RBMO

ELSEVIER

ARTICLE

Reproductive functions and fertility preservation in transgender women: a French case series

BIOGRAPHY

Charlotte Dupont specializes in reproductive biology and is currently working at the Tenon Hospital in Paris. Her clinical activity focuses on IVF techniques, gamete donation and fertility preservation. Since gaining her PhD in 2013, she has been pursuing research activity in the field of environment, lifestyle and fertility.

Nathalie Sermondade[1,2], Emmanuelle Benaloun[1], Isabelle Berthaut[1], Emilie Moreau[1], Marie Prades[1], Alix Béranger[1], Nathalie Chabbert-Buffet[3], Nicolaï Johnson[3], Rachel Lévy[1,2], Charlotte Dupont[1,2,*]

KEY MESSAGE

Fertility may be impaired by gender-affirming hormone treatment (GAHT), and suppressed by gender-affirming surgery involving bilateral orchiectomy. Sperm cryopreservation should be included in a patient's care programme. Compared to sperm donors, no significant difference in semen parameters of transgender women who had not started GAHT were observed.

ABSTRACT

Research question: The reproductive potential of transgender people may be impaired by gender-affirming hormone treatment (GAHT) and is obviously suppressed by gender-affirming surgery involving bilateral orchiectomy. The evolution of medical support for transgender people has made fertility preservation strategies possible. Fertility preservation in transgender women mainly relies on sperm cryopreservation. There are few studies on this subject, and the sample sizes are small, and so it difficult to know whether fertility preservation procedures are feasible and effective in trans women.

Design: This retrospective study reports the management of fertility preservation in transgender women referred to the study centre for sperm cryopreservation, and the semen parameters of trans women were compared with those of sperm donors.

Results: Ninety-six per cent of transgender women who had not started treatment benefitted from sperm cryopreservation, compared with 80% of those who attempted a therapeutic window and 50% of those receiving hormonal treatment at the time of sperm collection. No major impairment of semen parameters was observed in transgender women who had not started GAHT compared with sperm donors. However, even though the frequency of oligozoospermia was no different, two transgender women presented azoospermia. Some transgender women who had started GAHT could benefit from sperm freezing. None of them were treated with gonadotrophin-releasing hormone (GnRH) analogues.

Conclusions: Parenthood strategies for transgender people have long been ignored, but this is an important issue to consider, especially because medical treatments and surgeries may be undertaken in adolescents or very young adults. Fertility preservation should ideally be offered prior to initiation of GAHT.

[1] Service de Biologie de la Reproduction CECOS, Hôpital Tenon (AP-HP), Sorbonne Université, Paris 75020, France
[2] Sorbonne Université, Centre de Recherche Saint-Antoine, Inserm US938, Paris 75012, France
[3] Service de Gynécologie, Obstétrique et Médecine de la Reproduction, Hôpital Tenon (AP-HP), Sorbonne Université, 75020 Paris, France

*Corresponding author. E-mail address: charlotte.dupont@aphp.fr (C. Dupont). https://doi.org/10.1016/j.rbmo.2021.04.016
1472-6483/
Declaration: The authors report no financial or commercial conflicts of interest.

KEYWORDS

Fertility preservation
Semen parameters
Sperm cryopreservation
Transgender woman
Trans identity

INTRODUCTION

Trans identity is defined as a gender identity different to the sex assigned at birth. The evolution of transgender people generally corresponds to a physical transition that may involve several stages, including changes in physical appearance and clothing style, as well as medical and surgical interventions. Medical treatments include hormone therapy that suppresses the sexual characteristics of the original gender, usually combined with gender-affirming hormone treatment (GAHT), which induces the evolution of physical characteristics towards the gender with which the individual identifies (*Tangpricha and den Heijer, 2017*). For transgender women, hormonal treatment generally consists of the administration of hormones that allow feminization (anti-androgens and progestogens with or without oestrogens). Gender-affirming surgery, although not systematic, is also a therapeutic option.

