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Original article

Reproductive and Family Building Considerations for Female Patients with Anorectal And Urogenital Malformations

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ABSTRACT

Background: Little is known about fertility and pregnancy outcomes in patients with anorectal malformations (ARM), particularly those with long common channel cloaca and cloacal exstrophy who may have impaired fertility. The purpose of this study is to describe pregnancy and offspring data from a cohort of patients with ARM.

Methods: A retrospective review of female patients with ARM from our database, which includes patients operated on since 1980, was performed as well as a review of the literature. Demographic, operative, and self-reported fertility, obstetric, and offspring data were collected.

Results: There were 37 females identified in our database who reported any pregnancy or having children. There were 59 pregnancies, 48 (81.3%) of which resulted in live birth. The most common mode of delivery was cesarean delivery. There were five patients with long channel cloaca (>3 cm) and one with cloacal exstrophy that reported 11 total pregnancies, eight of which resulted in live birth. Four cloaca patients in which the native vagina was pulled through were able to conceive spontaneously. Three patients with cloacal anomalies required *in vitro* fertilization to conceive; one was unsuccessful. No patients who underwent bowel partial vaginal replacement became pregnant. Women with ARM face many unique challenges in assisted reproduction, pregnancy, and delivery owing to their anatomy and associated anomalies.

Conclusions: Women with recto-perineal, recto-vestibular, and cloacas in which the native vagina was pulled through are capable of spontaneous pregnancy. Assisted reproduction, however, may be needed those with more complex anomalies and surgical repairs.

Level of evidence: IV.

1. Introduction

Anorectal malformations (ARM) are rare congenital anomalies characterized by a spectrum of severity. Improved management and surgical techniques have increased survival of these individuals into adulthood, and there is an increased focus on long-term outcomes. Specifically, for females with ARM, fertility and pregnancy outcomes are of interest. Patients with recto-perineal and recto-vestibular fistulas are expected to have fertility similar to the unaffected population [1–4]. However, less is known about patients with more complex ARMs, such as a long common channel cloaca or cloacal exstrophy.

There are a variety of factors that may contribute to impaired fertility or pregnancy complications in this population. Between 40 and 70% of patients with ARM have associated congenital malformations, such as those present in the VACTERL association [1,5–7]. Patients with more complex ARM have a higher incidence of associated Mullerian anomalies, and 60% of women with a cloaca have a double Mullerian system [8–10]. Additionally, the surgical reconstruction and subsequent procedures may impact their fertility, obstetric outcomes, and mode of delivery [11–13]. Multiple attempts to report fertility and pregnancy outcomes in this population have been made. However, the literature is largely characterized by case reports, small case series or literature reviews. The difficulty in characterizing these outcomes arises from the rarity of these conditions, the small numbers available for long term follow-up and the heterogeneity of this population.

The purpose of this study is to describe pregnancy data and outcomes from a cohort of patients with anorectal malformations

Abbreviations: ARM, anorectal malformations; COMIRB, Colorado Multiple Institutional Review Board; IVF, *in vitro* fertilization; TCS, tethered cord syndrome.

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(ARM). Of particular interest is fertility among those with more complex ARM, such as cloaca and cloacal exstrophy, as many have associated anomalies, complex anatomy, or significant surgical history which may result in impaired fertility. We, therefore, secondarily focused on those considered to have complex ARM to highlight reproductive and pregnancy challenges faced by our patients, corroborated by the literature with considerations for future study and management.

2. Methods

This was a retrospective review of all females in our colorectal database with the diagnosis of anorectal malformation who self-reported pregnancy or offspring. The database is compromised of the records of patients operated on by the senior authors and has been prospectively maintained since 1980. For the purposes of this study, the database and charts were retrospectively reviewed between October 2021 and February 2022. Data collected included demographics, information on initial malformation, and operative reconstruction was collected. Additionally, any information on fertility, pregnancy, and offspring information available in the database was collected. This information is self-reported and the result of patients informally reporting during follow-up visits or by contacting the senior authors to share such information. No formal follow-up regarding pregnancy, fertility or offspring outcomes has been undertaken and patients were not contacted for the purposes of this study. For those patients treated at Children's Hospital Colorado (CHCO), electronic medical records were reviewed to determine if any information on fertility, pregnancy, or offspring outcomes was available to supplement data in the colorectal database. Study data were collected and managed using REDCap electronic data capture tools hosted by University of Colorado Anschutz [14]. Frequency and proportions were calculated for categorical variables of interest. This study was approved by the Colorado Multiple Institutional Review Board (COMIRB) (#21-4365).

