Effects of Cross-Sex Hormone Treatment on Emotionality in Transsexuals

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Abstract

The aim of the study was to investigate whether cross-sex hormone treatment in transsexuals affected the intensity of negative and positive emotions in general, and aggressive and sexual feelings in particular. With respect to emotional behavior, changes in non-verbal expressiveness and anger readiness were examined in 47 female-to-male transsexuals (FtMs) and 54 male-to-female transsexuals (MtFs). We were also interested in finding out whether, in FtMs, the rapidly changing testosterone levels in the two-week cycle testosterone treatment had predictable effects on moods, the development of male physical characteristics and sexuality.

Keywords: sex hormones, transsexuals, emotionality, sexuality, aggression.

Introduction

Sex hormones evoke not only organizing but also activating effects in mammals and humans. Four different activating effects have been distinguished (Buchanan et al., 1992). Firstly, sex hormones can directly influence physical appearance, and thereby provoke new behaviour (as in puberty). Secondly, sex hormones can bring about

sensorial changes of receptors in the cortex that indirectly cause mood changes by secretion of neurotransmitters (for instance, serotonin). A higher sensitivity to the environment could cause increased irritation when negative life events occur or an elevation of well being in the case of positive life events. Thirdly, metabolic processes can be increased or decreased by sex hormones and can therefore cause mood changes. Finally, sex hormones directly influence the hypothalamus and the hippocampus of the central nervous system. These two areas are known to play an important role in the psychological functions of emotion and perception and are known to be responsible for the interpretation of sensory information (Buchanan et al., 1992).

In humans, the influence of the psychosocial environment on behavior is clearly more prominent and difficult to disentangle than the biological one. Hormonal influences on behavior are generally best described as modulating ones. It is as yet unclear which sex hormones play a role in influencing human behavior and precisely in what way. Although both women and men produce estrogens and androgens, the ratios of production vary enormously between the sexes. There are indications that, in addition to same-sex hormones, cross-sex hormones (testosterone in women, estrogens in men) contribute to the expression of sex-dimorphic behaviors in adulthood, for instance aggression and sexual motivation (Archer, 1991; Van de Poll and Van Goozen, 1992). It is unclear to what extent which hormones influence what type of behavior. It would be interesting to study the effects of exogenously administered testosterone on women and the effects of androgen deprivation and estrogen administration on men. However, such experimental research on humans is, for ethical reasons, virtually impossible.

Sex hormones and emotional functioning

Many studies have focused on the effects of estrogen on the psychological functioning of women. A continuous, moderate level of estrogen in circulating blood has been held responsible for a positive feeling of satisfaction (Buchanan et al., 1992). Downward fluctuations of the estrogen level (just before menstruation, after the birth of a child, or during menopause) may be responsible for feelings of depression, irritation, tiredness and fear. In contrast, upward fluctuations can increase a woman's aggressiveness in reaction to anger provocation (Van Goozen et al., 1996; Finkelstein et al., 1997). However, how sex hormones precisely affect

individual feelings and behavior seems to be dependent on inter-individual differences in hormone sensitivity (Buchanan et al., 1992). Virtually nothing is known about the involvement of estrogens in man's emotional functioning.

Apart from the influence of estrogen, emotional functioning is also influenced by testosterone. The focus in research has been mainly on aggression and sexuality. For women, a positive relationship has been described between testosterone and initiative, inventive and uninhibited impulsive behavior (Baucom et al., 1985). Among female prison inmates, testosterone was found to be related to unprovoked violence and aggressive dominance (Dabbs Jr. et al., 1988; Dabbs Jr. and Hargrove, 1997). For men, a similar relation has been found between testosterone and uninhibited behavior (Daitzman and Zuckerman, 1980). It has also been suggested that higher levels of testosterone are related to increased feelings of irritation and impatience in frustrating situations in 16-year-old boys (Olweus et al., 1980; Olweus et al., 1988). For both healthy adult men and women, testosterone has been found to correlate positively with aggression, and negatively with a pro-social personality (Harris et al., 1996). Moreover, androgen administration to strength bodybuilders, athletes and hypogonadal adolescents has been shown to directly result in enhanced feelings of aggressiveness (Galligani et al., 1996; Finkelstein et al., 1997).

It is well established that testosterone affects the sexual interest and arousal of adult males (Cohen-Kettenis and Gooren, 1992). Women are probably more responsive to minor variations in circulating testosterone levels (Sherwin, 1988; Van Goozen et al., 1997). For example, female sexual desire, excitement, sexual initiative and responsiveness have been found to correlate significantly with (mid-cycle) levels of testosterone (Adams et al., 1978; Persky et al., 1978; Morris et al, 1987). Exposure to exogenous androgens in women has yielded only conflicting results so far (Carney et al., 1978; Mathews et al., 1983; Sherwin and Gelfand, 1987).

