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Low Anabolic Profile in Assessing a Patient's Overall Hair Loss

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Abstract

Today's society recognizes how supplementation affects the body physiologically; conversely society does not understand the hidden side effects supplementation has on hair. This paper investigates and explains how hair loss is affected by various supplements. This paper was written in order to provide current and future hair loss professionals with an understanding of the numerous biochemical pathways that cause hair loss, and a method to evaluate, educate, and correct patients, resulting in hair loss prevention, growth, and/or faster regrowth. Supplements previously studied were included in this paper and explored further with relativity to the hair. These supplements include: anabolic steroids, creatine, growth hormone, androstenedione/similar pro-hormones, whey protein isolate(WPI), arginine, orthinine, DHEA (dehydroepiandrosterone), HCG (human chorionic gonadotropin), carnivores vs. vegetarians, soy, iodine, egg whites, and caffeine. In finding, particular supplements have a negative effect on hair loss (as illuminated through various metabolic pathways presented in this research). Specifically, whey protein isolate, growth hormones (GH), and anabolic precursors result in the highest amount of hair loss. Review of the patient's supplements allows the medical practitioner to develop a plan towards hair loss prevention.

Keywords: Hair loss anabolic supplements; Testosterone and hair loss; Growth hormone and hair loss; IGF-1 serum and hair loss

Introduction

In today's world, a person's lifestyle choices and supplements play an important role in regulating their nutritional diet. However, certain supplements can modify the body's metabolic processes so significantly that they lead to hair loss. Knowing the identity of each supplement has aided in diagnosing and understanding the effects they have on the patient. The purpose of this study was to identify different supplementations and assess them relative to hair loss and provide hair loss specialists with a method to identify and correct a patient's hair loss risk. Supplements previously studied were included and explored further. This s paper provides an in depth explanation on numerous supplements, and investigates their metabolic pathways to see how they effects hair growth and hair loss.

Substantiating Data

a. Pathway 1

"Anabolism" is defined as "any state in which nitrogen is differentially retained in lean body mass, either through stimulation of protein synthesis and/or decreased breakdown of protein anywhere in the body" [1]. Anabolic steroids are extremely common and almost 1.5% of 12th graders have tried them at least once [2]. Anabolic steroids are technically called anabolic-androgen steroids (AAS) [1]. Anabolic steroids are technically called anabolic-androgen steroids (AAS). They are drugs that mimic the effects of testosterone (T). Anabolic steroids increase the protein synthesis that takes place within cells (Figure 1). This has the consequence of cellular tissue build-up (anabolism), particularly in the muscles [1].

In skeletal muscles, anabolic steroids increase protein synthesis [3]. They reverse catabolic processes [3]. Anabolic steroids are often blamed for causing adverse effects. Serious adverse effects include: endocrine dysfunction; hepatic dysfunction; cardiovascular changes; and behavioural changes [3]. All anabolic steroids currently in use are either derivatives of testosterone, or they are structural modifications of testosterone [1]. Testosterone binds to the androgen receptor to exert its androgenic activity but is also 5 alpha reduced in some target tissues (including the male urogenital tract, skin, liver, and sebaceous glands) to dihydrotestosterone (DHT). It can also be aromatized to estradiol and exert estrogenic activities [1]. The latter two actions are highly undesirable in anabolic drugs. 5 alpha-reduction is the major cause of hair loss [1] and aromatization causes feminizing side effects [4]. Dimethandrolone (DMA: 7α,11β-dimethyl-19-nortestosterone) and 11β-methyl-19-nortestosterone (MNT), synthetic androgens, are exceptional because they do not need to convert to DHT to act as potent steroids. They are being developed for male hormonal therapy. A study on them may have shown that "inhibition of 5α-reductase activity in vivo does not affect the androgenic potency of DMA, MNT, or MENT [4]". This is important because as hair loss physicians, we need to also look at supplements that cause hair loss and their anabolic effects on secondary pathways in addition to DHT.