2.1. Literature search strategy

A literature search was additionally performed in PubMed to supplement findings of the retrospective review, owing to limited information on this topic. The following Medical Subject Headings (MeSH) Major Topics: "cloaca," "cloacal exstrophy," and "anorectal malformation" and the following MeSH terms: "pregnancy," "fertility," "infertility," "vaginal delivery," "reproductive outcomes," and "cesarean section" were used. Articles that reported data on only males were excluded. References of resulting articles were reviewed to ensure the number of publications captured by the search was maximized.

3. Results

There were 897 females greater than 18 years of age with a diagnosis of ARM identified in the database. Thirty-seven females who self-reported any pregnancy or having children were identified in the database: 35 reported successful pregnancy and two were unable to conceive. The type of anorectal malformations included: 20 (54.1%) recto-vestibular fistulas, 12 (32.4%) cloacal anomalies, one (2.7%) cloacal exstrophy, and one (2.7%) perineal fistula (Table 1). Additionally, there was one (2.7%) patient with an H-type recto-vaginal fistula. This woman was born with a presacral mass and anal stenosis; the H-type recto-vaginal fistula resulted from treatment of the anal stenosis with rectal dilation at an outside institution. One (2.7%) had a complex malformation, that included caudal duplication with double external genitalia, and pubic bone diastasis. Of all patients, 13 (35.1%) patients have known Mullerian anomalies, which are categorized in Table 2. Data on uterine anatomy are missing for 10 patients. Among the patients with cloacal anomalies, 7 of 13 (53.8%) had long common channels (defined as > 3 cm). Data on common channel length was missing for two patients.

Table 1
Distribution of study population's anorectal malformations.

	Frequency (n)
Recto-vestibular Fistula	20
Cloaca	12
Short Common Channel	4
Long Common Channel	6
Unknown Common Channel Length	2
Cloacal Exstrophy	1
H-type recto-vaginal fistula	1
Caudal duplication, double external genitalia, pubic bone diastasis	1

3.1. Pregnancy data for overall cohort

Fifty-nine pregnancies were reported. Conception was spontaneous for 33 (55.9%) pregnancies, and *in vitro* fertilization (IVF) was reported for two (3.4%) pregnancies. Data on mode of conception were missing for 15 (41.7%) women. One woman with a cloaca was unable to become pregnant, and had twins born via surrogacy. Another woman with a cloaca was unable to become pregnant and had one unsuccessful round of IVF with planned surrogate delivery. The outcomes of pregnancies include: 46 (78.0%) singleton births, two (3.4%) sets of twins, eight (13.6%) miscarriages, two (3.4%) second trimester intrauterine fetal demises, and one (1.7%) ectopic pregnancy. The most common mode of delivery was cesarean delivery, which was reported by 22 (59.5%) of the women within our series. Six (16.2%) women delivered vaginally, none of whom had a cloacal anomaly. Two of these women delivered both vaginally and by cesarean delivery. Data on mode of delivery is missing for nine women.

3.2. Patients with complex anorectal malformations

There were five patients with long common channel cloaca and one with cloacal exstrophy that reported 11 total pregnancies. Two patients reported spontaneous pregnancies; mode of conception was unknown for the remaining patients. Pregnancy outcomes included eight (72.7%) singleton births, two (18.2%) miscarriages, and one (9.0%) ectopic pregnancy. None of these patients required vaginal replacement with bowel with their initial reconstruction; all had reconstruction with native vagina. Among those with complex ARM, one woman who had vaginal replacement with colon was unable to conceive spontaneously and had an unsuccessful round of IVF. In our database, we also identified 105 women greater than 18 years who underwent vaginal replacement with bowel; none have reported pregnancy.

3.3. Assisted reproduction/family building

There were three patients in our series who reported IVF attempts. Two patients reported successful pregnancy via IVF, both of whom had a cloaca. One patient has a short common channel cloaca and a didelphys uterus with longitudinal vaginal septum. The other patient also has a cloacal anomaly with a didelphys uterus with longitudinal vaginal septum; however, the length of her common channel is not available as her index operation was performed elsewhere. Her pregnancy resulted in intrauterine fetal demise and she ultimately adopted a child. The third patient

Table 2
Summary of patients' anatomy and obstetrical outcomes.