Cross-sex hormone treatment in transsexuals

Transsexuality is defined as an incongruence between the biological sex and the experienced and self-declared gender identity (Gooren, 1984). As a part of their sex reassignment, anti-androgens in combination with estrogens are administered to MtFs, while FtMs receive androgen therapy. Earlier studies established that untreated MtFs do not differ in sex hormone levels from other biological men (Spijkstra et al., 1988), and that FtMs do not differ in this respect from other biological

women (Spinder et al., 1989). After three months of hormone treatment, sex hormone levels of transsexuals are in the range of those of the opposite sex (Meyer et al., 1986).

Effects of cross-sex hormone treatment on emotional functioning

Little is known about the influence of cross-sex hormones on the psychological functioning of transsexuals. Although physical changes during hormone treatment are thoroughly documented, research on psychological changes has lagged behind. In a review of 30 years of studies on the psychological functioning of transsexuals (Lothstein, 1984), it was concluded that, prior to hormone therapy, MtFs, when compared to FtMs, were less stable and showed more psychopathology. However, after the start of hormone treatment during the 'real-life' test, the emotional stability of MtFs clearly increased, a process which continued until after the sex reassignment (Lothstein, 1984). This emotional adjustment, as a result of a decrease of depression and psychastenia, has been ascribed to the direct effects of the estrogen treatment (Leavitt et al., 1980). In keeping with these observations, others (Van Kemanade et al., 1989) observed an increase in energy and relaxation after eight weeks of anti-androgen treatment in MtFs, and a decrease in feelings of fear and exhaustion. In a large study, the psychological functioning of three groups of transsexuals were compared, before, during and after their sex reassignment (Kuiper, 1991). MtFs in the pre-treatment phase showed as much somatization as MtFs during and after their sex reassignment, whereas FtMs somatized less during and after sex reassignment than pre-treatment FtMs. Also, the further the sex reassignment had proceeded in these three groups, the more extrovert FtMs were, and the less extroversion was observed in MtFs. In general, transsexuals who had finished sex reassignment were more content than those who were still going through the process, and the latter group were more content than those who had not yet begun sex reassignment. Occasionally, shortly after the onset of hormone therapy, MtFs experience increased feelings of lability and depression. This phenomenon has been ascribed to the direct influence of hormone treatment (Asscheman and Gooren, 1992): the rapid rise of the estrogen level in the early stages of hormone treatment causing sudden changes in hormone levels. After stabilisation MtFs supposedly experience an emotional adjustment to estrogen.

It has been suggested more recently that there is a direct relationship between

exogenous sex hormones and sex-specific behavior in both MtFs and FtMs (Van Goozen et al., 1995). After three months of cross-gender sex hormone treatment, MtFs showed a decrease in irritability and sexual arousability. After three months of androgen-intake, FtMs became more prone to anger and aggression, and their sexual motivation and arousability increased. According to their diaries, in which they reported their feelings on a daily basis, neither group experienced remarkable mood swings. However, MtFs reported more mood swings than FtMs, showing a peak in the second month.

While many studies have focused on the relationship between sex hormones and emotionality in general, little is known about how affect intensity is influenced. It has been found that women experience emotional reactions to both negative and positive life events more intensively than do men (Larsen and Diener, 1987; Manstead, 1992). Furthermore, there are indications that the non-verbal emotional expressiveness of women is greater than that of men (Friedman et al., 1980; Reinisch and Sanders, 1986; Manstead, 1992). In contrast, the anger intensity is reported to be more pronounced in men than in women (Reinisch and Sanders, 1986; Gladue and Bailey, 1995). The purpose of the present study was to investigate whether cross-sex hormones influence affect intensity of negative and positive emotions in general, thereby addressing aggressive feelings, anger readiness, and non-verbal emotional expressiveness in particular. We predicted that affect intensity and non-verbal emotional expressiveness would increase in MtFs and would decrease in FtMs as a result of their hormone treatments.

It was found that testosterone therapy in FtMs clearly stimulated aggression and sexual feelings, and had a diminishing effect on their affect intensity in general. Although FtMs derive large benefits from their sex reassignment, they seemed to be less emotionally susceptible to either positive or negative life events, but more to situations with a provocative or sexual content. In contrast, the influence of estrogen treatment in MtFs was less clear. Although their sensitivity to negative life events remained high over time, they reported experiencing more positive feelings, and they were more emotionally expressive and anger prone, after the start of hormone treatment. None of these results could be attributed to the fact that transsexuals changed in a manner they believed to be stereotypical of their desired sex or according to their expectations.

In a small subgroup of six FtMs that we intensively examined on a daily basis, rapid physical changes were found after the start of testosterone therapy. Feelings of depression, irritation, impulsiveness, well being, withdrawal, tiredness, and sexual interest did not vary systematically with changing testosterone levels during the two-week cycle of hormone treatment. However, sexual behavior clearly occurred more frequently seven to ten days after Free Testosterone levels were at their maximum (the so called FT-peak, approximately two days after testosterone injection). It is therefore suggested that testosterone has a delayed effect on sexuality.

