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Rates and subsequent clinical course of fetal congenital anomalies detected by prenatal targeted ultrasonography of 137 cases over 5 years in a single institute: a retrospective observational study

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Background: With the establishment of international guidelines and changes in insurance policies in Korea, the role of targeted ultrasonography has increased. This study aimed to identify the rates and clinical course of anomalies detected using prenatal targeted ultrasonography.

Methods: This study was a retrospective analysis of all pregnancies with targeted ultrasonography performed in a single secondary medical center over 5 years.

Results: Fetal anomalies were detected by targeted ultrasonography in 137 of the 8,147 cases (1.7%). The rates of anomalies were significantly higher in female fetuses (2.0% vs. 1.3%). In cases of female fetuses, the rate of anomalies was significantly higher in the advanced maternal age group (2.4% vs. 1.2%). In cases of male fetuses, the rate of anomalies was significantly higher in nulliparous (2.4% vs. 1.5%) and twin (5.7% vs. 1.9%) pregnancies. Pulmonary anomalies were significantly more common in the multiparity group (17.6% vs. 5.8%). Among the 137 cases, 17.5% terminated the pregnancy, 16.8% were diagnosed as normal after birth, and 42.3% were diagnosed with anomalies after birth or required follow-up.

Conclusion: Through the first study on the rates and clinical course of anomalies detected by targeted ultrasonography at a single secondary center in Korea, we found that artificial abortions were performed at a high rate, even for relatively mild anomalies or anomalies with good prognosis. We suggest the necessity of a nationwide study to establish clinical guidelines based on actual incidences or prognoses.

Keywords: Congenital abnormalities; Prenatal diagnosis; Prenatal ultrasonography

Introduction

Current ultrasonography, with its high resolution and sensitive Doppler imaging, is a noninvasive and safe method suitable for monitoring fetal growth and well-being, and for identifying structural fetal abnormalities. The Eurofetus study examined the accu-

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racy of routine midtrimester ultrasonographic examinations in unselected populations. Of 4,615 malformations, 2,593 were detected (sensitivity, 56.2%) before 24 weeks of gestation. Detection sensitivity was higher for major abnormalities than for minor abnormalities (73.7% vs. 45.7%) [1]. With the development of ultrasonography and the establishment of international guidelines, 'targeted ultrasonography' that is more accurate and comprehensive than conventional routine ultrasonography has become possible. In a recent retrospective study, the congenital malformation detection rate was compared in those that underwent routine conventional obstetric ultrasonography vs. targeted ultrasonography. The sensitivity, specificity, and diagnostic coincidence rate were 53.33%, 53.81%, and 53.75%, respectively, in the routine conventional group and 90.00%, 84.76%, and 86.67%, respectively, in the targeted ultrasonography group [2].

The main purpose of mid-trimester targeted ultrasonography is to provide accurate diagnostic information for the delivery of optimized antenatal care, with the best possible outcomes for the mother and fetus. To reduce the burden on families and society, the timely detection of severe fetal malformations and improving the quality of newborns are important issues in current antenatal care. Prenatal diagnosis can lead to improved outcomes for fetuses requiring in utero fetal intervention or for newborns requiring neonatal surgery or neonatal intensive care by ensuring that delivery is performed in a hospital equipped with the necessary facilities and personnel. Some structural anomalies are associated with genetic conditions, and recognition can lead to prenatal genetic diagnosis. Parents have the option of either terminating or continuing with the pregnancy after proper counseling.

Although targeted ultrasonography was initially performed mainly in mothers with risk factors, its importance for all pregnant women has become apparent. Most major countries, including the United States, United Kingdom, Australia, and New Zealand, have reached a consensus that all pregnant women should be offered targeted ultrasound for the detection of fetal structural anomalies and pregnancy complications. The International Society of Ultrasound in Obstetrics and Gynecology recommends that targeted ultrasonography be performed between 18 and 22 weeks; by developing guidelines for examination, this has contributed to improving the consistency and quality of examinations [3].

In Korea, targeted ultrasonography has been paid for by the National Health Insurance Corporation since October 2016. Accordingly, as economic accessibility increases, the role of targeted ultrasonography is expected to increase. Meanwhile, as the age of first marriage is delayed, the proportion of pregnancies in older women is gradually increasing, and promoting the health of the fetus and newborn is an important public health issue.