The (BCAA's) Branched Chain Amino Acids in whey protein isolate (WPI) are the real culprit in raising the testosterone levels during and after exercise as shown in the Sharp [5] study. In the Sharp study, subjects consumed high branched chain amino acids (BCAA's) with high-intensity total-body resistance training. Blood serum was analyzed for testosterone. "Serum testosterone levels were significantly higher in the BCAA's group during and following resistance training [5]." Whey protein is in general prevalence and usage compared to proteins such as soy or pea is due to its low cost, availability and easy digestibility. Whey protein also has a high (BV) High Biological Value (6) and is absorbed easily due to its small molecular weight [5-7]. Many muscle magazines advertise that WPI will make you more "cut" by raising your testosterone levels. Being "cut" is referred to as having a body composition primarily of lean muscle, while decreasing visibility of body fat. WPI (80-100%) is made when cow's milk is homogenized and separated into curds and whey. The percentage represents the amount of protein. The whey is a liquid that is then dried using various filters. The sweet whey is then processed to Whey Protein Concentrate (WPC-34%) [5] by removing the lactose and fat.

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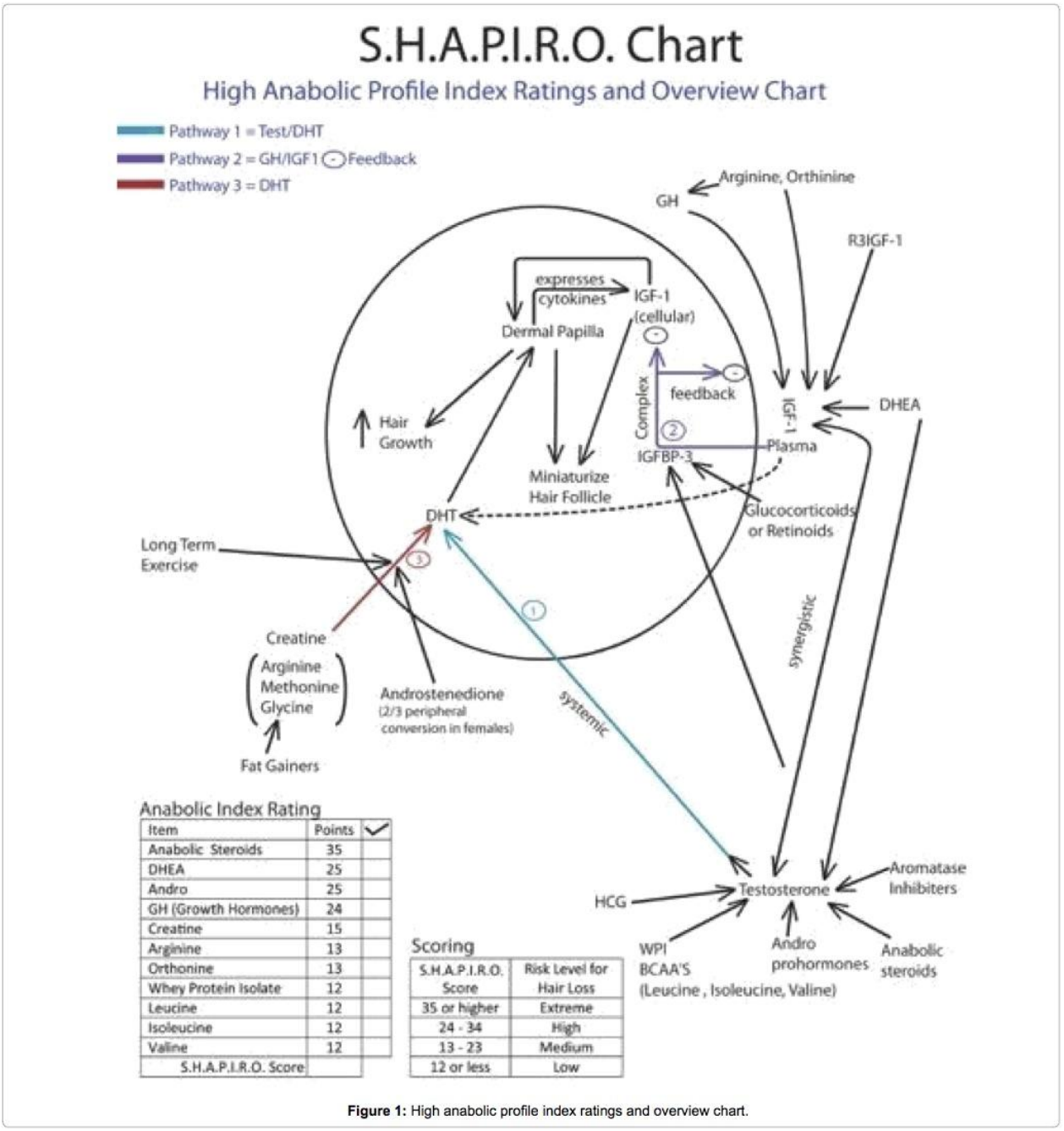