Materials and Methods

Sample

Our sample included 54 male-to-female transsexuals and 47 female-to-male transsexuals, all diagnosed as such by the psychologists and psychiatrists of the Free University Hospital gender team in Amsterdam. They were all eligible for sex reassignment and participated voluntarily in our research. All procedures were carried out with the adequate understanding and written consent of the subjects. The study was approved by the institutional ethical review board. The mean age of MtFs was 32.9 years (SD=10.8; range 19-66 years) and that of FtMs was 25.7 years (SD=7.5; range 16-44 years). The groups differed significantly in age ($p< 0.001$). Hormone treatment for MtFs consisted of orally taken cyproterone acetate (Androcur: 50 mg/twice a day) as an anti-androgen, in combination with either orally taken ethynyl-estradiol (Lynoral: 0.05 mg/twice a day, N=32) or 17ß oestradiol-plasters (Estraderm TTS: 0.1 mg/day, N=22). Forty-two FtMs were administered with intramuscular testosterone-esters (Sustanon: 250 mg/2 weeks); five subjects used orally taken undecanated testosterone (Andriol: 200 mg/day). A subgroup of six FtMs using testosterone-esters participated in the study on emotional effects of their two-week cycle of rapidly changing testosterone levels (see Figure 1). Their ages were between 21 and 28 years.

Procedure

A test battery containing five different questionnaires was applied twice to all transsexual subjects: once before the onset of hormone therapy, and once after approximately 14 weeks of hormone therapy. In order to diminish the variation in testosterone levels during their two-week testosterone cycle, the second test session was six days after their last hormone injection.

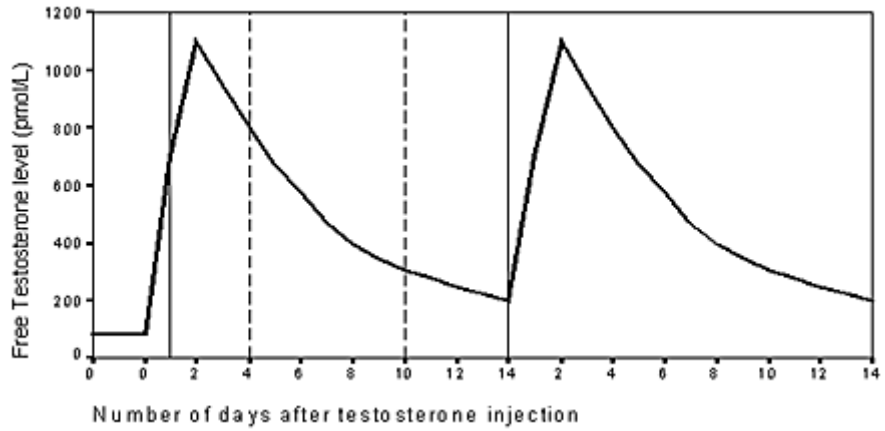

Figure 1. Example of a two-week cycle of Free Testosterone (FT) before and after hormone injection as measured in saliva of a female-to-male transsexual

The subgroup of six FtMs was asked to fill out a diary for 11 weeks, starting one week prior to hormone treatment and expected onset of menses. In addition, they collected saliva samples on days 1, 4 and 7 in the week prior to the start of hormone treatment and for 10 weeks on days 3, 9 and 14 during their two-week cycle of hormone injections. In this 14-day period, testosterone is expected to rise rapidly, reaching its peak level around day 2, after which testosterone levels slowly decline to levels that are slightly above those of the baseline (Behre et al., 1990). Data from the diary were correlated with saliva FT-levels: (a) baseline (mean of first week prior to hormone treatment); (b) cycle 1 (mean of the two weeks of adjustment after first hormone injection); (c) day 1 through day 3 of cycle 2-5 (peak of FT after hormone injection); (d) day 4 through day 9 of cycle 2-5 (average level of FT); and (e) day 10 through day 14 of cycle 2-5 (lowest FT level during the 2-week cycle, just prior to the next hormone injection). Figure 1 shows the expected FT levels during the two-week cycle after hormone injection and the time periods during which means of the diary data were calculated.

Instruments

Expectancy list of mood and sexual interest. This list was included to investigate the expectations of the transsexuals regarding possible hormonal effects, and whether they changed accordingly. Before the onset of hormone treatment, subjects rated on a 15-item list how much they expected their moods and sexual interest to change under the influence of hormone therapy. On the second testing occasion, after 14 weeks of treatment, they rated the same items again indicating how much they felt they really had changed during this period of hormone therapy. The 15 items could

be rated on a 10-point scale (1=no change at all, 10=very much so). Four categories were calculated: positive emotions (cheerful, easy to get on with, energetic & lively, relaxed, active, and satisfied), negative emotions (tired & flat, tense & nervous, gloomy & depressed, and changeable mood), aggressiveness ((quickly) irritated, aggressive, and bad-tempered and grumbling), and sexuality (interested in sex and sexual fantasies).