In Korea, a few recent studies have examined the rates and subsequent clinical course of fetal anomalies detected by prenatal targeted ultrasonography. The most recent study by Lee et al. [4] was published in 2010 and was limited to congenital heart anomalies diagnosed between 1994 and 2005. Considering the results of the study by Jang et al. [5] that the rates of congenital anomalies were high in newborns from multicultural families, it is also necessary to investigate the current status of prenatal diagnosis in multicultural families.

The purpose of this study was to identify the rates and subsequent clinical course of congenital anomalies detected by prenatal targeted ultrasonography, including pregnancies in multicultural families.

Methods

Ethical statements: This study was approved by the Institutional Review Board (IRB) of Yeungnam University Hospital (IRB No: YUMC 2018-05-003), and the requirement for informed consent was waived.

This study was a retrospective analysis of 8,147 pregnancies (including 224 twins) with targeted ultrasonography from September 15, 2012 to September 14, 2017, in a single secondary obstetrical medical center in Daegu, Korea. Targeted ultrasonography was performed between 20 and 26 weeks of gestational age by a registered diagnostic medical sonographer with an obstetrics and gynecology specialty. The ultrasonograms were then interpreted and diagnosed by obstetricians.

The ultrasound machine used for diagnosis was a Voluson 730 Expert (GE Healthcare, Chicago, IL, USA) with a convex array ultrasound probe, type 4C-A (GE Healthcare). Fetal anomalies were classified according to the organ in which the anomaly was diagnosed: central nervous system (CNS), face and neck, cardiac and pulmonary systems, gastrointestinal system, genitourinary system, musculoskeletal system, skin and soft tissue, multiple anomalies, and other anomalies. Cases with two or more anomalies were classified as having multiple anomalies. Other anomalies included umbilical cord anomalies, hydrops fetalis, and abdominal masses of unknown origin. Among prenatal ultrasound diagnoses, the findings that could be improved during prenatal and postnatal follow-up, such as renal pelvis dilatation [6], choroid plexus cyst [7], mild lateral ventricle dilatation [8], and transient fetal arrhythmias [9], were excluded from the analysis.

Statistical analyses were performed using IBM SPSS ver. 22.0 (IBM Corp., Armonk, NY, USA). The rates of fetal anomalies ac-

cording to maternal age, parity, race, residential locality, number of fetuses, and fetal sex were analyzed using the chi-square test and Fisher exact test, as appropriate. The rate of each affected organ according to maternal age, parity, and fetal sex was analyzed using the chi-square test and Fisher exact test, as appropriate.

Results

1. Rates of fetal anomalies detected by targeted ultrasonography according to maternal characteristics and fetal sex

Of the 8,147 cases in which targeted ultrasonography was performed, fetal anomalies were detected in 137 (1.7%). Among the fetuses, 84 (61.3%) were male and 53 (38.7%) were female.

The rates of targeted ultrasonography-found anomalies organized by maternal age were as follows: 0% (0 of 33) for mothers younger than 21 years, 1.7% (7 of 422) for those aged 21 to 25 years, 1.9% (51 of 2,722) for those aged 26 to 30 years, 1.4% (55 of 3,834) for those aged 31 to 35 years, 2.0% (21 of 1,028) for those aged 36 to 40 years, and 2.8% (3 of 108) for those older than 40 years. The rates according to parity were 1.8% (86 of 4,746) for primiparous women, 1.4% (40 of 2,896) for para 1 multiparous women, and 2.2% (11 of 505) for para 2+ or greater multiparous women. The rates according to maternal race were 1.7% (135 of 8,050) for Koreans, 2.3% (1 of 44) for Vietnamese, 0% (0 of 22) for Chinese, and 3.2% (1 of 31) for others. The races in 'others' included, in decreasing prevalence, Filipinos, Cambodians, and Thais, among other races. The rates according to region of residence were 1.6% (111 of 6,856) for Daegu, 1.9% (20 of 1,079) for Gyeongsangbuk-do, and 2.8% (6 of 212) for other regions. The regions in 'other' included, in decreasing prevalence, Gyeongsangnam-do, Gyeonggi-do, and Ulsan, among other areas. The

Table 1. Rates of fetal anomalies detected by targeted ultrasonography according to maternal characteristics and fetal sex

