

Management of children with disorders of sex development: 20-year experience in southern Thailand

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Background: Disorders of sex development (DSD) is a group of sexual differentiation disorders resulting in genital anomalies with defects in gonadal hormone synthesis and/or incomplete genital development. These conditions result in problems concerning the sex assignment of the child. This study aims to describe the clinical features, diagnosis and management of children with DSD in southern Thailand.

Methods: The medical records of 117 pediatric patients diagnosed with DSD during the period of 1991-2011 were retrospectively reviewed.

Results: Disorders of sex development were categorized into 3 groups: sex chromosome abnormalities (53.0%), 46,XX DSD (29.9%) and 46,XY DSD (17.1%). The two most common etiologies of DSD were Turner syndrome (36.8%) and congenital adrenal hyperplasia (29.9%). Ambiguous genitalia/intersex was the main problem in 46,XX DSD (94%) and 46,XY DSD (100%). Sex reassignment was done in 5 children (4.3%) at age of 3-5 years: from male to female in 4 children (1 patient with congenital adrenal hyperplasia, 1 patient with 45,X/46,XY DSD, and 2 patients with 46,XX ovotesticular DSD) and from female to male in 1 patient with 46,XX ovotesticular DSD. Of the total 20 children with 46,XY DSD, 16 (80%) were raised as females.

Conclusion: Management of DSD children has many aspects of concern. Sex assignment/reassignment depends on the phenotype (phallus size) of the external genitalia rather than the sex chromosome.

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Key words: ambiguous genitalia; disorders of sex development; genital ambiguity; gonadal dysgenesis; intersex; sex assignment

Introduction

Disorders of sex development (DSD) comprises a clinically heterogeneous group of conditions involving interference with normal sex differentiation, gonadal hormone synthesis, and/or incomplete genital development in the embryo.^[1-3] Ambiguous genitalia, one of the common clinical manifestations of DSD, can be detected at birth by both physicians and parents, while other manifestations of DSD, such as pubertal disorders, are usually detected later in the childhood or adolescent period by parents. In 2006, the LWPES/ESPE consensus group issued a new nomenclature and classification system for DSD, which included sex chromosome abnormalities, a group of disorders which mostly have unambiguous genitalia, such as Turner syndrome and Klinefelter syndrome, in the category of sex chromosome DSD.^[4-6] It is estimated that the birth prevalence of complex genital anomalies where sex assignment may be difficult at birth is approximately 1 in 4500-5000,^[1,7] and the overall prevalence of sex chromosome DSD and intersex may be as high as 1.7%.^[8]

The presence of genital anomalies in the newborn period is a major concern of parents as well as physicians, and is regarded as a serious problem when a decision regarding sex assignment cannot be made. There have been various algorithms of investigation suggested, but with the wide spectrum of clinical findings and differential diagnoses, no single evaluation protocol can be applied in all circumstances. The main ongoing problems and difficulties in the management of children with DSD involve sex assignment/reassignment. Published articles regarding these difficulties are mostly from western countries. In Thailand, however, where culture, traditions and beliefs are different from western countries, there may be a different set of difficulties and problems in the

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management of DSD. This study aims to describe the clinical features, diagnosis, and management of a cohort of Thai patients presenting with intersex/ambiguous genitalia and pubertal disorders according to the 2006 LWPES/ESPE DSD classifications. A secondary purpose is to describe our approach to patients with ambiguous genitalia for sex assignment/reassignment based on 20 years experience in our institute.