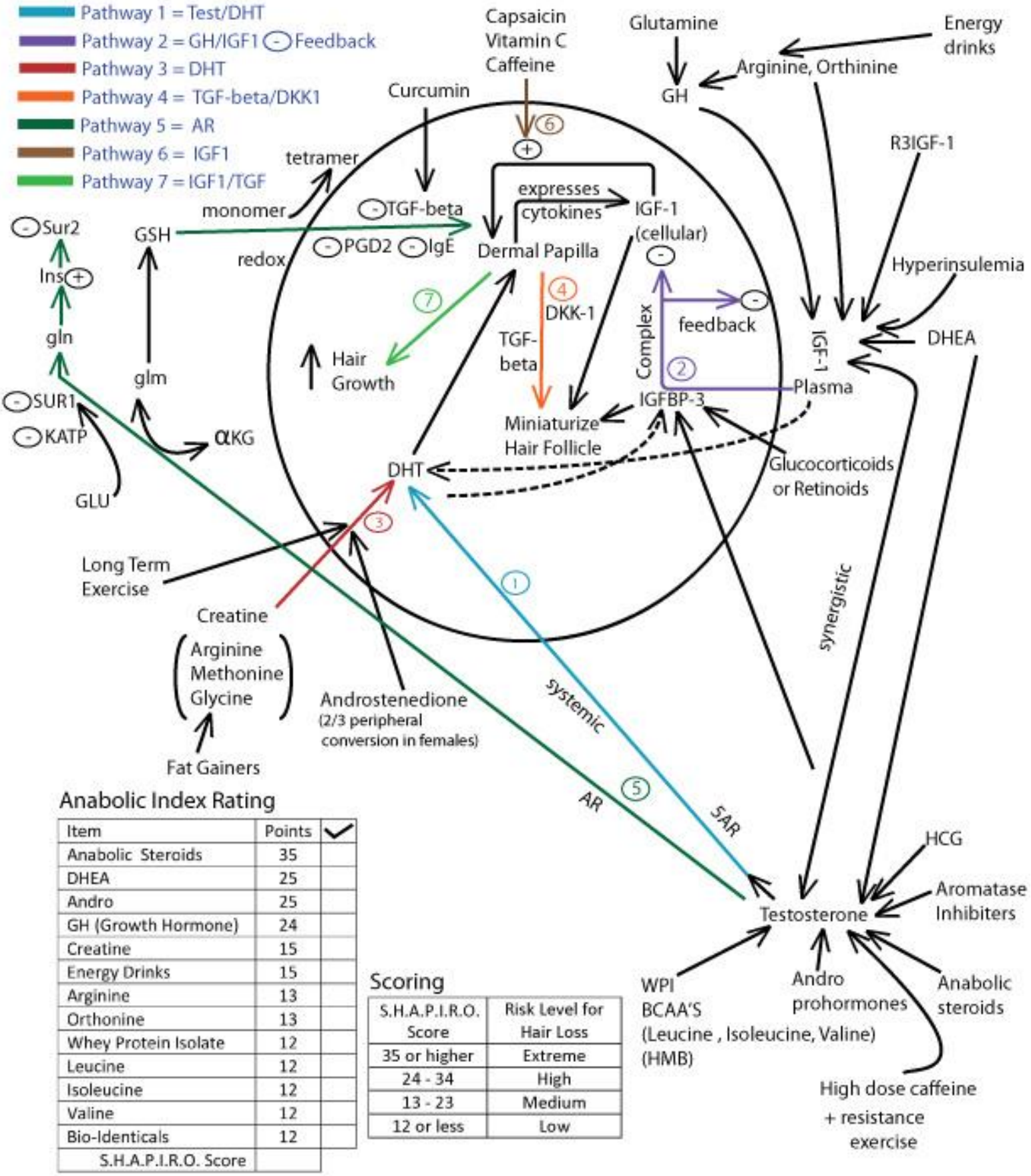
Figure 1: High anabolic profile index ratings and overview chart.