The Dutch Sex Role Questionnaire (NSRV in Dutch) (Willemsen and Fisher, 1992) was included in order to control for the possibility that transsexuals answered in a manner they believed to be stereotypical of their desired sex. This questionnaire consists of personality characteristics that are usually ascribed to females (15 items) or to males (15 items) and behaviors that are supposed feminine (14 items) or masculine (14 items). Examples of feminine characteristics are curious, dependent, and sensitive; masculine characteristics are adventurous, ambitious, and dominant. An example of a question on behavior is: "Which sport would you prefer to play: ballet, horse riding, swimming, soccer, or boxing?" All items have a 5-point scale and four subscores are calculated: a female character score and male character score (range: 15-75) and a female behavior score and male behavior score (range: 14-70). The Cronbach alpha coefficient for the internal consistency of the NSRV has been rated between 0.67 and 0.71 on these four subscales (Willemsen and Fisher, 1999). Men have higher scores than women on masculinity scales, whereas women have higher scores than men on femininity (Willemsen and Fisher, 1999). For the transsexual group, reversed gender differences were expected, but the scores were predicted to remain stable and not to change over the course of the 14-week treatment.

The Affect Intensity Measure (AIM) (Larsen and Diener, 1987) is a 40-item questionnaire that assesses the intensity by which an individual experiences his or her emotions. On a 6-point scale, from 1 (never) to 6 (always), the subject indicates how often each statement applies to him/herself. An example of an item is "Whenever I solve a personal problem I feel happy and excited". The Cronbach alpha coefficient for the internal consistency of the AIM has been rated between 0.90 and 0.94 (Larsen and Diener, 1987). The minimum total score is 40, the maximum total score 240. In addition, separate scores were calculated for the intensity of negative emotions, such as guilt and shame (12 items; AIM Neg. scores between 12-72) and

positive emotions, such as happiness and excitement (28 items; AIM Pos. scores between 28-168). On this particular questionnaire, women were found to experience more affect intensity in both negative and positive emotions than men (Larsen and Diener, 1987).

The Short Anger Situation Questionnaire (ASQ) (Van Goozen et al., 1994) for measuring anger, negative emotions and angry readiness was administered in a version of 17 items. Each item starts by describing a situation in which the subject has to imagine him/herself. For each vignette three questions are asked: 1) "How would you feel in such a situation?" One can choose one of five answers (I would feel nothing, sad, powerless, disappointed or angry); 2) "How intense would your feeling be?" Answers are on a 5-point scale from 1 (hardly) to 5 (very much); 3) "What would you incline to do in such a situation?" Each vignette offers five action tendencies that are tailored to the situation under consideration. These action tendencies are converted into five categories (1=duck out of the situation, 2=do nothing; 3=indirect angry behaviour; 4=assertive behaviour; 5=aggressive behaviour). The intensity of (negative) emotions was measured by a mean score of the intensity scale whenever a subject labelled the situation as one of sadness, powerlessness or disappointment (ASQ Emot. Intensity). The intensity of anger was measured by a mean score of the intensity scale whenever a subject labelled the situation as one of anger (ASQ Anger Intensity). An anger readiness score was calculated as the percentage of items checked for assertive and aggressive behavior (ASQ Anger Readiness). The ASQ was originally designed to test women's anger. Since the vignettes typically apply to anger provoking situations in women, it has been found that women score higher on anger than men on this questionnaire (Van Goozen et al., 1995). Nevertheless, we predicted an increase in anger intensity and anger readiness under the influence of testosterone administration in FtMs.

The Affective Communication Test (ACT) (Friedman et al., 1980) measures individual differences in non-verbal emotional expressiveness. The respondent indicates on a 9-point scale how much s/he agrees or disagrees with each of 13 statements. The ACT has six items that are reversed and therefore ought to be rekeyed. An example of a statement is: "When telephoning I express my feelings quite easily". The Cronbach alpha coefficient for the internal consistency of the ACT equals 0.77. The scores range from 13 to 117. The non-verbal expressiveness as measured by this

questionnaire was greater in women than in men at the level of $p<0.1$ (Friedman et al., 1980)

Diary We used a shortened and translated version of the *Premenstrual Assessment Form* (PAF) (Halbreich et al., 1982) containing 25 items, which were rated on a scale from 1 (not at all) to 5 (very much). Three scales were computed: depressed mood (12 items), irritation/impulsiveness (6 items), social withdrawal/ tiredness (4 items) and well being (3 items). Sexual interest was measured by adding 4 items: sexual fantasies, thinking of sex, desire to look at erotic pictures or movies, and feeling sexually aroused (range 4-20). Sexual activity was measured by the daily report of the frequency of masturbation and sex involving a partner. Physical changes, such as beard growth, clitoral enlargement, and pitch of the voice were recorded daily on eight items in a multiple choice format (yes, no, don't know).

