CP: Anabolic Steroids

Jeremy Gaza, Alon Lee, Jeremy Wong
Roadmap

- Hypothesis
- Clinical Use
- Mechanism of Action
- RDA and Safe use
- Evidence supporting
- Evidence refuting
- Conclusion
- References
Hypothesis

**Counter Point**: Anabolic steroids are not safe ergogenic aids to increase strength, body size, and performance.

**Point**: Anabolic steroids are safe ergogenic aids to increase strength, body size, and performance.
Clinical use

- Oxandralone used to treat muscle wasting associated with HIV, catabolic disorders, and to assist in regaining weight lost from surgery, infections, and malnutrition.¹
- Methandrostenalone is used to reduce pain from osteoporosis.²
- Nandrolone decanoate is used to relieve joint pain and treat anemia.²
Mechanism of action

- Direct and Indirect anabolic action\textsuperscript{1}
- Testosterone acts as an androgen traveling through blood and binding to an androgen receptor on the target cell.\textsuperscript{1,3}

Figure 2. AS Mechanism (From Silverthorne - Human Physiology 6E)\textsuperscript{1}
RDA and Safe Use

- There is no RDA for anabolic steroids because it is not a nutrient.
- Athletes take around 5mg/kg body weight, while other consumers with androgenic deficiencies take around 1mg/kg⁴.
- Toxicity was presented as mild and seldom reported².
Research Supporting CP 1

A study by Kanayama et al., 2015 claims: Users of Anabolic Steroids have a much greater risk of tendon ruptures than non-users\(^5\).

- 22% of Anabolic Steroid users suffered from one or more tendon ruptures.
- 6% of Non-users experienced tendon ruptures.
- Ruptures occur primarily in upper half of body.
Research Supporting CP 1 cont’d

Interesting Highlight

- Tendon ruptures occurred in events outside of weightlifting\(^5\).
- Of the 19 reported ruptures, only 5 occurred during weightlifting\(^5\).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Race</th>
<th>Age at time of evaluation</th>
<th>Tendon ruptured(^6)</th>
<th>Age at time of rupture</th>
<th>Activity at time of rupture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>W</td>
<td>35</td>
<td>Pectoralis</td>
<td>29</td>
<td>Wrestling</td>
</tr>
<tr>
<td>2</td>
<td>W</td>
<td>35</td>
<td>Biceps</td>
<td>34</td>
<td>Bowling</td>
</tr>
<tr>
<td>3</td>
<td>W</td>
<td>35</td>
<td>Pectoralis</td>
<td>28</td>
<td>Unknown</td>
</tr>
<tr>
<td>4</td>
<td>W</td>
<td>36</td>
<td>Quadriceps</td>
<td>25</td>
<td>Weightlifting</td>
</tr>
<tr>
<td>5</td>
<td>W</td>
<td>37</td>
<td>Biceps</td>
<td>35</td>
<td>Moving heavy object</td>
</tr>
<tr>
<td>6</td>
<td>AA</td>
<td>41</td>
<td>Biceps</td>
<td>38</td>
<td>Football</td>
</tr>
<tr>
<td>7</td>
<td>W</td>
<td>41</td>
<td>Biceps</td>
<td>36</td>
<td>Moving heavy object</td>
</tr>
<tr>
<td>8</td>
<td>W</td>
<td>42</td>
<td>R Patellar</td>
<td>33</td>
<td>Foul</td>
</tr>
<tr>
<td>9</td>
<td>W</td>
<td>43</td>
<td>Biceps</td>
<td>34</td>
<td>Martial arts fighting</td>
</tr>
<tr>
<td>10</td>
<td>W</td>
<td>45</td>
<td>R Biceps</td>
<td>38</td>
<td>Football</td>
</tr>
<tr>
<td>11</td>
<td>AA</td>
<td>44</td>
<td>Achilles</td>
<td>43</td>
<td>Batting in softball</td>
</tr>
<tr>
<td>12</td>
<td>W</td>
<td>46</td>
<td>Biceps</td>
<td>40</td>
<td>Moving heavy object</td>
</tr>
<tr>
<td>13</td>
<td>W</td>
<td>46</td>
<td>Pectoralis</td>
<td>44</td>
<td>Weightlifting</td>
</tr>
<tr>
<td>14</td>
<td>W</td>
<td>47</td>
<td>Biceps</td>
<td>44</td>
<td>Moving heavy object</td>
</tr>
<tr>
<td>15</td>
<td>W</td>
<td>48</td>
<td>Triceps</td>
<td>47</td>
<td>Weightlifting</td>
</tr>
<tr>
<td>16</td>
<td>W</td>
<td>49</td>
<td>Patellar</td>
<td>40</td>
<td>Jumping rope</td>
</tr>
<tr>
<td>17</td>
<td>W</td>
<td>49</td>
<td>Quadriceps</td>
<td>41</td>
<td>Fall</td>
</tr>
<tr>
<td>18</td>
<td>W</td>
<td>51</td>
<td>Biceps</td>
<td>45</td>
<td>Weightlifting</td>
</tr>
<tr>
<td>19</td>
<td>W</td>
<td>51</td>
<td>L Biceps</td>
<td>41</td>
<td>Volleyball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R Biceps</td>
<td>48</td>
<td>Weightlifting</td>
</tr>
</tbody>
</table>