WPC is further processed to WPI by several methods such as ion exchange or Cross Flow Micro Filtration (CFM). This further processing leaves a higher percentage of branched chain amino acids (BCAA's) [5]. BCAA's including leucine, isoleucine, and valine are of special importance for athletes because they are metabolized in the muscle, rather than in the liver [8,9] This is important since there is increased protein synthesis in the muscle and therefore less muscle breakdown [7,9,10] and therefore faster recovery time for the muscle after workout. Leucine is a major amino acid for protein synthesis. BCAA's, especially leucine, are the key amino acids to modulate muscle protein metabolism and lead to muscle protein anabolism. It is thought that leucine is a nutritional signal to indicate that amino acids are available after a meal containing protein [2]. It has been shown that BCAA's promote muscle protein synthesis and inhibit muscle protein breakdown [10].

But we also need to look at the various milk proteins effect on IGF-

S.H.A.P.I.R.O. Chart

Shapiro High Anabolic Profile Index Ratings and Overview Chart



Anabolic Index Rating

Item	Points	✓
Anabolic Steroids	35	
DHEA	25	
Andro	25	
GH (Growth Hormone)	24	
Creatine	15	
Energy Drinks	15	
Arginine	13	
Orthonine	13	
Whey Protein Isolate	12	
Leucine	12	
Isoleucine	12	
Valine	12	
Bio-Identicals	12	
S.H.A.P.I.R.O. Score		

Scoring

S.H.A.P.I.R.O. Score	Risk Level for Hair Loss
35 or higher	Extreme
24 - 34	High
13 - 23	Medium
12 or less	Low

1 (Pathway 2). Milk increases both fasting insulin and Insulin-like Growth Factor 1 (IGF-1). Casein is a byproduct of milk. It is considered the "curds" in "curds and whey". When we compare whey and casein, whey protein doesn't increase SERUM IGF-1. However, there is an increase in serum IGF-1 with casein which can increase DHT [7]. Whey does increase fasting insulin levels but casein has no effect [11]. "Between milk mineral groups (high, low) and milk protein groups (whey, casein) Serum IGF-1 increased by 15% ($P<0.0001$), whereas there was no change in fasting insulin ($P=0.36$) in the casein group. In the whey group, fasting insulin increased by 21% ($P=0.006$), with no change in IGF-1 ($P=0.27$) [12]." Enhanced Whey Protein with low Branched Chain Amino Acids given to patients after a Hair Transplant in conjunction with the Low Anabolic Profile has shown to accelerate regrowth. Currently over 800 patients have started to grow by 6-8 weeks and full growth at 5-6 months. This is called AFR or Accelerated Follicular Restoration. Normally regrowth after a hair transplant starts at 4-6 months and could take up to 18 months to regrow. Patients also report less shock loss after the procedure.

Another new supplement touted by medical clinics is Human Chorionic Gonadotropin (HCG). Homeopathic concentration of HCG is a new fad weight loss diet that has been banned by the federal government [12]. Regular concentrations of HCG have been shown to increase testosterone levels [13-15]. There is no evidence supporting that HCG works to reduce weight.

b. Pathways 1, 2

DHEA is a supplement used mostly by pre- and post-menopausal women. A precursor to androstenedione. With aging humans, there is a progressive decline in the secretion of the adrenal androgens. (17). DHEA is extremely anabolic because it raises testosterone AND androstenedione, and DHT levels [16,17]. In women, but not in men, serum A, T and DHT were increased to levels above gender-specific young adult ranges [18].This is due to peripheral conversion (20) because DHEA is a precursor to androstenedione.

Testosterone and androstenedione are precursors (pro-hormones) for plasma-dihydrotestosterone [19]. Pathway 3-testosterone conversion accounts for at least 70% of plasma DHT in the male, but less than 20% in the normal female. Androstenedione appears to be a major pro-hormone of plasma dihydrotestosterone, accounting for at least two-thirds plasma dihydrotestosterone by peripheral conversion in adult females [20]." Androstenedione is a naturally occurring OTC drug used by muscle builders. It is a pro-hormone that goes by the street name "Andro" [1] and it directly converts to testosterone [1]. This is the most common performance enhancing drug on the market in professional sports. Andro has no real effect on performance [1]. DHEA has also been shown to raise IGF-1 level which has been shown to raise DHT [20] and testosterone [21] but had no effect on GH or IGFB-3 [17]. Many weightlifters are under the false impression that they can block just DHT (Pathway 1) with a DHT blocker and continue to take anabolic supplements without hair loss as a side effect. The effects of supplements on IGF-1 must be considered when assessing a patient's hair loss situation.

c. Pathway 2

There is a secondary pathway referred to as a "parallel axis" which consists of both GH and insulin-like growth factor-I (GH-IGF-I) 19 [22]. The effects of supplements on IGF-1 must be considered when assessing a patient's hair loss situation. IGF-1 is a major player on Pathway 2 of the S.H.A.P.I.R.O. Chart. To understand the S.H.A.P.I.R.O. Chart, we must have a basic understanding of this polypeptide [23-25].