Hormone assay

Free testosterone in saliva was measured in six FtMs after diethylether extraction using an in-house competitive radio-immunoassay employing a polyclonal antitestosterone-antibody (Dr.Pratt AZG 3290). [1,2,6,7-^{3}H]-Testosterone (TRK402, Amersham Nederland B.V.) was used as a tracer following chromatographic verification of its purity. The lower limit of detection was 10 pmol/L and inter-assay variation was 16.1; 11.5; and 5.1% at 21; 100 and 230 pmol/L respectively (n=4,5,5).

Data analysis

Our study involved a combined between-within subject design. The influence of cross-sex hormone treatment on emotionality was investigated by means of separate repeated measures analyses of variance (ANOVA) for the categories of the expectancy list, the NSRV, the AIM, the ASQ, and the ACT. In all analyses, "group" (MtFs vs. FtMs) was taken as a between-subjects factor and "time" as a within-subjects factor (pre-test vs. post-test). Additional paired comparisons were conducted whenever a time or interaction effect was found to be significant.

One-way ANOVAs were conducted in order to analyse the hormonal data and the diary data, comparing emotional factors at the five time periods at which testosterone levels differed. Whenever the outcome of ANOVA was significant, additional Helmert contrast and simple contrast analyses were conducted. By using Helmert contrasts the effect for each time period was compared to the mean effect of subsequent time periods: a) baseline with hormonal treatment (cycle 1-5); b) cycle 1 with cycle 2-5; c) day 1-3 of cycle 2-5 with day 4-14 of cycle 2-5; d) day 4-9 of cycle 2-5 with day 10-14

of cycle 2-5. By using simple contrasts, the effect of each time period during hormone treatment was compared to effect of the baseline.

Results

Expectations and self evaluations of hormonal influences

Table 1 presents the data of the results of expectancy list. Comparisons, of expectations before and actual experienced feelings after a 14-week period of hormone therapy, revealed a time effect for positive emotions, aggressive and sexual feelings. Paired comparisons showed that MtFs experienced significantly more positive emotions ($t=2.03$, $p<0.05$), whereas FtMs experienced significantly more aggressive ($t=2.77$, $p<0.01$) and sexual feelings ($t=2.40$, $p<0.05$) than they actually expected as a result of the hormone therapy. There were no changes over time, but a group difference was found for negative emotions. Overall, MtFs expected and experienced more feelings of being tired and flat, tense and nervous, gloomy and depressed, and having changeable moods than FtMs. No interaction of time and group was found for any of the emotion categories assessed.

Table 1. Mean scores of transsexuals on expectancy of hormone influence on emotional functioning (t1) and their actually experienced changes (t2) with their standard deviations. Differences were analyzed by ANOVA using Time as a within-subjects factor and Group as between-subjects factor.

Instrument	t	MtFs (n=54)	sd	FtMs (n=47)	sd	Time F(1,99)	Group F(1,99)	Time x Group F(1,99)
Positive Emotions	1 2	4.6 5.4	2.2 2.4	4.5 4.9	2.5 2.2	4.03*	0.75	0.26
Negative Emotions	1 2	4.6 4.5	2.0 2.2	3.5 3.5	1.5 2.0	0.00	12.51***	0.01
Aggressive Emotions	1 2	3.3 3.4	2.0 2.4	3.8 4.9	2.3 2.9	5.47*	0.056	3.80
Sexuality	1 2	4.1 4.7	2.8 2.9	4.9 6.2	2.9 2.8	7.01**	6.70*	0.81

t1=before hormone treatment; t2=after 14 weeks of hormone treatment;
MtF=Male-to-Female transsexuals; FtM=Female-to-Male transsexuals; sd=standard deviation
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Hormonal effects on gender role and emotionality

Table 2 shows the data from the gender role and emotion questionnaires. No group differences were found for female and male character or female behavior. However, a significant group difference for male behavior (MtFs<FtMs) became apparent. No

significant time or interaction effects of time and group were found for any of the subscale scores, indicating that these gender role aspects had not changed during cross-sex hormone treatment.

As for emotionality, an interaction between time and group was found on the Affect Intensity Measure (AIM). Paired comparisons showed that MtFs increased in affect intensity ($t(1,99)=4.27$, $p<0.001$), while FtMs decreased ($t(1,99)=3.26$, $p<0.001$) over time during hormone therapy. When the affect intensity was analyzed separately for positive (AIM Pos.) and negative emotions (AIM Neg.), an interaction effect was only found for positive emotions due to a significant increase in MtFs ($t=2.59$, $p<0.05$) and no significant change in FtMs ($t=1.11$, ns). Thus, the increase of MtFs in total score on the AIM was due to an increase in the intensity of positive emotions, while in FtMs the significant decrease in affect intensity could be attributed to a decrease of the combined positive and negative emotions (Table 2).