Methods

The medical records of patients with DSD (age range: 0-15 years), who attended the Pediatric Endocrine Clinic at Songklanagarind Hospital, the major tertiary care facility in southern Thailand, from January 1991 to December 2011, were retrospectively reviewed. The DSDs were classified according to the 2006 consensus statement on management of intersex disorders into 3 categories: sex chromosome DSD, 46,XY DSD, and 46,XX DSD. The genital phenotype was considered ambiguous in patients with overt ambiguity, or who had apparent female genitalia with an enlarged clitoris, posterior labial fusion, or labial/inguinal mass, or who had apparent male genitalia with bilateral undescended testes, unilateral undescended testis with micropenis or hypospadias detected by the physicians and/or the parents, or a discordance between genital appearance and karyotype detected after investigation for delayed puberty or primary amenorrhea. The diagnostic evaluation of these patients was based on a history and full clinical examination, a chromosome study, gonadal and pelvic ultrasonography, serum electrolytes, 17-hydroxyprogesterone (basal and stimulated after an adrenocorticotrophic hormone test) and testosterone levels (basal and stimulated after a human chorionic gonadotropin test). A laparoscopic examination and gonadal biopsy were performed in selected cases for definitive determination of gonadal histology. Further data collection included age at initial presentation, clinical manifestations (birthweight, clinical presentations, weight, length/height, phallus length, urogenital sinus opening, the appearance of urogenital folds and labioscrotal swellings), blood chemistries (blood urea nitrogen, creatinine, electrolytes), hormonal studies (cortisol, 17-hydroxyprogesterone, testosterone, estradiol) and radiographic studies (abdominal/pelvic ultrasonography, computed tomography or magnetic resonance imaging of the abdomen and pelvic region). This study included only DSD patients with sex chromosome abnormalities and/or ambiguous genitalia, but those with isolated cryptorchidism, isolated hypospadias, cloacal anomalies, and labial adhesion were excluded.

At initial presentation, all patients had their weight and length/height measured, expressed in cm and kg, respectively, and transformed to a standard deviation score based on chronological age using growth data of the Thai population as a reference.^[9] Ambiguous genitalia was rated according to the Prader classification: grade 1 refers to the presence of mild phallic enlargement without labioscrotal fusion; grade 2 is the presence of mild phallic enlargement and posterior labioscrotal fusion; grade 3 involves a greater degree of phallic enlargement with almost complete labioscrotal fusion and presence of a urogenital sinus; grade 4 refers to the phallic enlargement with urethral orifice at the base of the phallus and completely fused labioscrotal folds, and grade 5 describes a male phenotype with completely fused labioscrotal folds.^[10]

A laparoscopic examination was performed in all patients diagnosed with 46,XY DSD who were female phenotype or who had ambiguous genitalia, in 46,XX DSD patients who were suspected of having intra-abdominal testis or ovotestis, and in patients with the 45X/46,XY karyotype.

The initial sex assignment (at the initial presentation of the patients) was recorded. After the investigations were completed, and the definite diagnosis was made, the sex of some of the patients was reassigned following discussion on the options of sex assignment/reassignment between the pediatric endocrinologist, pediatric surgeon, pediatric psychiatrist and the parents, considering such factors as possibility/probability of a functionally adequate adult phallus and sexual function, the maturing child's body image, fertility, the cosmetic appearance of reconstructed genitalia, and psychosexual aspects of the future adolescent and adult.

The protocol for this study was approved by the Institutional Review Board and the Ethics Committee of the Faculty of Medicine, Prince of Songkla University.

Results

During the 20-year study period, 117 patients were diagnosed with DSD according to the 2006 classification: 62 (53%) with sex chromosome DSD, 35 (29.9%) with 46,XX DSD, and 20 (17.1%) with 46,XY DSD. The disorders in each category of DSD and the ages at initial presentation are shown in Table 1. The most common sex chromosome DSD was Turner syndrome, followed by Klinefelter syndrome and 45,X/46,XY DSD. Girls with Turner syndrome, either 45,X or 46,XX_{abnormal} (46,XXa) presented at a median age of 6.9 years (range: 1.0-14.5 years) in the childhood period with short stature (72.1%) and in the adolescent period with delayed pubertal development and short

stature (27.9%). Nine boys with Klinefelter syndrome presented at a median age of 1 year; 5 (55.6%) were diagnosed by prenatal diagnosis and were followed up for developmental assessment, and 4 (44.4%) presented at age of 3 years with questionable delayed speech. Eight patients with 45,X/46,XY DSD were referred at a median age of 1.5 years (range: 15 days to 5 years) for

evaluation of ambiguous genitalia.

46,XX DSD was diagnosed in 35 patients: 17 (48.6%) with 21-hydroxylase deficiency congenital adrenal hyperplasia, salt-wasting type; 11 (31.4%) with 21-hydroxylase deficiency congenital adrenal hyperplasia, simple virilizing type; 2 (5.7%) with 20,22 desmolase/steroidogenic acute regulatory protein deficiency congenital adrenal hyperplasia (20,22D/StAR deficiency CAH); 1 (2.9%) with 3 β -hydroxysteroid dehydrogenase deficiency congenital adrenal hyperplasia (3 β -HSD deficiency CAH); and 4 (11.4%) with ovotesticular DSD.