The reproductive potential of transgender people is suppressed by gender-affirming surgery involving bilateral orchiectomy, and it can also be impaired by hormonal treatments. Although the consequences probably vary widely based on the treatment strategy (*Schneider et al., 2015*), testicular histology of transgender women shows a major decrease in or even a lack of spermatogenesis after initiation of GAHT (*Schneider et al., 2017*). Moreover, there is little research on the potential recovery of normal spermatogenesis during a therapeutic window, and discontinuing GAHT is usually difficult for transgender people to consider because it is viewed as a backward step. Hence, offering fertility preservation prior to the initiation of hormonal treatment is particularly important. Many scientific organizations, including the American Society for Reproductive Medicine (ASRM), have proposed recommendations concerning information about the potential impact of treatments on reproductive functions and about fertility preservation techniques in a trans identity context (*Ethics Committee of the American Society for Reproductive Medicine, 2015*; *World Professional Association for Transgender Health, 2012*).

The main method of fertility preservation for transgender women is sperm cryopreservation. There are few studies on transgender women who have benefitted from sperm cryopreservation, and the sample sizes are small (*Baram et al., 2019*). A significant alteration in semen parameters was observed in transgender women taking GAHT, as well as a high risk of azoospermia (*Adeleye et al., 2019*). However, a recent retrospective study showed that the sperm parameters of transgender women before beginning GAHT were significantly lower compared to WHO data from the general population and nearly 10% of them presented with azoospermia (*de Nie et al., 2020*).

Although the need to inform patients about the effect of the transition on fertility and the options for fertility preservation has been emphasized, the suspected sperm alterations could complicate and limit the efficiency of such procedures. The aim of this study was to evaluate the feasibility and effectiveness of the fertility preservation procedure in transgender women by comparing their semen parameters with those of a population of healthy sperm donors and by reporting the results of the cryopreservation.

MATERIALS AND METHODS

Patient selection

This was a retrospective study of transgender women who contacted the Assisted Reproductive Technology (ART) Centre at Tenon University Hospital, Paris, between 2018 and 2020. They contacted the ART Centre to get information about fertility preservation and, in most cases, to benefit from sperm cryoconservation. Most of the patients were referred by their physicians (endocrinologists or general practitioners). A medical prescription was necessary for them to benefit from sperm freezing. Patients were offered medical and psychological consultations, followed, if necessary, by an appointment for sperm collection and freezing.

Data collection

The healthcare path of transgender women after the first contact in the study centre was fully recorded, including attendance at the different appointments, such as consultations and sperm freezing. Data about age, hormonal treatment, semen parameters and sperm cryoconservation were collected. The patients were classified into three groups based on GAHT intake: no history of hormonal medication (NHM), previous hormonal medication (PHM) and current hormonal medication (CHM).

Clinical and biological data about sperm donors recruited to the study public centre between 2018 and 2020 were also collected in order to compare semen parameters between the groups. The sperm donors were healthy men aged 18 to 44 years old, with or without children. All sperm donors presented normal semen parameters.

The study protocol was approved by a local ethics committee (IRB CLEA-2020-109) on 17 April 2020.

Sperm parameters analysis

Semen samples were collected following masturbation into a sterile plastic cup in the laboratory. After 30 min of liquefaction at room temperature, conventional semen parameters (semen volume and sperm concentration and motility) were evaluated according to WHO guidelines (*World Health Organization, 2010*). Sperm morphology was assessed using David's classification (*Auger et al., 2016*). Oligozoospermia, or a decrease in total sperm count, is defined as a total of fewer than 39 million spermatozoa in the ejaculate according to WHO guidelines (*World Health Organization, 2010*).

Only semen parameters from the first sperm collection were considered for statistical analyses. All samples from patients and sperm donors were collected at the same centre and analysed under the same conditions.

Sperm freezing

The semen samples of trans women and sperm donors were frozen according to the same standardized protocol. The semen samples were diluted with cryoprotectant medium (SpermFreez™, FertiPro NV, Belgium) and distributed into sperm straws (SpermFreezeTM, FertiPro, Beernem, Belgium). They were frozen in liquid nitrogen vapour using an automatic freezer (Nano-Digitcool, Cryo Bio System). The straws were then plunged into liquid nitrogen and stored in nitrogen tanks. Freezing tolerance was evaluated after one straw had been thawed. Motility and sperm concentration were analysed, and the total number of progressive motile spermatozoa per straw (NMSPS) was calculated. A possible assisted

reproductive technology (ART) strategy was defined according to NMSPS as follows: straws containing fewer than 1 million progressive motile spermatozoa were considered usable for IVF with or without intracytoplasmic sperm injection (ICSI), and straws containing more than 1 million progressive motile spermatozoa were considered usable for intrauterine insemination (IUI).