Patient	Description of Anorectal Malformation	Common Channel Length	Reconstruction/ Colorectal Procedure	Number of Surgeries	Mullerian Anomaly	OB History	Mode of Conception	Mode of Delivery	Notes
1	Cloaca	Long	PSARVUP; vaginal dome flap for vaginal reconstruction	8	Didelphys uterus with longitudinal vaginal septum	G2P1011	Spontaneous	Cesarean	Tethered Cord
2	Recto-vestibular Fistula	n/a	PSARP	3	No	G3P0121	Spontaneous	Vaginal	Double Outlet Right Ventricle
3	Recto-vestibular Fistula	n/a	PSARP; Malone; Malone revision	3	No	G1P1001	Spontaneous	Vaginal	
4	Cloaca	Short	PSARP	3	Didelphys uterus with longitudinal vaginal septum	G3P3003	Spontaneous	Cesarean	Multiple UTIs during pregnancy
5	Recto-vestibular Fistula	n/a	PSARP; PSARP revision	3	No	G4P4004	Spontaneous	Vaginal (1); Cesarean (3)	Vaginal delivery complicated by vaginal and rectal injury requiring redo PSARP
6	Recto-vestibular Fistula	n/a	PSARP	3	No	G1P1001	Spontaneous	Unknown	
7	Recto-vestibular Fistula	n/a	PSARP	2	No	G1P1001	Unknown	Cesarean	
8	Cloaca	Long	PSARVUP; vaginal dome flap for vaginal reconstruction	6	Didelphys uterus with longitudinal vaginal septum; Hydrocolops	G1P1001	Unknown	Cesarean	
9	Cloaca	Long	PSARVUP; vaginal septal reconstruction	4	Didelphys uterus with longitudinal vaginal septum	G1P1001	Unknown	Cesarean	
10	Cloaca	Short	PSARVUP	3	No	G2P2002	Unknown	Cesarean	Tetralogy of Fallot; anomalous pulmonary artery
11	Cloaca	Unknown	Unknown	Unknown	Unknown	G0P0	Surrogacy		Ventricular Septal Defect; Twins via surrogacy
12	Caudal duplication, double external genitalia, pubic bone diastasis	n/a	PSARVUP	6	Double external genitalia	G3P2100	Unknown	Cesarean (2); Vaginal (1)	
13	Posterior cloaca	Long	PSARP; vaginal dome flap for vaginal reconstruction	4	Didelphys uterus with longitudinal vaginal septum	G1P1001	Spontaneous	Cesarean	
14	Cloaca	Long	PSARP; vaginal dome flap for vaginal reconstruction	4	Didelphys uterus with longitudinal vaginal septum; Hydrocolpos	G2P1011	Unknown	Cesarean	
15	Recto-perineal Fistula	n/a	PSAP	1	No	G1P1001	Unknown	Unknown	

(*continued on next page*)

Table 2 (*continued*)

Patient	Description of Anorectal Malformation	Common Channel Length	Reconstruction/ Colorectal Procedure	Number of Surgeries	Mullerian Anomaly	OB History	Mode of Conception	Mode of Delivery	Notes
16	Cloaca	Short	PSARVUP	8	Didelphys uterus with longitudinal vaginal septum	G1P1001	IVF	Cesarean	
17	Recto-vestibular Fistula	n/a	PSARP	1	No	G1P1001	Unknown	Cesarean	
18	Recto-vestibular Fistula	n/a	PSARP	3	No	G1P1001	Unknown	Unknown	
19	Recto-vestibular Fistula	n/a	PSARP	4	No	G1P1001	Spontaneous	Unknown	
20	Recto-vestibular Fistula	n/a	PSARP	3	No	G1P1001	Spontaneous	Unknown	
21	Recto-vestibular Fistula	n/a	PSARP; PSARP revision	5	No	G5P2032	Spontaneous	Vaginal	Vaginal delivery complicated by fourth degree laceration
22	Cloacal exstrophy	Long	PSARVUP; vaginoplasty, resection of bladder, reconstruction of urethra	3	Unknown	G4P3013	Unknown	Unknown	
23	Recto-vestibular Fistula	n/a	PSARP	3	Unknown	G1P1001	Unknown	Unknown	
24	Recto-vestibular Fistula	n/a	PSARP	4	Unknown	G1P1001	Unknown	Cesarean	
25	Recto-vestibular Fistula	n/a	PSARP	3	Didelphys uterus with longitudinal vaginal septum	G1P1001	Unknown	Cesarean	Severe constipation during pregnancy; elected for permanent colostomy
26	Cloaca	Short	PSARVUP	3	No	G3P2012	Unknown	Cesarean	
27	Cloaca	Unknown	PSARVUP	7	Didelphys uterus with longitudinal vaginal septum	G1P0010	IVF	Unknown	Adopted child after second trimester intrauterine fetal demise
28	Cloaca	Short	PSARVUP	4	No	G1P1001	Spontaneous	Cesarean	
29	Recto-vestibular Fistula	n/a	PSARP	4	Unknown	G1P1002	Spontaneous	Cesarean	
30	Recto-vestibular Fistula	n/a	PSARP	4	Didelphys uterus with longitudinal vaginal septum	G1P1001	Unknown	Unknown	
31	H-Type Recto-vaginal Fistula	n/a	Other	6	Unknown	G1P1001	Spontaneous	Cesarean	Bladder injury during cesarean delivery
32	Recto-vestibular Fistula	n/a	PSARP; PSARP revision	6	Unknown	G2P2002	Spontaneous	Cesarean	
33	Recto-vestibular Fistula	n/a	PSARP	4	Unknown	G2P1011	Spontaneous	Cesarean	
34	Recto-vestibular Fistula	n/a	PSARP	6	Unknown	G1P1001	Spontaneous	Cesarean	
35	Recto-vestibular Fistula	n/a	PSARP; PSARP revision	8	Unknown	G1P1001	Spontaneous	Vaginal	
36	Recto-vestibular Fistula	n/a	PSARP	Unknown	Didelphys uterus with longitudinal vaginal septum	G1P1001	Spontaneous	Cesarean	
37	Cloaca	Long	PSARVUP; vaginal reconstruction with colon	Unknown	Didelphys uterus with longitudinal vaginal septum	G0	Failed IVF with planned surrogacy		Adopted child