Twenty patients were diagnosed with 46,XY DSD: 7 (35.0%) with 46,XY gonadal dysgenesis; 6 (30.0%) with complete androgen insensitivity syndrome; 3 (15.0%) with ovotesticular DSD; 2 (10.0%) with 20, 22D/StAR deficiency CAH, and 2 (10.0%) with 3 β -HSD deficiency CAH.

Patients presenting with genital ambiguity

Of the total 117 DSD patients, 43 (36.8%) presented with genital ambiguity, Prader classification 2-4 (Table 2): 21-hydroxylase deficiency congenital adrenal hyperplasia, salt-wasting type ($n=17$, 39.5%), 21-hydroxylase deficiency congenital adrenal hyperplasia, simple virilizing type ($n=11$, 25.6%), 45X/46,XY DSD ($n=8$, 18.6%), and ovotesticular DSD ($n=7$, 16.3%). The clinical manifestations and the age at initial presentation varied depending on the underlying diseases. The patients with 21-hydroxylase deficiency

Table 1. Clinical features of 117 DSD patients at initial presentation

	n (%)	Age at presentation (y)	
		Median	Range
Chromosomal abnormalities	62		
45,X and 46,XXa	43 (36.8)	6.9	1.0-14.5
47,XXY	9 (7.7)	1.0	0.1-4.5
45,X male	2 (1.7)	0.1	0.1
45X/46,XY DSD	8 (6.8)	1.5	0.1-6.5
46,XX DSD	35		
21-OHD, SW	17 (14.5)	0.15	0.05-0.4
21-OHD, SV	11 (9.4)	4.6	2.5-7.2
20,22 D/StAR CAH	2 (1.7)	0.15	0.1-0.2
3 β -HSD CAH	1 (0.9)	0.1	0.1
46,XX ovotesticular DSD	4 (3.4)	5.4	1.0-14.5
46,XY DSD	20		
46,XY gonadal dysgenesis	7 (6.0)	4.3	0.1-13.5
CAIS	6 (5.1)	3.3	0.3-14.5
46,XY ovotesticular DSD	3 (2.6)	2.4	0.5-5.5
20,22 D/StAR CAH	2 (1.7)	0.15	0.05-0.18
3 β -HSD CAH	2 (1.7)	0.13	0.1-0.15

46,XXa: 46,XX_{abnormal}; DSD: disorders of sex development; 21-OHD, SW: 21-hydroxylase deficiency, salt-wasting type; 21-OHD, SV: 21-hydroxylase deficiency, simple virilizing type; 3 β -HSD CAH: 3 β -hydroxysteroid dehydrogenase deficiency; 20,22 D/StAR: 20,22 desmolase/steroidogenic acute regulatory protein deficiency; CAIS: complete androgen insensitivity syndrome.

Table 2. Clinical findings of DSD patients presenting with ambiguous genitalia

Clinical findings	21-OHD, SW ($n=17$)	21-OHD, SV ($n=11$)	45,X/46,XY DSD ($n=8$)	Ovotesticular DSD ($n=7$)
Age at presentation (y)				
Median	0.15	4.6	1.5	3.4
Range	0.05-0.4	2.5-7.2	0.1-6.5	0.5-14.5
Clinical presentation	Dehydration, ambiguous genitalia	Clitoromegaly	Ambiguous genitalia	Ambiguous genitalia
Phallus length (cm)	2.1	3.5	2.5	2.8
Testis	-	-	Unilateral (5) Non-palpable (3)	Bilateral (1) Unilateral (3) Non-palpable (3)
Cortisol level (μ g/dL)	10.3	9.2	9.7	14.7
Peak cortisol level (μ g/dL)	11.7	23.4	25.3	32.3
Peak 17-hydroxyprogesterone (ng/mL)	237	211	-	-
Testosterone (ng/mL)	7.42	1.65	0.49	0.65
Sex chromosome	46,XX	-	45,X/46,XY	46,XX (4) 46,XY (3)
Initial gender assignment	1 male 16 females	All females	5 males 3 females	5 males 2 females
Laparoscopy				
Gonads	-	-	Dysgenesis + testis (8/8)	Ovary + testis (2) Ovary + ovotestis (3) Ovotestes (2)
Gender reassignment	1 from male to female	-	1 from male to female	2 from male to female 1 from female to male