1. Insulin-Like Growth Factor-I plays a specific role in the regulation of --- growth and metabolism. IGF-I circulates with specific Binding Proteins (BPs). Six different IGFBPs circulate as a high-affinity complex by binding with IGF-1 [23]
2. IGF-1 binds as a high affinity complex to IGFBP-3, limiting its effects on metabolism
3. IGF-I also binds to low molecular weight - IGFBP-1, which is produced in the liver -It -a major short-term modulator of IGF-I bioavailability [24]
4. Less than 1% of IGF-I is circulating in a free state. It is readily "available to mediate effects on target tissues through an endocrine mechanism, similar to the situation with steroid and thyroid hormones" [26,27].

d. GH-IGF-1 pathway

Growth hormone is another very common supplement and is synergistic with testosterone [25,26]. Both boost IGF-1 [27,28] levels which can affect DHT directly by increasing 5AR. [22] IGF-1 is increased in men with vertex baldness [28]. GF-1 correlated in women with higher acne levels [29]. IGF-1 in women with acne was correlated with increased DHT. Both increased GH [30] and IGF lower Sex Hormone Binding Globulin (SHBG) and release free testosterone (T) [31,32] into the bloodstream to produce an anabolic effect. "Insulin and IGF-1 stimulate the synthesis of androgens in ovarian [31,32] and testicular [20,33] tissues. Furthermore, insulin and IGF-1 inhibit the hepatic synthesis of sex hormone binding globulin [SHBG] [34] thereby increasing the bioavailability of circulating androgens to tissues. Cross-sectional studies demonstrate the inverse relationships between IGF-1 and SHBG [34]. GH also increases leucine metabolism at rest, and during and after exercise, which then exerts an anabolic effect [35].

There is much controversy with growth hormone as many people consider it to be the fountain of youth. Bio-identically, which are given as low doses of growth hormone, are touted to promote hair growth; however there is no evidence of this effect. On the contrary, hair loss can occur from growth hormone because the serum levels of elevated IGF-1 cause hair loss directly through increased DHT [22] even though the cytokines papilla are producing their own IGF-1 independently [31,36] of serum IGF-1 and may cause growth [31,37,38]. There is no evidence that growth hormone affects the dermal papilla directly, however, "there is mounting evidence that suggests that GH exerts its anabolic affect mainly by locally produced IGF-1 rather than liver – derived circulating IGF-1 [28]." DHT, however, does affect IGF-1 cellular by inhibiting production in the dermal papillae [28,39].

To make matters worse, growth hormone increases both serum IGF-1 [40,41] and IGFBP-3 [37] and this binding molecule binds both serum [37] and cellular IGF-1 to reduce the concentration of IGF-1 cellular available for hair stimulation. [21,34,36] IGFB3-1 is less sensitive than IGF-1 to growth hormone stimulation [37] and this may account for some patients thinking that initially their hair has some positive effects because growth hormone affects cellular IGF-1 initially but then the binding molecule acts to decrease cellular IGF-1 decreasing hair growth [37].

The study showed that in normal young adults, the IGF-I and IGFBP-3 responses to Recombinant Human Growth Hormone (rhGH) depend on gender and dosage. The minimum rhGH dose able to increase IGF-I and IGFBP-3 levels was lower than expected. They concluded that IGFBP-3 is less sensitive than IGF-I to rhGH stimulation [37]. The researchers also found that "IGFBP-3 is less

sensitive than IGF-I to rhGH stimulation, in agreement with previous results in GH-deficient adults. Actually, IGFBP-3 synthesis and release depend on GH but probably also on IGF-I. This could also explain why the timing of the IGFBP-3 response is delayed with respect to that of IGF-I." [37] Testosterone plays a factor in modulation of IGF-1 and IGFBP-3 by increasing their production in rats [38] and had an additive effect with IGF-1 raising IGFBP-3 [40]. IGFBP-3 is increased by glucocorticoids and retinoids. Plasma IGF-1 has a negative feedback on growth hormone in the pituitary [40]. Insulin-Like Growth Factor Binding Protein-3 has been shown to regulate DHT [41].