who attempted IVF had an unsuccessful round of IVF and adopted a child as well. Another woman with a cloaca in this cohort had twins born via surrogacy. Her original anatomy is unknown, and it is unknown if she attempted IVF initially. It also is not known if she used her own eggs or required an egg donor.

3.4. Literatures search results

The search resulted in 318 abstracts in PubMed. All abstracts were reviewed and reasons for exclusion included not reporting on patients with ARM, reporting solely on male patient outcomes, reporting on embryological development of cloaca or ARM, and reporting on prenatal diagnoses of ARM or cloaca. There were 27 articles identified that reported pregnancy, fertility or offspring outcomes for females with cloaca or ARM and were included. All articles served as references, and included 14 case reports, nine retrospective case series, three systematic reviews, and one expert review. There were no prospective studies identified.

4. Discussion

The fertility and pregnancy outcomes of patients within our database who self-reported pregnancy or having children are presented. These data support that women with ARM are capable of spontaneous pregnancy. Specifically, those with more complex ARM which required vaginal reconstruction using a native vagina pull through are also capable of spontaneous pregnancy. In our series, however, none of the patients who underwent bowel partial vaginal replacement have reported pregnancy. Assisted reproduction, therefore, may be needed, especially in those with more complex anomalies and surgical repairs. Based on our patients' experience, we also recognize several reproductive and obstetrical challenges faced by this population. These challenges are important for clinicians to be aware of and their suggested management are reported below reflect the experience of the authors, their patients, and available literature on the topic.

