Effects of Successful Adenomectomy on Body Composition in Acromegaly

ATSUSHI TOMINAGA, KAZUNORI ARITA, KAORU KURISU, TOHRU UOZUMI*, KEISUKE MIGITA, KUNIKI EGUCHI, KOJI IIDA, HITOSHI KAWAMOTO, AND TATSUYA MIZOUE

Department of Neurosurgery, Hiroshima University, School of Medicine, Hiroshima 734-8551, and
*Hiroshima Prefectural Hospital, Hiroshima 734-0007, Japan

Abstract. The purpose of the present study was to investigate postsurgical change in body composition in patients who have undergone surgery for acromegaly. Eight patients with acromegaly had determination of serum GH, insulin-like growth factor-I (IGF-I), height, body weight, and bioelectric impedance before surgery and at 2 weeks, 1 month, 3 months, and 6 months after surgery. Body composition was analyzed by bioelectric impedance analysis (BIA). We analyzed body fat (BF), body lean mass (BLM), body cell mass (BCM), total body water (TBW), intracellular water (ICW) and extracellular water (ECW). The serum GH concentration and IGF-I had decreased significantly 2 weeks after surgery. Body weight had decreased significantly 1 month after surgery and recovered 3 months after surgery. BIA showed that TBW and BCM had decreased significantly 2 weeks after surgery. BF gradually increased up to 1 month after surgery and was increased significantly at 3 months after surgery. The percent ratio of TBW/body weight decreased and the percent ratio of BF/body weight increased during the 6 months after surgery. The percent ratio of ECW/TBW did not change during the 6 months following surgery. In conclusion, the rapid body weight loss which occurred within 2 weeks after surgery was caused by decreases in TBW and BCM. The recovery of body weight, which was seen later than 1 month after surgery, was caused by an increase in BF. The postoperative change in body composition in acromegaly ceased 3 months after surgery.

Key words: Body composition, Acromegaly, Surgery

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GH helps to regulate metabolism of glucose, lipids and protein [1–4]. Excessive GH changes the metabolism and body composition in acromegalic patients [6–9]. Total body water (TBW) increases and body fat (BF) decreases [6]. When serum GH and insulin-like growth factor I (IGF-I) concentrations normalize after surgery, the body composition changes dramatically.

The purpose of the present study is to investigate the postsurgical change in body composition in patients who have undergone surgery for acromegaly.

Materials and Methods

Patients

Ten patients with GH producing pituitary adenomas underwent surgery at Hiroshima University Hospital in 1996. Eight of them were followed up for more than 6 months and were evaluated in the present study (Table 1). They comprised five females and three males. Their ages ranged from 46 to 69. All of them underwent
The voltage drop between the inner two electrodes was measured with a high input impedance amplifier. The accuracy of measured resistance was ± 5% and the reactance was ± 1%. Body composition was calculated from the bioelectric impedance with Weight Manager 2.05 software (RJL Systems Inc., Clinton, U.S.A.). Body fat (BF), body lean mass (BLM), body cell mass (BCM), total body water (TBW), intracellular water (ICW) and extracellular water (ECW) were calculated.

Hormone measurement

The serum GH concentration was measured with commercially available IEMA kits [E test TOSOH II (HGH) kit (Tosoh Inc., Tokyo, Japan)]. The serum IGF-I concentration was measured with commercially available RIA kits [Somatomedin C-2 kit (Chiba Corning, Tokyo, Japan)]. The coefficient of variation of each assay was less than 5%.

Statistical analysis

The results were expressed as the mean ± SEM. The Wilcoxon signed rank test was used for statistical analysis. A P value < 0.05 was considered significant.

Results

The preoperative serum GH concentration ranged from 7.4 to 363 ng/ml (Table 1). Preoperative serum IGF-I concentrations ranged from 533 to 971 ng/ml (Table 1); the mean value was 743 ± 51.4 ng/ml (mean ± SEM). In all patients, the postoperative serum GH concentration decreased to less than 5 ng/ml within 2 weeks after surgery (Fig. 1), and postoperative serum IGF-I concentrations decreased to less than 300 ng/ml within 1 month after surgery (Fig. 2).