Table 2. Mean scores of transsexuals on gender role and emotional functioning and their standard deviations. Differences were analyzed by separate ANOVA's using Time as a within-subjects factor and Group as between-subjects factor.

Instrument	t	MtFs (n=54)	sd	FtMs (n=47)	Sd	Time F(1,99)	Group F(1,99)	Time x Group F(1,99)
Female Character	1 2	53.0 53.4	5.5 4.4	52.2 51.5	5.5 4.9	0.16	1.41	1.72
Male Character	1 2	49.0 48.7	5.1 5.4	49.1 49.2	7.1 7.1	0.03	0.07	0.15
Female Behavior	1 2	45.8 46.2	5.0 5.1	48.1 47.1	5.8 5.3	0.43	2.30	2.56
Male Behavior	1 2	38.7 36.8	5.1 5.3	44.9 44.8	6.6 6.3	3.70	47.22***	3.25
AIM Total	1 2	140.7 144.7	21.0 21.1	143.6 140.5	22.3 20.6	0.12	0.03	6.55*
AIM Neg.	1 2	42.9 42.6	8.9 9.6	40.7 39.4	9.7 9.1	1.82	2.28	0.80
AIM Pos.	1 2	97.9 102.1	15.8 14.1	102.9 101.1	16.4 16.4	1.16	0.48	6.84**

ASQ Neg.	1 2	2.8 2.7	0.8 1.0	2.1 2.2	0.9 1.0	0.00	11.55**	0.81
ASQ Anger	1 2	3.5 3.3	0.8 0.7	3.4 3.5	0.7 0.8	1.14	0.00	2.93
ASQ Anger Readiness	1 2	57.2 61.9	17.1 14.1	59.3 62.5	17.0 17.4	4.91*	0.24	0.19
ACT	1 2	62.8 66.9	13.4 14.0	61.3 60.8	16.3 15.7	2.95	1.91	4.74*

t1=before hormone treatment; t2=after 14 weeks of hormone treatment; MtF=male-to-female transsexuals; FtM=female-to-male transsexuals; sd=standard deviation; AIM=Affect Intensity Measure; ASQ=Anger Situation Questionnaire; ACT=Affective Communication Test. $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

No time effects or interactions between time and group were found for (negative) emotional intensity as measured by the Anger Situation Questionnaire (ASQ Neg.). Similar to what we found on the expectancy list, there was a significant group effect for the intensity of negative emotions, with MtFs scoring generally higher (Table 2). No significant main effect of time, of group or interaction was observed for the intensity of anger (ASQ Anger; Table 2). As for angry behavior (ASQ Anger Readiness), a time effect was found with both MtFs and FtMs scoring higher on the second occasion. For non-verbal expressive behavior (ACT), an interaction effect between time and group was found. Separate paired comparison tests revealed that MtFs increased in emotional expressiveness ($t(1,99)=4.1$, $p<0.001$) over time, while FtMs remained stable ($t(1,99)=0.33$, ns).

Results of study on two-week cycle effects of testosterone administration

Hormonal assay

Table 3 shows the mean Free Testosterone (FT) levels as measured at different time periods: the first week (mean FT of day 1, 4 and 7) to obtain baseline data before the start of testosterone administration, the first two-week cycle of testosterone treatment (mean FT of day 3, 9 and 14) when subjects are adjusting to the hormone treatment, and day 3, day 9 and day 14 as separate variables as measured by their means over cycle 2 through 5.

Table 3. Mean free testosterone (FT) levels measured in saliva in six female-to-male transsexuals (FtMs) and their mean sexual interest (Sex interest) and sexual activity (Sex act) as measured by frequency of masturbation and sex involving a partner (per week) and their

standard deviations						
Time	**FT (pmol/L)**		**Sex interest**		**Sex act (p/w)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Baseline : day 1,4,7	75.83	26.47	6.12	2.11	1.68	1.89
Cycle 1 : day 3,9,14	283.89	162.85	5.87	2.36	1.75	1.89
Cycle 2-5: day 3	946.04	272.56	6.58	3.36	2.52	3.22
Cycle 2-5: day 9	372.08	104.84	7.07	3.08	4.27	3.99
Cycle 2-5: day 14	204.17	60.50	7.26	2.91	5.53	5.04

Baseline=one week before the start of hormone treatment;
cycle 1=two weeks after first testosterone injection;
cycle 2-5=two weeks after respectively second, third and fourth testosterone injection.

Results of a one-way ANOVA showed that there were significant differences in FT levels between the five time periods measured ($F(4,103)=105.01$, $p<0.0001$). Helmert contrasts showed that baseline FT levels were significantly lower than mean FT levels during hormone treatment ($t=-9.31$, $p<0.0001$); FT levels of cycle 1 were lower than mean FT levels of cycle 2 through 5 ($t=-5.44$, $p<0.0001$); day 3 of cycle 2-5 showed the highest FT level compared to the mean of day 9 and day 14 ($t=16.86$, $p<0.0001$); FT levels on day 14 in cycle 2-5 were lower than those on day 9 ($t=3.73$, $p<0.001$). Simple contrast analyses showed that baseline FT levels differed from cycle 1 ($t=4.00$, $p<0.001$), from day 3 in cycle 2 through 5 ($t=17.88$, $p<0.0001$), from day 9 in cycle 2 through 5 ($t=6.09$, $p<0.0001$), and from FT levels on day 14 in cycle 2 through 5 ($t=2.64$, $p<0.01$).