4.1. Fertility considerations

Multiple series have reported impaired fertility among women with complex ARM [1–3,10,15]. Within our series, three women pursued IVF, for which two became pregnant, and another woman had children via surrogacy. For those who require assisted reproduction, oocyte retrieval may be necessary; this is most frequently performed via transvaginal ultrasonography. Though it has been reported previously, complexity of reconstructed cloaca and associated Mullerian anomalies may make this approach difficult [16]. Anatomical reasons hindering transvaginal approach have been characterized in other conditions, as well as in women with prior reconstruction for ARM [17,18]. In cases where transvaginal retrieval is difficult, laparoscopic or transabdominal oocyte retrieval can be considered. However, these options may be equally difficult in women with cloaca owing to intrabdominal scarring from prior reconstruction. There are two potential options that can be considered for patients who may not be able to undergo standard oocyte retrieval when attempting pregnancy. These options include oophoropexy or ovarian cryopreservation. Oophoropexy is performed for repeat ovarian torsion or in those with absent contralateral ovaries to preserve fertility in premenopausal women as well as to preserve ovarian function in females who require pelvic radiation [19–21]. This requires an abdominal operation, so would ideally occur at time of the initial reconstruction. However, this procedure is not without potential long-term complications, including small bowel obstruction, tubal obstruction owing to adhesions, dyspareunia, and functional ovarian cysts, which has been reported in patients who underwent ovarian transposition during childhood [22]. Additionally, there lacks consensus on whether standard oophoropexy would remain effective through adulthood. Ovarian cryopreservation is currently offered to patients with conditions requiring treatment with gonadotoxic chemotherapy and radiation or other gynecological conditions such as endometriosis [23]. This can be performed via oocyte retrieval, which presents the aforementioned challenges and is only possible in postpubescent individuals, or through ovarian tissue cryopreservation, which involves surgical resection of ovarian tissue and subsequent preservation through freezing [21,23,24]. This procedure could also be performed at the time of initial reconstruction. However, this procedure would ultimately require auto-transplantation within the pelvis, which may not be possible or effective owing to pelvic adhesions. Although ovarian tissue cryopreservation is considered clinical care for pre- and post-pubertal patients, there are limited data on live births among females who cryopreserve tissue before menarche [21,25]. Though these approaches have not been used in this specific patient population, and would require clinical trials, oocyte cryopreservation may not be an option for women with complex ARM. Additionally, even if oocyte retrieval is successful, transfer of embryos may also represent a challenge if the cervix cannot be identified on speculum vaginal examination. Given these concerns, providers and surgeons should discuss options to optimize and preserve fertility in patients with complex ARM, as proactive fertility counseling and planning may be necessary and beneficial for these females.

4.2. Complex anorectal malformations

This study aimed to characterize pregnancy outcomes of women with ARM, with specific attention to those with more complex ARM. It is hypothesized that women who undergo vaginal replacement with bowel will have difficulty with spontaneous conception. Consistent with our findings, there are no reported cases of viable pregnancy in women who underwent a partial vaginal replacement in the literature. In the literature, we identified one case of spontaneous conception in a woman born with a cloaca who underwent multiple surgeries including a second vaginoplasty with sigmoid colon to improve vaginal stenosis [26]. She ultimately conceived spontaneously, but her pregnancy was ectopic. Other similar reports include spontaneous pregnancy in women with persistent cloaca through persistent rectovaginal openings, though neither underwent reconstruction [27,28]. Salvi et al. reported a spontaneous pregnancy in a woman with cloacal and vaginal reconstruction, but details of her reconstruction are lacking [13]. *In vitro* fertilization has been described in case reports and series of women with complex ARM, but it is unclear if these women underwent vaginoplasty with intestinal reconstruction [17,29–32]. Research in mice has shown that the spermatozoa motility, viability, and fertilization decrease after contact with colonic mucosa, which, if true in humans, could compromise fertility among women with colonic vaginoplasty [33]. There is no research on the impact of small bowel mucosa on spermatozoa vitality. This may suggest that assisted reproduction is necessary for these women to conceive.

4.3. Associated anomalies

Patients with complex ARM may have associated anomalies that could impact pregnancy and delivery. The prevalence of congenital heart anomalies is cited to be 9-37% among individuals with ARM [34]. The complexity of these anomalies can range significantly and includes anomalies requiring surgical repair and lifelong management. Women with minor congenital heart defects can tolerate pregnancy well; medical management should be a component of preconception, pregnancy and delivery counseling

as cardiac anomalies may warrant management by an adult congenital heart disease cardiology and high-risk obstetrician [35]. In our series, one woman had a double outlet right ventricle, which prevented her ability to Valsalva, therefore, she required forceps during vaginal delivery. She additionally required a dilation and curettage procedure for spontaneous abortion, which required cardiac anesthesia. Tethered cord syndrome (TCS) is estimated to occur in 15 to 30% of patients with ARM and cloaca and is even more prevalent in patients with cloacal exstrophy [9,36–38]. TCS effectively excludes a patient from having spinal anesthesia as the conus medullaris terminates at a lower level than normal and even extends to L5-S1, putting the spinal cord at risk from needle puncture. One woman in our series, with TCS, required general anesthesia during cesarean section, for this reason. This forms an essential component of patient education and anesthetic preparation.