DSD: disorders of sex development; 21-OHD, SW: 21-hydroxylase deficiency, salt-wasting type; 21-OHD, SV: 21-hydroxylase deficiency, simple virilizing type.

congenital adrenal hyperplasia, salt-wasting type presented with weight loss and dehydration at a median age of 2 months. Physical examination of the genitalia of these patients revealed clitoromegaly with a median length of 2.1 cm (range: 1.6-2.5 cm). One patient with 46,XX was initially assigned as a boy due to marked clitoromegaly of 2.5 cm with nearly completely fused labial folds and scrotal-like labia (Prader classification 4). The parents decided to have the sex reassigned as female after the diagnosis was made, and the girl underwent clitoroplasty and genitoplasty at the age of 1 year. All patients were regularly followed up every 4-6 months. Two patients aged 12 and 14 years (one was assigned at birth as a boy) had declared themselves as girls and had female peer groups, but acted as tomboys (short hair, dressed like boys, had tattoos).

The patients with 21-hydroxylase deficiency congenital adrenal hyperplasia and simple virilizing type presented with growth acceleration, the presence of pubic hair, and progressive clitoromegaly at a median age of 4.6 years. Physical examination of the genitalia of these patients revealed clitoromegaly with a median length of 3.5 cm (range: 2.2-5.5 cm) and pubic hair Tanner 2-3 in 7 patients. After treatment with glucocorticoid, these patients all underwent a clitoroplasty within 6-12 months of diagnosis according to the convenience of the family.

Eight patients with 45,X/46,XY DSD presented with genital ambiguity at a median age of 1.5 years. Physical examination of the genitalia of these patients revealed a median phallus length of 2.5 cm (range: 1.2-3.0 cm). A testis was palpable unilaterally in 5 patients (62.5%). In this group, sex was initially assigned as male in 5 patients and female in 3 patients. Later, after further discussion between the parents and the multidisciplinary team (consisting of a pediatric endocrinologist, a pediatric surgeon, a geneticist, and a child psychiatrist), 1 of these patients (aged 4 years) was reassigned from male to female because of the opening of urogenital slit and the small phallus of originally 1.0 cm in length (Prader classification 2) which had increased to only 1.5 cm after an hCG

stimulation test. Testicular removal and genital reconstruction were performed at the age of 5 years according to the convenience of the family. This patient was regularly followed up and was doing well with her female phenotype and female behavior at age 10.

Seven patients with ovotesticular DSD presented with genital ambiguity at a median age of 3.4 years. Laparoscopic examinations revealed both Wolffian and Mullerian systems in all patients, and various gonadal findings: one ovary and one testis in 2 patients (28.5%), one ovary and one ovotestis in 3 patients (42.9%), and bilateral ovotestes in 2 patients (28.5%). In this group, sex was initially assigned as male in 5 patients and female in 2 patients, and then after discussion between the parents and the multidisciplinary team, 2 patients with 46,XX were sex reassigned from male to female because of the markedly small phallus in both of only about 1.0 cm in length at the age of 3 years and the playing behaviors of both patients were evaluated by the pediatric psychiatrist to be more female in nature. The testis or ovotestis of the two patients was removed at the age 10-12 years after a second psychological evaluation and the declaration of the patients that they preferred to live as girls. Another patient (46,XX) was sex reassigned from female to male at the age of 4 years due to the presence of 3.5 cm, an appropriate size for a male of this age. This patient was lost to follow-up for several years, but then presented with breast development at age 14. He perceived himself as a man by this time; however, he requested breast tissue removal. Genital reconstruction with left gonadectomy (ovariectomy), and bilateral mastectomy were performed on this patient at the age of 15 years. The right testis was situated in a well-formed right scrotal sac.

XY DSD patients presenting with female phenotype

Of the total 20 patients with 46,XY DSD, 16 (80%) presented with the female phenotype, Prader classification 0-1 (Table 3): 46,XY gonadal dysgenesis ($n=7$, 43.8%), complete androgen insensitivity syndrome ($n=6$, 37.5%), 20,22D/StAR deficiency CAH

Table 3. Clinical findings of 46,XY patients presenting with apparent female genitalia or mild degree of ambiguous genitalia

Clinical findings	20,22 D/StAR ($n=2$)	CAIS ($n=6$)	XY gonadal dysgenesis ($n=7$)
Age at presentation (y)			
Median	0.15	3.3	4.3
Range	0.05-0.18	0.3-14.5	0.1-13.5
Clinical presentation	Dehydration/shock	Palpable mass at inguinal area (3) Amenorrhea (3)	Palpable mass at inguinal area (3) Absence of pubertal development (4)
Testosterone, hCG stimulation test (ng/mL)	0.20	2.68	0.60

One patient with 46,XY ovotesticular DSD was not shown in this table. 20,22 D/StAR: 20,22 desmolase/steroidogenic acute regulatory protein deficiency; CAIS: complete androgen insensitivity syndrome; hCG: human chorionic gonadotropin; DSD: disorders of sex development.