Mood diary

No mood changes were found when the five time periods with varying FT levels were compared for depressed mood ($F=0.83$, ns), irritation and impulsiveness ($F=0.62$, ns), well being ($F=1.06$, ns) or withdrawal and tiredness ($F=0.19$, ns). Thus, at the time of the FT-peak (day 1-3) moods were reported not to be different from the days on which FT levels were significantly lower.

Sexual interest and sexual activity

Sexual interest did not differ between the time periods measured ($F(4,91)=0.74$, ns). However, sexual activity showed a significant difference ($F(4,91)=3.79$, $p=0.007$) and a linear increase over the time periods measured ($t=2.85$, $p=0.0054$; see Table 3.3). Helmert contrasts showed that during cycle 2-5 sexual activity was higher than during cycle 1 ($t=-2.38$, $p=0.019$), whereas during day 4-14 in cycle 2-5 mean sexual activity was higher than during day 1-3 ($t=-2.55$, $p=0.012$). No difference in sexual activity was observed between day 4-9 and day 9-14 in cycle 2-5 ($t=-1.17$, ns). According to simple contrasts, sexual activity was the lowest in the week prior to hormone treatment and during the first cycle, with no statistical difference ($t=0.062$, ns). Sexual activity during the baseline period was also comparable to that on day 1-3 ($t=0.51$, ns) and day 4-9 ($t=1.53$, ns), but lower than sexual activity during day 9-14 in hormone cycle 2-5 ($t=2.28$, $p=0.025$). Thus, FtMs were sexually most active about 7-10 days after their FT-peak.

Physical changes

According to ratings in their diaries, FtMs experienced the following physical changes after the start of their testosterone injections. In order of appearance, they experienced clitoris sensitivity ($M=8.67$ days, $SD=4.50$ days), clitoris growth ($M=21.67$ days, $SD=22.20$), pitch of voice ($M=23.33$ days, $SD=12.64$) and beard growth ($M=42.17$ days, $SD=15.24$). Within ten weeks of hormone treatment, five FtMs experienced weight gain ($M=32.20$ days, $SD=20.73$), had less body fat and more muscles ($M=34.60$ days, $SD=16.86$) and an increase in body hair ($M=41.60$ days, $SD=19.78$), while only three FtMs experienced an increase in body strength near the end of the measurement period ($M=52.67$ days, $SD=9.45$).

Discussion

Research indicates that estrogens are involved in emotional well being in general, whereas testosterone has been more specifically linked to feelings of aggression and sexuality. It has also been shown that there are sex differences in emotional intensity and expressiveness, with women being more emotional in these aspects than men. The aim of the study was to investigate whether cross-sex hormone therapy in transsexuals had predictable effects on affect intensity, anger readiness, and non-verbal emotional expressiveness. We were also interested in whether the rapidly

changing testosterone levels in FtMs in their two-week cycle of hormone treatment had effects on moods, physical appearance and sexuality.

Emotions in general

The results of the present study are in line with earlier studies, namely that cross-sex hormones have a clear effect on the emotional functioning of transsexuals (Van Kemanade et al., 1989; Cohen-Kettenis and Gooren, 1992; Van Goozen et al., 1995). In general, MtFs experienced more negative emotions, both before and after hormone treatment, whereas positive emotions and anger readiness seemed to be increased by hormone therapy. FtMs showed less affect intensity for both negative and positive emotions after testosterone administration, but more anger readiness. Despite these changes, we found no indications that transsexuals changed in a manner they believed to be stereotypical of their desired sex, as their self-attributed gender-related characteristics and gender-role behavior remained stable over the time of hormone treatment. This makes it plausible that the fluctuations in emotional reactions found are due to the variations in sex hormone levels and/or their socio-psychological circumstances.

Negative emotions

Comparisons of initial expectations before, and actually experienced feelings during, hormone therapy revealed that both MtFs and FtMs changed according to their expectations in feelings of depression, tiredness, tenseness and changeable mood (Table 1). However, MtFs experienced these and other negative emotions, such as powerlessness, disappointment and sadness, more intensely than FtMs did, both before and after 14 weeks hormone therapy (Tables 1 and 2). In FtMs, feelings of depressed mood, withdrawal, and tiredness did not vary systematically with changing FT levels during the two-week cycle of hormone treatment. This is in line with the data collected in the female-to-male group as a whole (see Tables 1 and 2).