4.4. Management during pregnancy

Given the associated fecal and urinary symptoms experienced by these patients and expected changes during pregnancy, they are at risk for variety of gastrointestinal and urological complications. In diagnosing pregnancy, patients who have a history of bladder reconstruction with bowel have a 57% false-positive rate with a urinary pregnancy test; a serum hCG is needed to confirm the result [39]. Ideally, they should be counseled of this in advance, for their own education and in case they encounter providers who were not aware of this. Up to 40% of all women report some form of constipation during pregnancy or after delivery [40]. This is confounded by the fact that up to 60% of patients with ARM may report constipation, which typically declines with age, but persists at a rate of approximately 20% [41,42]. Many of our patients have successful bowel regimens, and these should continue through pregnancy. Though there have been concerns regarding the potential teratogenic effect of senna use during pregnancy, published data support its safety during pregnancy at doses up to 30 mg daily [43,44]. Adjustments of bowel management regiments may be necessary and support from the colorectal team in conjunction with the patient's high-risk obstetrician is important for this. One woman within our series had severe constipation during pregnancy that ultimately resulted in bowel perforation requiring a colostomy, which she elected to keep permanently. Reconstruction of the patient's ARM may increase their risk of urinary tract infections; these need careful management to protect both fetus and mother [45]. Another patient in our series was noted to have a minor mucosal prolapse of Malone, which resolved after delivery.

4.5. Mode of delivery

Patients with ARM require multidisciplinary involvement and counseling on the mode of delivery. Owing to their surgical history, anatomy, associated anomalies, and degree of fecal or urinary continence, patients may be counseled to avoid vaginal delivery. Though this recommendation does not have a strong evidence-base, women with more complex ARM, such as cloaca, and associated reconstruction are recommended to undergo cesarean section to avoid injury to the reconstructed vagina. This is the most common mode reported in the literature [9,12,16,28,46–50]. No patient in our series with cloaca delivered vaginally, although it has been previously reported [35,51]. It is important to note that vaginal stenosis may limit digital cervical examination in labor, further supporting cesarean delivery. All patients with ARM, regardless of how minor or severe their defect, should undergo perineal body examination, as this will assess the risk of injury from vaginal delivery. Patients with adequately repaired perineal fistula or rectovestibular fistula with sufficient perineal body on physical exam can safely deliver vaginally. However, if the patients lack adequate perineal body following reconstruction, regardless of their ARM complexity, they are at increased risk of perineal damage during vaginal delivery [52]. This occurred in two patients in our series. Both women had recto-vestibular fistulae with repair at outside hospital, and suffered vaginal and rectal trauma following vaginal delivery, which required repeat PSARP.

When these patients undergo cesarean delivery, the involvement of urology or colorectal surgeons is important given their complex anatomy and associated anomalies. Patients with cloacal malformations may have a Mitrofanoff appendicovesicostomy, Malone appendicostomy, vaginal interposition, a reconstructed urethra and bladder, and/or substantial adhesions from prior surgeries, which may make the cesarean delivery more difficult and increase the risk of organ injury [9,12,32,35]. Within our series, two patients with cloaca required assistance by colorectal surgery during their cesarean delivery. One woman suffered a bladder injury during cesarean delivery, which has resulted in subsequent bladder dysfunction. The ideal is to plan an elective cesarean section; to ensure the surgical team is familiar with the patient's anatomy and that assisting surgeons are available.

4.6. Limitations

The limitations of this study include its retrospective nature and resultant missing data and reliance upon self-reported fertility outcomes; these challenges are noted in other literature on this subject. This study does not included data from a large number of women of child-bearing age in our database and our results may not be reflective of the overall population. More reliable, prospective data will improve the ability to report long-term outcomes. Specifically, data on type of malformation, the length of the common channel in cloaca and standardized reporting of surgical technique is necessary. In those who require vaginal replacement, the type of tissue used is important. Fertility outcomes require data recording for conception efforts, which includes data on those who attempt pregnancy but do not conceive, spontaneous conception and need for assisted reproductive technology. We recognize there is inherent bias in relying on self-reported data, especially with regards to pregnancy attempts. Additionally, more objective measures, such as appropriate hormone levels, would provide further context to these results. We additionally acknowledge that there may be other fertility and pregnancy challenges these women experience that were not reported by our patients and thus not included in this paper.

5. Conclusions

Given the nature of this study, it is important to note that the suggested management for the challenges faced by these patients reflects the views of the authors, based on data available from their patients' experience and available literature on the topic. However, there are clearly a variety of challenges that are faced by women with ARM, specifically cloacas, who wish to become pregnant. Within this population, there is a specific concern regarding fertility for those with complex malformations and repairs as their ability to conceive naturally may be impaired and standard assisted reproductive techniques may be limited by their anatomy. Further research is needed examine fertility potential and the need for fertility preservation. Early fertility counseling should be offered to patients and parents of patients with complex cloacal malformations.

Declaration of Competing Interest

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Supplementary materials

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