, And Body Composition Parameters In Hypogonadal Men*. J Clin Endocrinol Metab [Internet]. 2000; 85:2839-2853.

31. Pope HG, Cohane GH, Kanayama G, et al. *Testosterone Gel Supplementation For Men With Refractory Depression: A Randomized, Placebo-Controlled Trial*. Am J Psychiatry [Internet]. 2003; 160:105-111.
32. Seidman SN, Rabkin JG. *Testosterone replacement therapy for hypogonadal men with SSRI-refractory depression*. J Affect Disord [Internet]. 1998;48:157-161.
33. Yates WR. *Testosterone In Psychiatry: Risks And Benefits*. Arch Gen Psychiatry [Internet]. 2000; 57:155-156.
34. Bhasin S, Storer TW, Javanbakht M, et al. *Testosterone Replacement And Resistance Exercise In HIV-Infected Men With Weight Loss And Low Testosterone Levels*. JAMA [Internet]. 2000; 283:763-770.
35. Grinspoon S, Corcoran C, Parlman K, et al. *Effects Of Testosterone And Progressive Resistance Training In Eugonadal Men With AIDS Wasting: A Randomized Controlled Trial*. Ann Intern Med [Internet]. 2000; 133:348-355.
36. Rabkin JG, Wagner GJ, Rabkin R. *A Double-Blind Placebo-Controlled Trial Of Testosterone Therapy For HIV-Positive Men With Hypogonadal Symptoms*. Arch Gen Psychiatry [Internet]. 2000; 57:141-147.
37. Sattler FR, Jaque SV, Schroeder ET, et al. *Effects Of Pharmacological Doses Of Nandrolone Decanoate And Progressive Resistance Training In Immunodeficient Patients With Human Immunodeficiency Virus*. J Clin Endocrinol Metab [Internet]. 1999; 84:1268-1276.
38. Sattler FR, Schroeder ET, Dube MP, et al. *Metabolic Effects Of Nandrolone Decanoate And Resistance Training In Men With HIV*. Am J Physiol Endocrinol Metab [Internet]. 2002; 283:E1214-E1222.
39. Stawford A, Barbieri T, Van Loan M, et al. *Resistance Exercise And Supraphysiological Androgen Therapy In Eugonadal Men With HIV Related Weight Loss: A Randomized Controlled Trial*. JAMA [Internet]. 1999; 281:1282-1290.
40. Dobs AS. *Is There A Role For Androgenic Anabolic Steroids In Medical Practice?* JAMA [Internet]. 1999; 281:1326-1327.

41. Brill KT, Weltman AL, Gentili A, et al. *Single And Combined Effects Of Growth Hormone And Testosterone Administration On Measures Of Body Composition, Physical Performance, Mood, Sexual Function, Bone Turnover, And Muscle Gene Expression In Healthy Older Men.* J Clin Endocrinol Metab [Internet]. 2002; 87:5649-5657.
42. Bross R, Javanbakht M, Bhasin S. *Anabolic Interventions For Aging-associated Sarcopenia.* J Clin Endocrinol Metab [Internet]. 1999; 84:3420-3430.
43. Schroeder ET, Singh A, Bhasin S, et al. *Effects Of An Oral Androgen On Muscle And Metabolism In Older, Community-Dwelling Men.* Am J Physiol Endocrinol Metab [Internet]. 2002; 284:E120-E128.
44. Snyder PJ, Peachey H, Hannoush P, et al. *Effect Of Testosterone Treatment On Body Composition And Muscle Strength In Men Over 65 Years Of Age.* J Clin Endocrinol Metab [Internet]. 1999; 84:2647-2653.
45. Vermeulen A. *Androgen Replacement Therapy In The Aging Male: A Critical Evaluation.* J Clin Endocrinol Metab [Internet]. 2001; 86:2380-2390.
46. Wilson JD. *Androgens.* In: Hardmann JG, Limbird IE, Molinoff PB, Ruddon RW, Goodman Gilman A (eds) *Goodman and Gilman's The Pharmacological Basis of Therapeutics*, 9th edn. McGraw Hill, New York. 1996. pp 1441–1457
47. Katzung BG, Masters SB, Trevor AJ, editors. *Farmakologi Dasar & Klinik*, Ed. 12, Vol. 2. Jakarta: EGC. 2013. p. 828; 829-830.
48. Shahidi NT. *A Review Of The Chemistry, Biological Action, And Clinical Applications Of Anabolicandrogenic Steroids.* Clin Ther 2001; 23: 1355-1390.
49. NIDA Research Report - *Steroid Abuse And Addiction*: NIH Publication No. 00-3721. April, 2000.
50. Fotherby K, James F. *Metabolism Of Synthetic Steroids.* Adv Steroid Biochem Pharmacol 1972; 3: 67-165.
51. Pederson L, Kremer M, Judd J, Pascoe D, Spelsberg TC, Riggs BL, Oursler MJ. *Androgens Regulate Bone Resorption Activity Of Isolated*