Statistical analysis

Semen parameters were compared between transgender women who had not started GAHT and sperm donors, as well as between transgender women who had started GAHT and those who had not. The number of sperm collection appointments was also compared across the three groups of trans women.

Variables are presented as mean ± standard error of measurement (SEM) for quantitative variables and as a percentage for qualitative variables. Quantitative variables were analysed using an independent *t*-test or Wilcoxon–Mann–Whitney test when appropriate and Fisher's exact test for qualitative variables. All statistical analyses were performed using Prism 6 software (GraphPad Software Inc., La Jolla, CA, USA), and $P < 0.05$ was considered significant.

RESULTS

Description of the population

Between June 2018 and November 2020, 118 patients were referred for fertility preservation counselling appointments. Twenty-two patients cancelled the appointment and 96 patients were seen in medical and psychological appointments. Among them, 83 attempted at least one sperm collection. One patient experienced sperm collection failure, nine presented with azoospermia and 73 could potentially benefit from sperm cryopreservation (FIGURE 1).

Among the 82 patients for whom sperm parameters could be evaluated, 65 patients had not started GAHT (NHM), five patients declared they had stopped treatment 3–6 months before sperm collection (PHM) and 12 patients were still on hormonal medication (CHM) (TABLE 1).

Comparison between trans women with no history of GAHT (NHM) and sperm donors

The transgender women were significantly younger than the sperm donors (23.9 ± 0.6 [NHM], 27.2 ± 2.5 [PHM], 30.8 ± 3.1 [CHM] versus 35.1 ± 1.0 [SD]; $P < 0.001$). The main semen parameters, including semen volume, sperm concentration, progressive motility and vitality, were not statistically different between transgender women and sperm donors (TABLE 1). However, normal sperm morphology was significantly lower in transgender women than in sperm donors ($P = 0.004$). Although two transgender women presented with azoospermia, the transgender women did not display a higher frequency of oligozoospermia compared with the sperm donors (TABLE 1).

Comparison between trans women with no history of GAHT (NHM) and trans women with a history of GAHT (PHM and CHM)

CHM patients were significantly older than the women with no history of GAHT (NHM) ($P = 0.003$). All semen parameters (volume, concentration, motility and morphology) were significantly altered CHM patients in comparison with those who had never had hormonal treatment ($P = 0.040$, $P < 0.001$, $P = 0.010$, $P < 0.001$, respectively). The finding of oligozoospermia and azoospermia was also more frequent ($P = 0.002$) (TABLE 1). No differences were observed in transgender women who stopped hormonal medication before sperm cryopreservation, but the number of patients included in the study was low.

Results of trans women's sperm cryopreservation

Ninety-seven per cent of women who had not started treatment benefitted from sperm cryopreservation, compared with 80% of those who attempted a therapeutic window and 50% of those receiving hormonal treatment at the time of sperm collection (TABLE 2). The total NMSPS was not significantly different across the three groups, but progressive motility after thawing was reduced in women under GAHT compared with women with no history of hormonal medication ($P = 0.030$). Possible ART strategies (IUI versus IVF/ICSI) were no different between groups.

The majority of the transgender women who had not started treatment (76.2%) and those who were under hormonal treatment (66.7%) visited the centre only once for semen collection and freezing, while most patients who attempted a therapeutic window (75.0%) had to visit at least twice.

The patients under GAHT therapy who could benefit from sperm cryopreservation were using oestrogens combined with progesterone ($n = 5$) or oestrogens combined with spironolactone ($n = 1$). None of the patients taking cyproterone acetate (alone or associated with oestrogens) ($n = 6$) could benefit from sperm cryopreservation due to azoospermia.