($n=2$, 12.5%), and 1 patient with 46,XY ovotesticular DSD (6.2%). The patients with 20,22D/StAR deficiency CAH all presented in the neonatal period with clinical findings of salt-wasting dehydration. The patients with complete androgen insensitivity presented in 2 age groups: 3 patients presented in infancy with a palpable mass at the inguinal area and 3 patients presented in adolescence with primary amenorrhea. The patients with XY complete gonadal dysgenesis also presented in 2 age groups: 3 presented in early childhood with a palpable mass at the inguinal area and 4 presented in adolescence with an absence of pubertal development. In our experience, the most helpful investigation to differentiate between complete androgen insensitivity and complete gonadal dysgenesis is checking the testosterone level after an hCG stimulation test: a significantly elevated level is found in patients with complete androgen insensitivity and a persistently low level in patients with complete gonadal dysgenesis. All of our patients in this group were sex assigned as female, and bilateral orchidectomy was performed at the age of 6-8 years at the convenience of the families.

Discussion

DSD is a serious problem to the patients and their families with different aspects in its different forms to be considered in the diagnosis, investigation, treatment and sex of rearing. The management of DSD is complex and requires a multidisciplinary approach by a team of appropriate professionals. Medical decisions made for patients with DSD are as yet mostly lacking any evidence-based principles, and -an early and correct diagnosis of DSD has important clinical implications for the sex of rearing, the timing of any intervention of the gonads which could carry a potential risk of malignancy, and the decision on the correct timing for a gonadectomy.

In our series of patients with DSD, sex chromosome DSD was more common than 46,XX DSD and 46,XY DSD. Turner syndrome and 21-OH deficiency congenital adrenal hyperplasia were the two most common disorders of all DSD cases (36.8% and 23.9%, respectively). This finding was consistent with the results of the study by Pasterski et al which examined cases from 60 centers in 23 European countries and found that Turner syndrome and congenital adrenal hyperplasia comprised 22.3% and 20.1%, respectively, of the total DSD cases.^[11] On the other hands, other studies in patients with DSD have found congenital adrenal hyperplasia to be the most common underlying etiology of ambiguous genitalia.^[12,13] In our study, if patients with sex chromosome DSD with no ambiguous

genitalia, such as Turner syndrome was excluded, then congenital adrenal hyperplasia would have been the most common etiology of DSD patients with ambiguous genitalia. The varied age at initial presentation of our patients was due to the underlying etiology. Patients with congenital adrenal hyperplasia presented with the earliest age of approximately 1 month because of a salt wasting crisis or poor weight gain whether having ambiguous genitalia or not. In our experience, genital ambiguity alone without an adrenal crisis is not considered as an urgent problem in the neonatal period, as shown by the age of referral to the tertiary center for investigation of 2-4 years in patients with 45,X/46,XY mixed gonadal dysgenesis, ovotesticular DSD and XY gonadal dysgenesis. The main reason most parents gave for this delayed presentation was that they intended to observe their child's behaviors whether they were more male- or female-like before making the decision.

The majority of virilized 46,XX infants in our series were those with 21-hydroxylase congenital adrenal hyperplasia. In such cases, hormonal investigations for steroid profiles are helpful for definite diagnosis, particularly the 17-OHP level. In our series, all except one patient were correctly sex assigned at the initial presentation as girls. In this situation, chromosome studies are very helpful in the decision-making process for sex reassignment, since the prognosis of the outcome of CAH patients is very good after appropriate medical and surgical treatment in the neonatal period.