As long as formation of DHT is minimal or non-existent (Pathways 1, 3) then blocking IGFBP-3 formation or even blocking its ability to bind IGF-1 (Pathway 2) would allow for the possibility of cellular IGF-1 to produce growth uninhibited in the cytokines [36,41-43].

e. Pathway 3

Some workout products can lead to hair loss. Creatine is a common OTC product used by weight lifters to gain muscle mass and in addition, it is used as a weight gainer [44,45]. Creatine is made up of three amino acids: arginine, glycine and L-methionine. It raises DHT directly without affecting serum testosterone levels [46] although IGF-1 is elevated [47,48]. A study showed that after 7 days (1 week) of creatine loading, or a further 2 weeks of creatine maintenance dose, there was no change in serum T levels. However, DHT levels increased by 56% after a week of creatine loading and remained 40% above baseline after two weeks of maintenance [42]. The effect of IGF-I was about 100x that of androgen [48].

The researchers studied whether androgen induction of the enzyme activity could be via IGF-I production. Adding a monoclonal antibody against IGF-I significantly reduced the effect of DHT. The study -showed that, "simultaneous addition of a specific IGF-I receptor antibody blocked the expected induction of 5 alpha R activity (control, 4.9 +/- 0.5; DHT, 8.0 +/- 1.9; DHT plus IGF-I receptor antibody, 3.7 +/- 0.4%). These studies indicate that IGF-I may be an important regulator of skin 5 alpha R activity and, thus, may influence DHT formation. "The previously known androgen induction of this peripheral steroidogenic enzyme may be via paracrine/autocrine production of an IGF-I-type growth factor." [22] Even though IGF-1 increases DHT38 [43] and T39 [44] there may be an increased rate of conversion from T to DHT since IGF-123 [37,48] increases 5AR.

f. Pathways 2, 3

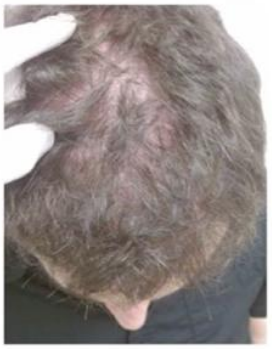
Arginine and ornithine are extremely anabolic amino acids and increase both growth hormone and IGF-1 levels. However, leucine, found in WPI had no effect on GH and IGF-1 levels [45-47]. "Of the amino acids, arginine is the most potent GH secretagogue in man. It potentiates the GH response to GHRH, exerts a weaker PRL-releasing effect, stimulates insulin and glucagon and induces a biphasic glucose variation. His and Leu did not significantly modify either basal or GHRH-induced GH secretion, basal PRL, insulin and glucose levels" [48]. Arginine is one of three amino acids found in creatine which affects DHT directly [29]. Interesting though is Arginine and orthinine decreased IGFBP-3 levels. Photos below: Examples of texture change of hair in patients taking supplements (Figures 2 and 3).

g. Anabolic index rating

Rating and evaluating a patient's Anabolic Index Rating will allow the health care physician to give an actual index of hair loss risk. Reviewing the patients supplement use is essential. The Review of Systems (ROS) must include the amount of supplements used and duration of use. The patient must be made aware of the delayed effects of the hair loss from supplement use. Usually a period of 6-9 months after the consumption of anabolic supplements is the period when hair loss will be noticed. This usually makes it harder to identify the immediate cause (Figure 4). Scoring with the Anabolic Index Rating is evaluated at the initial consultation and followed up at 2 months intervals. Long-term assessment of the patient's condition will change as the patient's education of supplement usage is curtailed.