Body weight had decreased significantly by approximately 4% at 2 weeks after surgery and maximum body weight loss was between 2 and 4.3 kg after surgery. All patients gradually regained body weight. At 6 months after surgery, the body weight returned to the preoperative values (Fig. 3). TBW had decreased significantly 2 weeks after surgery, with no change thereafter. BCM had also
decreased significantly 2 weeks after surgery (Fig. 4), with no change thereafter (Fig. 4). BF had increased constantly after surgery and increased significantly 3 months after the surgery, when it reached a plateau (Fig. 4). The change in BF was between 2.5 and 7.7 kg in female patients, and significantly 3 months after the surgery, when it reached a plateau (Fig. 4). The change in BF was between 2.5 and 7.7 kg in female patients, and
between 3.4 and 5.5 kg in male patients at 6 months after surgery (Fig. 4). The percent ratio of TBW/body weight decreased gradually in all patients during the 3 months after surgery (Fig. 5). The percent ratio of BF/body weight increased gradually in all patients until 3 months after surgery (Fig. 5) and reached a plateau 3 months after surgery. The percent ratio of ECW/TBW did not change during the 6 months after surgery (Fig. 6).

**Discussion**

Recently, body composition has been analyzed by the bioelectric impedance analysis (BIA) method [10, 11]. The BIA method has some advantages over isotope dilution methods and hydrodensitometry because it is easy to use and noninvasive. A disadvantage of the BIA method is that the estimations are based on regression equations derived from densitometry studies in normal populations, although it has been proved to be accurate in normal subjects [10, 11]. There are some reports of body composition in acromegaly [6-9]. Some authors have reported body composition assessed by BIA in acromegaly [12-14]. Brummer et al. analyzed 10 patients with active acromegaly by several methods, which included BIA, and proved the accuracy of BIA even in acromegaly [12]. Hu et al. have reported body composition in Japanese with acromegaly [14]. In acromegaly, BCM and TBW are higher and BF is lower than in normal subjects. When our patients were compared with the normal Japanese subjects reported by Hu et al., lower BF, higher BCM and TBW were observed. Brummer et al. have reported a postsurgical change in body composition in acromegaly [8]. They compared values before and 1 year after adenomectomy. Our paper is the first report about the periodic effect of adenomectomy on body composition in acromegaly. It is well known that a rapid decrease in body weight is observed after successful adenomectomy. In the present study, body weight decreased by approximately 4% within 2 weeks after surgery and then increased. The body weight returned to the baseline between 3 and 6 months after surgery. There was no significant difference between values obtained before and 6 months after surgery. The rapid decreases in TBW and BCM brought about a rapid decrease in body weight followed by an increase in body weight brought about by the slow increase in body fat.

GH induces activation of the renin angiotensin system [15, 16] and suppresses atrial natriuretic peptide (ANP) [17]. As a result of these effects, an
expansion of extracellular volume and plasma volume, sodium retention and increased body water are observed in acromegaly. Møller et al. have reported that 14 days of high-dose GH administration caused an increase in extracellular volume [17]. The alteration in body fluid homeostasis caused by the water retentive effect of GH occurs rapidly. Postoperative transient diabetes insipidus also affects body fluid homeostasis, but in the present study transient...
diabetes insipidus disappeared within 4 days after surgery in all patients. A decrease in body weight was caused primarily by a reduction in GH and its water retention effect.

In lipid metabolism, the effect of GH is biphasic. The insulin-like effects, i.e. increased glucose uptake, acceleration of glucose metabolism and inhibition of lipolysis, are apparent up to 3 h after GH administration [1]. Then the insulin-like effects disappear and lipolysis ensues. GH promotes hydrolysis of triglyceride into glycerol and free fatty acids and reduces fat [2]. IGF-I also enhances lipolysis [18, 19]. The reductions in GH and IGF-I after surgery causes a reverse alteration in lipid metabolism. In cases 3, 4 and 7, the increase in BF was as great as in other patients in spite of their lower preoperative serum GH concentration. The decrease in IGF-I may have a greater effect on the increase in BF than on the decrease in GH. Hu et al. also said that the plasma IGF-I level correlated with percent BF in acromegaly, normal subjects and patients with GH deficiency [14]. Successful surgery normalizes the GH concentration within a day, and the IGF-I concentration does so within a

![Diagram](image-url)
week [20]. Møller et al. have stated that free fatty acid is normalized 2 months after successful surgery [3], but Hansen et al. have reported that no increase in fat mass was observed after 4 weeks of treatment with octreotide in acromegaly [21]. The increase in fat mass takes several months after surgery. In the present study, total body water rapidly decreased within 2 weeks after surgery, but the distribution of water did not change significantly.

The present study showed that the postoperative change in body composition in acromegaly ceased 3 months after surgery. Our patients' body composition at 3 months after surgery was nearly the same as that of the normal Japanese subjects reported by Hu et al. [14].

In conclusion, the rapid decrease in TBW and BCM resulted in rapid body weight loss within 2 weeks after surgery. The recovery of body weight was caused by an increase in body fat. The postoperative change in body composition in acromegaly ceased 3 months after surgery.

References