DISCUSSION

This study represents the first large French case series of transgender women referred for sperm cryopreservation for fertility preservation purposes. No major impairment of semen parameters was observed in transgender women who had not started GAHT compared with sperm donors. An increase in morphological abnormalities in transgender women was observed, but the clinical consequences are probably irrelevant (*Gatimel et al., 2017*). Moreover, even though the frequency of oligozoospermia did not appear different, two transgender women presented with azoospermia in this case series of 65, corresponding to an unexpectedly high prevalence. These findings are in line with previous publications suggesting that trans women had slightly poorer sperm parameters than cis gender men (*Li et al., 2018*) or young fathers (*Marsh et al., 2019*) or significantly decreased sperm parameters compared with WHO data from the general population (*de Nie et al., 2020*). The observed alterations may have been caused by an increase in scrotal temperature due to tight clothing or the tucking technique that hides the penis and testes (*Thonneau et al., 1998*). A decrease in the frequency or even the absence of ejaculation could also cause decreased sperm production (*AlAwaqi and Hammadeh, 2017*).

Some of the transgender women who had started treatment could benefit from sperm freezing. None of them were treated with cyproterone acetate, a treatment that led to azoospermia in 100% of the cases in this series. Although the literature on the subject remains scarce, a significant alteration in semen parameters was previously observed in transgender women treated with GAHT, as well as a high risk of azoospermia