Figure 3. Features of tendon ruptures in AAS users\(^5\)
Research Refute 1

Study by Georgieva & Boyadjiev, 2004 claims: Treatment with Anabolic Steroid Nandrolone Decanoate results in overall improvement in submaximal running endurance with no side-effects on cardiovascular properties and blood oxygen carrying capacity⁹.

- Reported submaximal running endurance increase by 41%
- No reported changes to: Muscle Oxidative Capacity or Muscle Glycogen Concentration
Research Refute 1 cont’d

Georgieva & Boyadjiev, 2004 cont’d

- Graph illustrates dramatic increase in running endurance over 8 weeks of testing.

Figure 4. Running endurance vs time
Research Refute 1 cont’d

Georgieva & Boyadjiev, 2004 cont’d

- However, population of measure consisted of 40 male Wistar Rats.
- Very different to translate and generalize information into human population.
- Thus, highly compromised external validity.
Research Supporting CP 2

Study by Herlitz et al., 2010 claims: Anabolic Steroid abuse results in asymptomatic proteinuria or nephrotic syndrome\textsuperscript{7}.

- Both issues closely related to damage in kidneys and renal system.
- 50\% of subjects in study developed Focal Segmental Glomerulosclerosis (FSGS) with different stages of progression and severity of damage.
Research Supporting CP 2

- Herlitz et al., 2010 cont’d

- 90% of subjects experienced mild to moderate levels of arteriosclerosis.

- Glomerulosclerosis & Arteriosclerosis in combination greatly increase risk of renal issues.
A study by Rowe, Berger, & Copeland, 2017 claims that anabolic steroids can be used safely as ergogenic aids by educating users of cycle lengths and safe injection points.

Methods:

- A short anonymous survey was conducted within 9 Needle and Syringe Program Sites (NSP) across Sydney.
- To be eligible for this study: participants had to be males of at least 18 years old and have used AS.
Research Refute 2 cont.

Results:

- 605 males participated in this study\(^8\).
- Strong association(*) between longer cycle lengths and frequency of adverse effects.

Figure 6. Percentage of men reporting adverse effects from AS use\(^8\)
Research Refute 2 cont.

- Results were acquired by analyzing self-reported surveys\(^8\).
  - Opens results up to response bias and inaccurate reports.
- Exclusively used males for recruitment\(^8\)
  - Not a representation of population that uses AS, as the study excluded females.
  - Other adverse effects that affect the opposite gender exclusively were not recorded/mentioned.
Research Supporting CP 3

Study by D’Andrea et al., 2007 claims: long-term misuse of Anabolic Steroids results in impairment of myocardial function\(^6\).