Positive emotions

Only MtFs experienced a higher than expected increase in positive emotions such as ‘easy to get on with’, relaxation, and activity (Table 1). This positive change during anti-androgen and estrogen treatment in MtFs was also reflected in higher scores on positive emotions, such as happiness and liveliness after hormone treatment (AIM Pos; Table 2). In MtFs, other aspects of emotional behavior, such as affect communication (that is, non-verbal emotional expressiveness), were also changed in a positive direction. No change in positive emotions was found in FtMs (Table 2).

Similarly, daily fluctuations in testosterone levels in FtMs were not related to variations in feelings of well being.

Aggression

After the start of testosterone treatment FtMs reported experiencing more aggression. They scored higher on anger readiness, suggesting that aggression may be influenced by testosterone (Table 1 and 2). This result replicates earlier findings (Van Goozen et al., 1995). However, the *intensity* of aggressive feelings in reaction to anger-eliciting situations was not increased by testosterone treatment in FtMs (ASQ Anger; Table 2), nor were daily fluctuations in testosterone levels related to variations in feelings of irritation and impulsiveness. We were unable to replicate another finding from this earlier study, namely that anger readiness decreased in MtFs after anti-androgen and estrogen treatment (Van Goozen et al., 1995). In fact, we found that MtFs showed more anger proneness after hormone treatment. The finding of increased anger readiness in both transsexual groups may seem unexpected. However, we predicted an increase in anger readiness in FtMs under the influence of the testosterone treatment. In MtFs we predicted an increase in emotionality in general. It is possible that hormone treatment makes MtFs more sensitive to emotional events, whether positive or negative. Thus, when an anger- or aggression-provoking situation comes up, increased levels of estrogens may result in greater aggressiveness (Van Goozen et al., 1996; Finkelstein et al., 1997).

Sexuality

FtMs experienced more sexual feelings than they had expected and showed higher levels of these feelings than MtFs after hormone treatment. In FtMs, sexual activity, as measured by the frequency of masturbation and sex involving a partner, was indirectly related to testosterone, in that sexual activity occurred most frequently seven to ten days after the FT-peak. As has been suggested by others (Bancroft, 1984; Van Goozen et al., 1997), testosterone in biological women could have a delayed effect on sexual activity. Surprisingly, in contrast with sexual activity, sexual interest did not vary along the hormone cycle.

Physical changes

In a small subgroup of six FtMs, rapid physical changes occurred after the start of the hormone therapy, although these varied strongly across individuals. In all FtMs, changes in clitoral sensitivity occurred first, followed by clitoral growth, lowered pitch of voice and beard growth. Other physical changes, such as weight gain, decreased

ratio of body fat and muscles, body hair growth, and increased muscle strength varied considerably across FtMs and were not noticed in all subjects within the ten-week period of measurement. As has been explained before, physical changes are not only influenced by blood levels of testosterone, but also by the individual hormonal sensitivity and genetic make up (Buchanan et al., 1992).

Conclusion

In general, MtFs, like FtMs, derive large benefits from hormone treatment. Hormone therapy not only brings about the important physical changes, but also psychological relief (Lothstein, 1984). It is undoubtedly the case that these physical and psychological influences have a direct effect on emotional feelings. There is clear evidence that MtFs have more difficulty in adapting to the female gender role (Kuiper, 1991) because of a lack of social support (Kockott and Fahrner, 1988). Physical masculinization occurs much faster in FtMs and results in a more convincing opposite sex appearance than feminization in MtFs (Asscheman, 1986; Meyer et al., 1986). It is therefore not surprising that in our study we found that MtFs experienced negative emotions more intensely than FtMs both before and after hormone treatment. However, there is also a large literature suggesting that emotionality is at least partly sex hormone dependent (see Buchanan et al, 1992 for a review). In this study we found that the intensity of emotions in MtFs appeared to be positively influenced by anti-androgen and estrogen treatment, whereas testosterone treatment in FtMs seemed to result in a reduced emotional intensity. While testosterone therapy seemed to stimulate aggression and sexuality in biological women, it seemed to have a dampening effect on their affect intensity in general. Although FtMs in general derive large benefits from their sex reassignment, testosterone may make them emotionally less susceptible to positive or negative life events, but more susceptible to situations with a provocative or sexual content. The potential influence of anti-androgen and estrogen treatment in MtFs is more difficult to disentangle from the socio-psychological one. The start of sex reassignment, initiating the long-wished physical changes, may explain their increased positive emotionality. However, the level of negative emotionality remains high, or is even increased, when they are confronted with aversive emotional events. These findings are in line with earlier findings on the influences of estrogen on negative emotionality (Van Goozen et al, 1996; Finkelstein et al., 1997).

In sum, transsexuals anticipated that some emotions would be influenced by changing hormone levels, but the actual changes were in most cases larger than expected. This finding, combined with the fact that they did not change in self-attributed gender characteristics and gender-role behavior, could be an indication that transsexuals are emotionally influenced by the cross-sex hormone treatment.

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