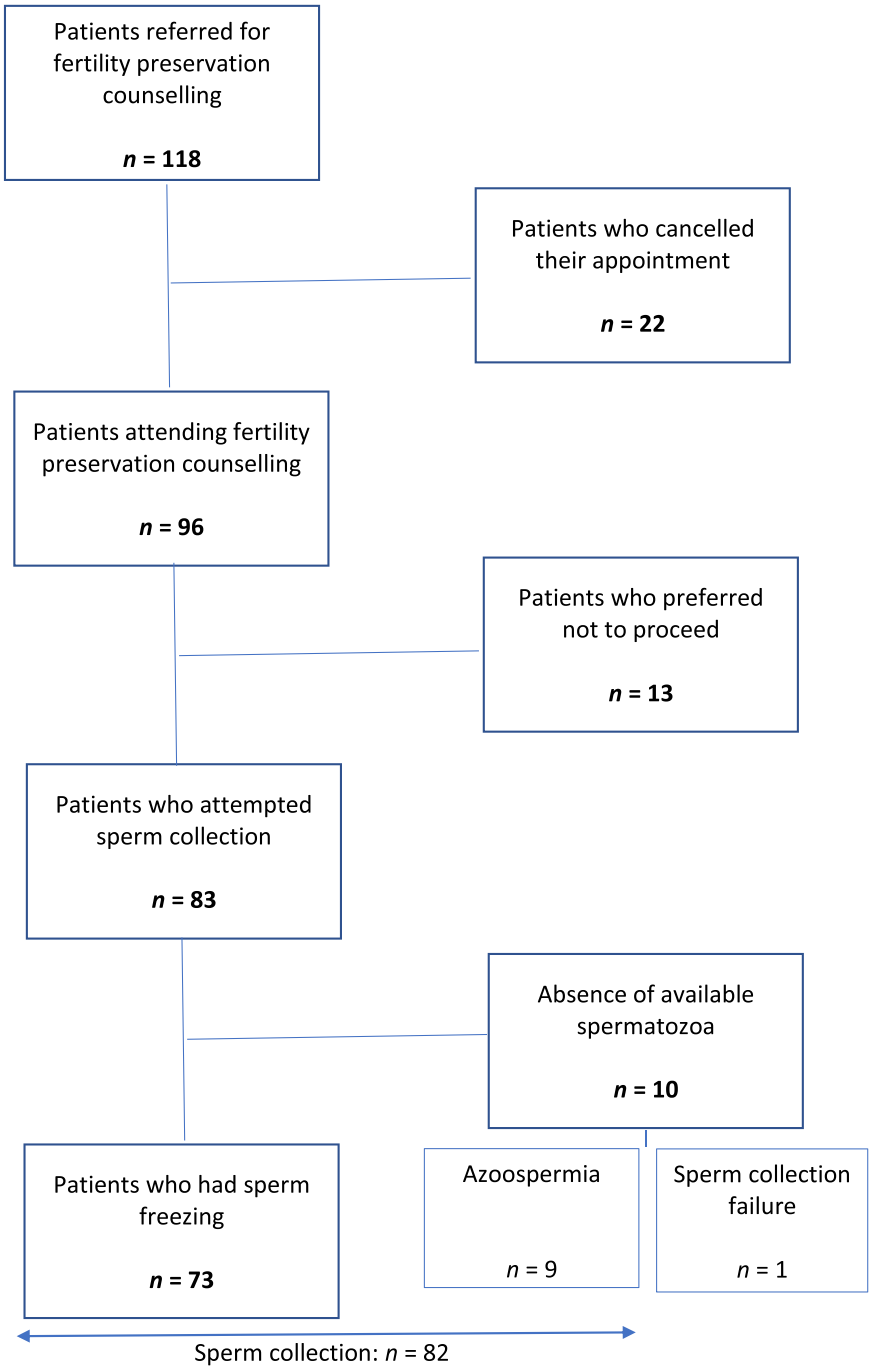

FIGURE 1 Flow chart showing the study population.

(*Adeleye et al., 2019*). In that study, the only patient with normal semen parameters was supplemented with oestrogens only (*Adeleye et al., 2019*). However, even if sperm production is maintained, there are concerns regarding the potential impact of hormonal treatments on the quality of the spermatozoa, such as epigenetic marks (*Semet et al., 2017*), as well as the safety of utilization in terms of embryo development and child health.

Some of the transgender women included in this study discontinued their hormonal treatments during a therapeutic window of 3–6 months for fertility preservation purposes, either by their own decision or following medical advice. These results suggest that the cyproterone acetate effects on semen parameters are not completely reversible. Many questions about the reversibility of GAHT remain, and the required duration of a therapeutic window for the recovery of normal spermatogenesis is unknown. Although it is likely to be at least 3 months (one complete cycle of spermatogenesis) (*Barnard et al., 2019*), it would probably depend on the duration, dose and nature of the hormones, as well as on individual factors. In a previous study, patients underwent a therapeutic window of 3–6 months and exhibited slightly poorer semen parameters than transgender women who had never taken hormones

TABLE 1 CONVENTIONAL SEMEN PARAMETER VALUES

Parameter	Trans women						SD
	CHM	CHM vs NHM *P*-value	PHM	PHM vs NHM *P*-value	NHM	NHM vs SD *P*-value	
n	**12**		**5**		**65**		**38**
Age (years)	30.8 ± 3.1	0.003	27.2 ± 2.5	0.188	23.9 ± 0.6	<0.001	35.1 ± 1.0
Abstinence (days)	13.1 ± 4.4	0.072	5.8 ± 1.7	0.526	5.2 ± 0.7	0.051	3.4 ± 0.3
Volume (ml)	2.1 ± 0.6	0.040	3.3 ± 0.9	0.899	3.6 ± 0.2	0.932	3.6 ± 0.3
Sperm concentration (10^6/ml)	20.3 ± 9.6	<0.001	48.5 ± 28.4	0.382	62.3 ± 5.7	0.152	79.5 ± 12.5
Sperm numeration (10^6)	77.4 ± 42.1	<0.001	237.62 ± 155.0	0.475	214.8 ± 24.7	0.221	273.4 ± 46.6
Progressive motility (%)	24.5 ± 8.2	0.010	26.6 ± 12.2	0.186	44.0 ± 1.7	0.054	42.9 ± 1.9
Vitality (%)	38.1 ± 9.6	0.034	32.7 ± 19.1	0.393	55.7 ± 1.9	0.062	61.3 ± 2.1
Morphology (%)	1.9 ± 0.6	<0.001	5.6 ± 3.6	0.337	7.5 ± 0.6	0.004	11.1 ± 1.2
Azoospermia	6 (50)	–	1 (20)	–	2 (3.1)	–	0
Oligozoospermia	2 (16.7)	–	2 (40)	–	10 (15.4)	–	4 (10.5)
Azoospermia + oligozoospermia	8 (66.7)	0.002	3 (60)	0.062	12 (18.5)	0.400	4 (10.5)

Data are presented as mean ± SEM or *n* (%).

$P < 0.05$ was considered significant.

CHM = current hormonal medication; NHM = no history of hormonal medication; PHM = previous hormonal medication; SD = sperm donor.