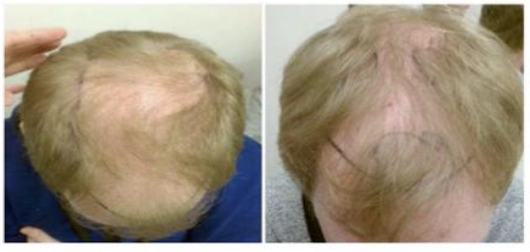
Two other lifestyle choices should be mentioned when reviewing a patient's low anabolic profile. "DHT increased 14.5% in exercisers versus 1.7% in controls at 3 months (P=0.04); at 12 months, it remained 8.6% above baseline in exercisers versus a 3.1% decrease in controls (P=0.03). SHBG increased 14.3% in exercisers versus 5.7% in controls at 3 months (P=0.04); at 12 months, it remained 8.9% above baseline in exercisers versus 4.0% in controls (P=0.13). A yearlong, moderate-intensity aerobic exercise program increased DHT and SHBG, but it had no effect on other androgens in middle-aged to older men [49]. Another study showed that serum levels of total and free IGF-I and IGFBP-3 are increased and maintained in long-term training [50].

A second lifestyle choice compared vegetarians and meat eaters. In vegetarians, there was no evidence that available androgens were higher. Although IGF-1 was 9% higher in meat eaters, further studies should be done to determine the amount of actual hair loss from elevated levels [51]. A further study showed there was very little difference in IGF-1 levels with animal or vegetarian diets [52]. Soy is another very common protein for working out. Surprisingly though, of all the supplemental proteins, it has the highest amount of arginine per



Change of texture of hair and even diffuse thinning throughout affected areas. This 27-year-old male used creatine for 4-5 months. His hair loss is commonly recognized to be from anabolic creatine since it has a very even, diffused pattern, and the hair has a change in texture.

Figure 2: Change of texture of hair in patient taking supplements.



FILENAME: g99_3.jpg
Took anabolics (creatine)

FILENAME: g99_4.jpg
Did not take anabolics

Identical twins: Twin on the left took creatine and had more hair loss than his identical twin brother on the right.

Figure 3: Change of texture of hair in identical twin patients.

Anabolic Index Rating		
Item	Points	✓
Anabolic Steroids	35	
DHEA	25	
Andro	25	
GH (Growth Hormones)	24	
Creatine	15	
Arginine	13	
orthinine	13	
Whey Protein Isolate	12	
Leucine	12	
Isoleucine	12	
Valine	12	
S.H.A.P.I.R.O. Score		

Scoring	
S.H.A.P.I.R.O. Score	Risk Level for Hair Loss
35 or higher	Extreme
24-34	High
13-23	Medium
12 or less	Low

Figure 4: Anabolic index rating from the S.H.A.P.I.R.O. chart.

100 grams [53] Arginine (per 100 g)

Soy: 7.6 g;

Beef: 6.3 g;

Egg: 5.8 g;

Cassein: 3.7 g;

Whey: 2.9 g

But soy isoflavones also have some goitrogenic and estrogenic activity [54] "Iodine deficiency greatly increases soy antithyroid effects, whereas iodine supplementation is protective. Thus, soy effects on the thyroid involve the critical relationship between iodine status and thyroid function. In rats consuming genistein-fortified diets, genistein was measured in the thyroid at levels that produced dose-dependent and significant inactivation of rat and human thyroid peroxidase (TPO) in vitro." [55] Another common protein used for working out is egg protein. Biotin binds with streptavidin, which is a similar compound to avidin. Avidin is found in egg whites, which also binds with biotin. [56]. Most interesting is there is still 25% Residual Avidin Activity in cooked egg white. Caffeine, a common stimulant, increases T and cortisol levels in resistance exercise. Caffeine increased testosterone 15% during exercise. Caffeine raised this concentration in a dose-dependent - cortisol increased moderately - with an 800 milligram dose of caffeine. The study concluded that caffeine might have a benefit to training outcomes due to the anabolic effects of the increase in testosterone concentration. However, "this benefit might be counteracted by the opposing catabolic effects of the increase in cortisol" [57,58].

Conclusion

In conclusion, certain supplements based on the theoretical S.H.A.P.I.R.O. Chart can have a negative effect on hair loss (as illuminated though various metabolic pathways). In entirety, it is crucial for hair loss professionals to properly educate themselves and their patients about the effects of supplements, whey protein isolate, growth hormones, and anabolic precursors. By understanding the multiple biochemical pathways causing hair loss, modern day and future hair loss professionals can look for further prevention, growth, and faster regrowth. A good history of the patient's supplement intake over their lifetime, and suggesting that they avoid potentially anabolic products in the future will help them reduce future hair loss.

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