The result from a chromosome study of 45,X/46,XY is very helpful for diagnosis of mixed gonadal dysgenesis.^[14,15] The other main helpful physical finding is a palpable gonad at the inguinal area in ambiguous genitalia patients who have the 46,XX chromosome which is a suggestive clinical sign of having a testis and can lead to the diagnosis of ovotesticular DSD. The two most important clinical characteristics that can help in differentiating between congenital adrenal hyperplasia and gonadal DSD (mixed gonadal dysgenesis and ovotesticular DSD) are progressive virilization and testosterone level. In patients with congenital adrenal hyperplasia, virilization is progressive with time and the testosterone level is markedly elevated for age, while in patients with gonadal DSD the virilization is non-progressive and the testosterone level is normal for age. The presence of Mullerian and Wolffian ducts, along with the presence of ovary and testis or ovotestes found through laparoscopic examination is an important finding for the diagnosis of ovotesticular DSD, whether the chromosome study result is 46,XX or 46,XY.

The situation of undervirilized 46,XY patients is more complex, and only 50% of cases can be assigned a definite diagnosis.^[16,17] In our series, the diagnosis of complete androgen insensitivity syndrome was made

in 46,XY patients with phenotypically female genitalia whose testosterone level was elevated after an hCG stimulation test. The diagnosis of gonadal dysgenesis was made in 46,XY patients with phenotypically female genitalia whose testosterone level was remained low after an hCG stimulation test. The definite etiology of gonadal dysgenesis could not be determined because of limitations with the current methods of investigation in our institute. All 46,XY patients whose genitalia were female or female-like (except patients with ovotesticular DSD) were raised as girls. In such cases, an orchidectomy is recommended to remove the 10%-15% risk of gonadal malignancy.^[18,19]

Another important management issue in patients with sexual ambiguity is to make a decision regarding sex assignment, particularly when the genital appearance is not compatible with the sex chromosome.^[20,21] The most important factors that influence sex assignment include the definite diagnosis, genital appearance, surgical options, potential for fertility, risks of gonadal malignancy and finally, the perception of the patients. In our experience, all patients with 46,XX CAH and all patients with 46,XY with phenotypically female appearance agreed with sex assignment as girls. The most difficult situation for sex assignment is in patients with mixed gonadal dysgenesis and ovotesticular DSD whose testicular function is evaluated to be normal since these patients could be assigned as either male or female in the neonatal or early childhood periods. However, this early decision at this early age might not be acceptable when they grow up and can make their own decision. In these patients in our situation, the decision regarding sex assignment was based on the potential for a functionally adequate adult phallus and sexual function, body image, fertility, the cosmetic appearance of reconstructed genitalia, and the psychosexual aspects of the future adolescent and adult. Full disclosure and complete involvement of the parents in decisions concerning gender assignment and/or genital surgery must be part of medical care for children presenting with findings consistent with DSD. In such cases, open communication with patients and families is essential. In our current practice, the decision for sex reassignment is based on thorough, extensive discussion with the family, gender appearance, and a psychological evaluation of the patient by a pediatric psychiatrist. Moreover, we postpone any final decision regarding surgical gonadal removal and reconstructive surgery for 5-6 years (or until the patient reaches an age when they are old enough to be aware of the issues) to allow time for psychological re-evaluation and to explore the patient's perception of gender identity before surgical gonadal removal and genital reconstructive surgery.

The study has some limitations. First, it used only data from our hospital, meaning that some children with mild clinical symptoms of DSD, or normal females who simply had delayed puberty might not have been detected and referred. Second, the definite etiology of patients with 46,XY gonadal dysgenesis could not be determined because of limitations with the current methods of investigation in our institute. The strength of this study is that the majority of the patients were regularly followed up for a significant period of time, and the overall psychosocial evaluation of the patients was generally positive as they mostly expressed satisfaction with their sex assignment. Even the two girls with congenital adrenal hyperplasia who had tomboy behavior still perceived themselves as girls and joined in the girls peer group. Follow-up studies regarding their long-term satisfaction with their gender identity, sexual ability, and quality of life would be useful when these patients reach adulthood.

In summary, the management of intersex conditions is a complex situation and requires an experienced multidisciplinary team approach to plan for both immediate and long-term management. All individuals diagnosed with DSD should receive their sex assignment only after careful medical, surgical and psychological assessment and full consultation between the medical team, the patient and his/her family. Genital reconstructive surgery and gonadal removal should be performed by trained and experienced surgeons at the appropriate time after the decision-making of the family and the patient.

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Competing interest: None.

Contributors: Jaruratanasirikul S contributed to concept and design, data analysis and interpretation, manuscript preparation. Engchaun V contributed to data collection and analysis.

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