(*Adeleye et al., 2019*). In a different case, an absence of sperm production was described 4 months after treatment interruption (*Barnard et al., 2019*), suggesting that a complete reversal of GAHT-related semen impairment cannot be guaranteed. Moreover, a therapeutic window could be difficult for people who have been in treatment for a long time to manage, because discontinuation of the treatment can lead to significant physical and psychological changes. Hence, offering fertility preservation prior to treatment initiation is particularly important.

However, transgender patients may experience difficulties in accessing fertility preservation procedures. Fertility preservation for transgender patients is not equally available in all countries and regions, and it has been reported that information about fertility preservation remains inconsistent (*Vyas et al., 2020*). Health professionals need more comprehensive information in order to provide more information to patients and healthcare facilities. Moreover, although the costs of fertility preservation strategies are covered by national health insurance in France, and all patients have equal access to care, the cost of sperm banking can constitute a barrier in many other countries.

Parenthood strategies for transgender people have long been ignored. Nevertheless, this issue is important to consider, especially because medical treatments and surgeries may be undertaken in adolescents or very young adults (*Rafferty et al., 2018*). Although the fertility of transgender women was not initially a priority, the recent increase in literature reflects a growing interest in this issue. In particular, some studies

TABLE 2 MTF SPERM CRYOCONSERVATION CHARACTERISTICS

Characteristic		CHM	CHM vs NHM *P*-value	PHM	PHM vs NHM *P*-value	NHM
Total number of patients		12		5		65
MtF who had sperm cryoconservation		6 (50)	<0.001	4 (80)	0.197	63 (96.9)
Number of straws at first sperm collection		14.2 ± 3.1	0.249	13.7 ± 4.6	0.969	15.4 ± 0.7
NMSPS (10^6)		1.0 ± 0.4	0.102	4.5 ± 4.0	0.770	2.7 ± 0.3
Progressive motility after thawing (%)		15.0 ± 4.6	0.030	34.7 ± 15.6	0.455	28.4 ± 1.9
Possible ART strategy	IUI + IVF/ICSI	3 (50)	0.390	2 (50)	0.592	43 (68.3)
	IVF/ICSI	3 (50)		2 (50)		20 (31.7)
Number of sperm collections		1.7 ± 0.3	0.196	2.8 ± 1.0	0.015	1.3 ± 0.1
Number of patients who visited once		4 (66.7)	0.630	1 (25.0)	0.056	48 (76.2)
Total straw number		15.7 ± 3.3	0.114	24.7 ± 5.5	0.500	17.8 ± 0.7

Data are presented as mean ± SEM or *n* (%).

$P < 0.05$ was considered significant.

ART = assisted reproductive technology; CHM = current hormonal medication; ICSI = intracytoplasmic sperm injection; IUI = intrauterine insemination; MtF = male to female patients; NHM = no history of hormonal medication; NMSPS = number of progressive motile spermatozoa per straw; PHM = previous hormonal medication.

relying on questionnaires reveal that information about reproductive functions and fertility preservation opportunities is more and more systematic during the transition process (*Baram et al., 2019*). The majority of transgender men and women interviewed stated that they wanted to become parents, but few of them actually benefitted from fertility preservation techniques (*Chen et al., 2019*; *Riggs and Bartholomaeus, 2018*; *Segev-Becker et al., 2020*). This may be due to several factors. Fertility preservation procedures are sometimes responsible for a delay in treatment initiation. The cost may also be a barrier in countries where patients have to pay for fertility preservation procedures. The possibilities of further use of cryopreserved gametes, depending on sexual orientation and the possibility of a partner carrying a pregnancy, may also play a role in the decision. Finally, it is also reported that transgender patients are sometimes not particularly attached to biological parenthood and would be open to alternative strategies such as adoption (*Chen et al., 2019*).

Frozen–thawed spermatozoa can be used for IUI or IVF with or without microinjection (ICSI). Very few cases of the use of frozen sperm samples have been reported in the literature. In 2014, a child was born after IUI was performed with cryopreserved spermatozoa in a couple consisting of a transgender woman and a cisgender woman (*Wierckx et al., 2012*). In 2017, a live birth was achieved following IVF using cryopreserved spermatozoa (*Broughton and Omurtag, 2017*), as well as an ongoing pregnancy following IVF with ICSI (*Jones et al., 2016*). French legislation does not allow the use of cryopreserved spermatozoa once the civil status change is official. To date, no request for cryopreserved sperm use has been made in the study centre.