- Osteoclasts In Vitro*. Proc Natl Acad Sci USA [Internet]. 1999; 96:505–510.
52. Nakamura T, Imai Y, Matsumoto T, Sato S, Takeuchi K, et al. *Estrogen Prevents Bone Loss Via Estrogen Receptor Alpha And Induction Of Fas Ligand In Osteoclasts*. Cell 2007; 130:811–823.
  53. Technische Universitat Munchen [Intenet]. Munchen; Harmonising the knowledge about biomedical side effects of doping. Diunduh dari: <http://www.doping-prevention.sp.tum.de/substances-and-methods/beta-blockers/beta-blockers.html>
  54. Athlete Guide to the 2015 Prohibited List. Diunduh dari: <http://www.usada.org/substances/prohibited-list/athlete-guide/>
  55. 2015 List of Prohibited Substances and Methods. Diunduh dari: <http://list.wada-ama.org/list/p2-beta-blockers/>
  56. Adiyati, P. N. 2011. Ragam Jenis Ektoparasit pada Hewan Coba Tikus Putih (*Rattus norvegicus*) Galur Sprague Dawley. *Skripsi*. Fakultas Kedokteran Hewan Institut Pertanian Bogor. Bogor.
  57. Priyambodo, S. 1995. *Pengendalian Hama Tikus Terpadu*. PT Swadaya. Jakarta. Halaman 30 – 31.
  58. Yuriska, F. Anindhita. *Efek Alokasan Terhadap Kadar Glukosa Darah Tikus Wistar*. Semarang : Fakultas Kedokteran Universitas Diponegoro; 2009.
  59. Mahesya, Andre Prasetyo., *Pengaruh Pemberian Minyak Goreng Bekas Yang Dimurnikan Dengan Buah Mengkudu (Morinda Citrifolia) Terhadap Gambaran Hepatosit Tikus Wistar Jantan*. Lampung: Universitas Lampung; 2013.
  60. Nilsson LO, Boman A, Savendahl L, Grigelioniene G, Ohlsson C, Ritzen EM, Wroblewski J. *Demonstration of estrogen receptor immunoreactivity in human growth plate cartilage*. J Clin Endocrinol Metab. 1999; 84:370–373.
  61. Colvard DS, Eriksen EF, Keeting PE, Wilson EM, Lubahn DB, French FS, Riggs BL, Spelsberg TC. *Identification of androgen receptors in normal human osteoblast-like cells*. Proc Natl Acad Sci USA. 1989; 86:854–857.

62. Carrascosa A, Audi L, Ferrandez MA, Ballabriga A. *Biological effects of androgens and identification of specific dihydrotestosterone-binding sites in cultured human fetal epiphyseal chondrocytes*. J Clin Endocrinol Metab 1990; 70:134–140.
63. Vanderschueren, D., Vandendput L., Boonen S., Lindberg M. K., Bouillon R., dan Ohlsson C. *Androgens and Bone*. The Endocrine Society. 2004; 25(3):392.
64. Kasperk CH, Wakley GK, Hierl T, Ziegler R. *Gonadal and adrenal androgens are potent regulators of human bone cell metabolism in vitro*. J Bone Miner Res 1997; 12:464–471.
65. Kousteni S, Bellido T, Plotkin LI, O'Brien CA, Bodenner DL, Han L, Han K, DiGregorio GB, Katzenellenbogen JA, Katzenellenbogen BS, Roberson PK, Weinstein RS, Jilka RL, Manolagas SC. *Nongenotropic, sex-nonspecific signaling through the estrogen or androgen receptors: dissociation from transcriptional activity*. Cell 2001; 104:719–730.
66. Riggs BL, Khosla S, Melton LJ 3<sup>rd</sup>. *Sex steroids and the construction and conservation of the adult skeleton*. Endocr Rev. 2002; 23:279–302.
67. Wang C, Swerdloff RS, Iranmanesh A, Dobs A, Snyder PJ, Cunningham G, Matsumoto AM, Weber T, Berman N. *Effects of transdermal testosterone gel on bone turnover markers and bone mineral density in hypogonadal men*. Clin Endocrinol (Oxf). 2001; 54:739–750.