- Loss in Strain Percentage
- Loss in Stroke Volume
- Loss in Cardiac Output
Research Supporting CP 3 cont’d

D’Andrea et al., 2007 cont’d

- Overall loss in strain percent.
- % Strain reflects percent of Total muscle contraction.
- Loss in %strain demonstrates reciprocal loss of stroke volume.

**Table 4** Strain rate and strain analysis of left ventricular lateral free wall and interventricular septal wall

<table>
<thead>
<tr>
<th>Segment</th>
<th>SR (1/s)</th>
<th>Strain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controls (n = 25)</td>
<td>Users (n = 20)</td>
</tr>
<tr>
<td>Left ventricular lateral free wall</td>
<td>-1.8 (0.4)</td>
<td>-1.6 (-0.3)*</td>
</tr>
<tr>
<td>Middle</td>
<td>-1.8 (0.2)</td>
<td>-1.1 (0.3)*</td>
</tr>
<tr>
<td>Interventricular septal wall</td>
<td>-1.9 (0.4)</td>
<td>-0.76 (0.3)**</td>
</tr>
<tr>
<td>Middle</td>
<td>-2 (0.3)</td>
<td>-0.74 (0.3)**</td>
</tr>
</tbody>
</table>

SR, strain rate. Values are mean (SD).
*p<0.01: users versus controls and non-users.
**p<0.001: users versus controls and non-users.

Figure 7. Strain rate and strain analysis of left ventricular lateral free wall and interventricular septal wall
Research Supporting CP 3 cont’d

D’Andrea et al. cont’d

- Combined with previous table:
  - Increased wall thicken
  - Decrease in stroke volume
- Resulting in impaired cardiac output and physical performance.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Standard Doppler echocardiographic quantitative analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Controls (n = 25)</td>
</tr>
<tr>
<td>M-mode echocardiography</td>
<td></td>
</tr>
<tr>
<td>Septal wall thickness (mm)</td>
<td>9.31.1</td>
</tr>
<tr>
<td>Posterior wall thickness (mm)</td>
<td>8.42.1</td>
</tr>
<tr>
<td>LV end-diastolic diameter (mm)</td>
<td>47.44.7</td>
</tr>
<tr>
<td>LV end-systolic diameter (mm)</td>
<td>28.22.9</td>
</tr>
<tr>
<td>Relative diastolic wall thickness</td>
<td>0.430.04</td>
</tr>
<tr>
<td>Endocardial fractional shortening (%)</td>
<td>36.73.7</td>
</tr>
<tr>
<td>LV mass index (g/m²)</td>
<td>48.45.9</td>
</tr>
<tr>
<td>LV ESSc (g/cm²)</td>
<td>96.110.2</td>
</tr>
<tr>
<td>RV end-diastolic diameter (mm)</td>
<td>21.22.8</td>
</tr>
<tr>
<td>Standard Doppler analysis</td>
<td></td>
</tr>
<tr>
<td>LV stroke volume (ml)</td>
<td>71.43.2</td>
</tr>
<tr>
<td>Mitral peak E velocity (m/s)</td>
<td>0.740.17</td>
</tr>
<tr>
<td>Mitral peak A velocity (m/s)</td>
<td>0.530.14</td>
</tr>
<tr>
<td>Mitral peak E:A ratio</td>
<td>1.50.5</td>
</tr>
<tr>
<td>Mitral E deceleration time (ms)</td>
<td>151.317.7</td>
</tr>
<tr>
<td>Mitral isovolumic relaxation time (ms)</td>
<td>82.313.4</td>
</tr>
</tbody>
</table>

ESSc, circumferential end-systolic stress; LV, left ventricular; RV, right ventricular.

Values are mean (SD).

*p<0.001: users versus controls.

**p<0.01: non-users versus controls.

***p<0.05 users versus non-users.

Figure 8. Standard Doppler echocardiographic quantitative analysis
Conclusion

- Negative health outcomes outweigh potential benefits to performance from AS use.$^{5-7,9}$
- Single dose of illegally obtained AS is equivalent to 2-4 times a clinical dosage.$^2$
- Animal models were used and may not be representative of how humans react to AS.$^9$
References


Reference cont.

Reference cont.

Reference cont.


Extra image references