This study presents inherent limitations due to its retrospective design. However, it represents the first French case series from a reference centre for transgender care, and the number of patients included is relatively high compared with most published studies. Moreover, the studied population includes transgender women who had not started GAHT as well as transgender women who had started GAHT with and without a therapeutic window. Lastly, it was possible to compare the semen parameters of these three groups with the semen parameters of a reference group of healthy sperm donors.

Although further use of cryopreserved gametes remains uncertain and will depend on current regulations in various countries, the cryopreservation of gametes represents an important step in global care for transgender people. The current research shows that it is feasible and effective to provide fertility preservation for trans women through sperm cryopreservation. When performed before the introduction of hormonal therapy, sperm parameters appeared to be slightly altered compared with those of healthy sperm donors. In this situation, one or two appointments were sufficient in most cases to obtain satisfactory results with a reasonable number of usable straws. The current results reveal that information about fertility preservation options should be provided early during the transition in order to facilitate optimal care and avoid the need to resort to a therapeutic window. The spread of this information will rely on networking between practitioners in endocrinology, surgery, gynaecology, reproductive biology, psychiatry and psychology.

ACKNOWLEDGEMENTS

The authors would like to thank Séda Kiliboz, Manel Ichou, Nadine Proust, Clément Lebulanger, Tapa Kaba, Hasret Kiliboz and Nadine Comper, who were all involved in the care of patients.

REFERENCES

Adeleye, A.J., Reid, G., Kao, C.N., Mok-Lin, E., Smith, J.F. **Semen parameters among transgender women with a history of hormonal treatment.** Urology 2019; 124: 136–141. doi:10.1016/j.urology.2018.10.005

AlAwaqi, A., Hammadeh, M.E. **Sexual abstinence and sperm quality.** International Journal of Women's Health and Reproduction Sciences 2017; 5: 11–17

Auger, J., Jouannet, P., Eustache, F. **Another look at human sperm morphology.** Hum. Reprod. 2016; 31: 10–23. doi:10.1093/humrep/dev251

Baram, S., Myers, S.A., Yee, S., Librach, C.L. **Fertility preservation for transgender adolescents and young adults: a systematic review.** Hum. Reprod. Update 2019; 25: 694–716. doi:10.1093/humupd/dmz026

Barnard, E.P., Dhar, C.P., Rothenberg, S.S., Menke, M.N., Witchel, S.F., Montano, G.T., Orwig, K.E., Valli-Pulaski, H. **Fertility preservation outcomes in adolescent and young adult feminizing transgender patients.** Pediatrics 2019; 144e20183943. doi:10.1542/peds.2018-3943

Broughton, D., Omurtag, K. **Care of the transgender or gender-nonconforming patient undergoing in vitro fertilization.** International Journal of Transgenderism 2017; 18: 372–375

Chen, D., Kyweluk, M.A., Sajwani, A., Gordon, E.J., Johnson, E.K., Finlayson, C.A., Woodruff, T.K. **Factors affecting fertility decision-making among transgender adolescents and young adults.** LGBT Health 2019; 6: 107–115. doi:10.1089/lgbt.2018.0250

de Nie, I., Meissner, A., Kostelijk, E.H., Soufan, A.T., Voorn-de Warem, I.A.C., den Heijer, M., Huirne, J., van Mello, N.M. **Impaired semen quality in trans women: prevalence and determinants.** Hum. Reprod. 2020; 35: 1529–1536. doi:10.1093/humrep/deaa133

Ethics Committee of the American Society for Reproductive Medicine. **Access to fertility services by transgender persons: an Ethics Committee opinion.** Fertil. Steril. 2015; 104: 1111–1115. doi:10.1016/j.fertnstert.2015.08.021

Gatimel, N., Moreau, J., Parinaud, J., Leandri, R.D. **Sperm morphology: assessment, pathophysiology, clinical relevance, and state of the art in 2017.** Andrology 2017; 5: 845–862. doi:10.1111/andr.12389

Jones, C.A., Reiter, L., Greenblatt, E. **Fertility preservation in transgender patients.** International Journal of Transgenderism 2016; 17: 76–82. doi:10.1080/15532739.2016.1153992

Li, K., Rodriguez, D., Gabrielsen, J.S., Centola, G.M., Tanrikut, C. **Sperm cryopreservation of transgender individuals: trends and findings in the past decade.** Andrology 2018; 6: 860–864. doi:10.1111/andr.12527

Marsh, C., McCracken, M., Gray, M., Nangia, A., Gay, J., Roby, K.F. **Low total motile sperm in transgender women seeking hormone therapy.** J. Assist. Reprod. Genet. 2019; 36: 1639–1648. doi:10.1007/s10815-019-01504-y

Rafferty, J. **C. Committee on Psychosocial Aspects of Child and Family Health, Committee on Adolescence and Section on Lesbian, Gay, Bisexual, and Transgender Health and Wellness. Ensuring comprehensive care and support for transgender and gender-diverse children and adolescents.** Pediatrics 2018; 142e20182162. doi:10.1542/peds.2018-2162

Riggs, D.W., Bartholomaeus, C. **Fertility preservation decision making amongst**

Australian transgender and non-binary adults. Reprod. Health 2018; 15: 181. doi:10.1186/s12978–018–0627-z

Schneider, F., Kliesch, S., Schlatt, S., Neuhaus, N. **Andrology of male-to-female transsexuals: influence of cross-sex hormone therapy on testicular function.** Andrology 2017; 5: 873–880. doi:10.1111/andr.12405

Schneider, F., Neuhaus, N., Wistuba, J., Zitzmann, M., Hess, J., Mahler, D., van Ahlen, H., Schlatt, S., Kliesch, S. **Testicular functions and clinical characterization of patients with gender dysphoria (GD) undergoing sex reassignment surgery (SRS).** J. Sex Med. 2015; 12: 2190–2200. doi:10.1111/jsm.13022

Segev-Becker, A., Israeli, G., Elkon-Tamir, E., Perl, L., Sekler, O., Amir, H., Interator, H., Dayan, S.C., Chorna, E., Weintrob, N., Oren, A. **Children and adolescents with gender dysphoria in Israel: increasing referral and fertility preservation rates.** Endocr. Pract. 2020; 26: 423–428. doi:10.4158/EP-2019-0418

Semet, M., Paci, M., Saias-Magnan, J., Metzler-Guillemain, C., Boissier, R., Lejeune, H., Perrin, J. **The impact of drugs on male fertility: a review.** Andrology 2017; 5: 640–663. doi:10.1111/andr.12366

Tangpricha, V., den Heijer, M. **Oestrogen and anti-androgen therapy for transgender women.** Lancet Diabetes Endocrinol. 2017; 5: 291–300. doi:10.1016/S2213-8587(16)30319-9

Thonneau, P., Bujan, L., Multigner, L., Mieusset, R. **Occupational heat exposure and male fertility: a review.** Hum. Reprod. 1998; 13: 2122–2125. doi:10.1093/humrep/13.8.2122

Vyas, N., Douglas, C., Mann, C., Weimer, A., Quinn, M. **Access, barriers, and decisional regret in pursuit of fertility preservation among transgender and gender-diverse individuals.** Fertil. Steril. 2020; 115: 1029–1034

World Professional Association for Transgender Health, 2012. Standards de Soins Pour la Santé des Personnes Transsexuelles, Transgenres et de Genre Non-Conforme. https://www.wpath.org/media/cms/Documents/SOC%20v7/SOC%20V7_French.pdf

World Health Organization. 2010 **WHO Laboratory Manual for the Examination and Processing of Human Semen.** World Health Organization Geneva

Wierckx, K., Stuyver, I., Weyers, S., Hamada, A., Agarwal, A., De Sutter, P., T'Sjoen, G. **Sperm freezing in transsexual women.** Arch. Sex Behav. 2012; 41: 1069–1071. doi:10.1007/s10508-012-0012-x

Received 17 December 2020; received in revised form 14 April 2021; accepted 20 April 2021.