Characteristic	Male			*p*-value (OR, 95% CI)	Female			*p*-value (OR, 95% CI)	Total			*p*-value (OR, 95% CI)
	Normal	Anomaly	Total		Normal	Anomaly	Total		Normal	Anomaly	Total	
Fetal sex				-				-				
Male									4,127	84 (2.0)	4,211	0.023* (1.49, 1.05–2.11)
Female									3,883	53 (1.3)	3,936	
Age (yr)				0.807 (0.92, 0.49–1.75)				0.024* (2.04, 1.09–3.84)				
≤35	3,548	73 (2.0)	3,621		3,350	40 (1.2)	3,390		6,898	113 (1.6)	7,011	0.223 (1.32, 0.84–2.06)
>35	579	11 (1.9)	590		533	13 (2.4)	546		1,112	24 (2.1)	1,136	
Parity				0.041* (0.62, 0.39–0.99)				0.411 (1.26, 0.73–2.16)				
Nulliparity	2,391	58 (2.4)	2,449		2,269	28(1.2)	2,297		4,660	86 (1.8)	4,746	0.279 (083, 0.58–1.17)
Multiparity	1,736	26 (1.5)	1,762		1,614	25 (1.5)	1,639		3,350	51 (1.5)	3,401	
Race				0.233 (2.26, 0.54–9.49)				>0.999				
Korean	4,083	82 (2.0)	4,165		3,832	53 (1.4)	3,885		7,915	135 (1.7)	8,050	0.679 (1.23, 0.30–5.06)
Foreigner	44	2 (4.3)	46		51	0 (0)	51		95	2 (2.1)	97	
Residential locality				0.268 (1.36, 0.79–2.32)				0.817 (1.09, 0.53–2.24)				
Daegu	3,476	67 (1.9)	3,543		3,269	44 (1.3)	3,313		6,745	111 (1.6)	6,856	0.311 (1.25, 0.81–1.92)
Others	651	17 (2.5)	668		614	9 (1.4)	623		1,265	26 (2.0)	1,291	
No. of fetuses				0.018* (3.13, 1.33–7.35)				0.674 (1.26, 0.30–5.25)				
Singleton	4,028	78 (1.9)	4,106		3,766	51 (1.3)	3,817		7,794	129 (1.6)	7,923	0.056 (2.24, 1.08–4.63)
Twin	99	6 (5.7)	105		117	2 (1.7)	119		216	8 (3.6)	224	

Values are presented as number only or number (%) unless otherwise specified.
OR, odds ratio; CI, confidence interval.
The *p*-values and ORs (95% CIs) were analyzed by chi-square test or Fisher exact test as appropriate.
*$p<0.05$.

rates according to fetus number were 1.6% (129 of 7,923) for singleton pregnancies and 3.6% (8 of 224) for twin pregnancies.

The rate of total anomalies according to fetal sex was significantly higher in the male fetal group than in the female fetal group (2.0% vs. 1.3%, $p=0.023$; odds ratio [OR], 1.49). In the case of female fetuses, the rate of ultrasonography-found anomalies was significantly higher in the advanced maternal age group (> 35 years) (2.4% vs. 1.2%, $p=0.024$; OR, 2.04). In the case of male fetuses, the rate of ultrasonography-found anomalies was significantly higher in the nulliparity (2.4% vs. 1.5%, $p=0.041$; OR, 0.62) and twin (5.7% vs. 1.9%, $p=0.018$; OR, 3.13) groups. Considering all fetuses regardless of sex, there was no significant difference in the rate of ultrasonography-found anomalies according to maternal age, parity, race, residential locality, and number of fetuses. However, the rate tended to be higher in the advanced maternal age (> 35 years), nulliparity, foreigner, other residential locality, and twin pregnancy groups (Table 1).

2. Rates of involved organ systems of fetal anomalies detected by targeted ultrasonography according to maternal age, parity, and fetal sex

The rates of involved organ systems of targeted ultrasonography-found anomalies were as follows: 19.0% (26 cases) for cardiac, 18.2% (25 cases) for musculoskeletal, 12.4% (17 cases) for CNS, and 12.4% (17 cases) for genitourinary anomalies. Among the cardiac anomalies, ventricular septum defects were the most common, followed by tetralogy of Fallot (TOF) and transposition of the great arteries. Polydactyly was the most common musculoskeletal anomaly. CNS anomalies included ventriculomegaly, agenesis of the corpus callosum, and holoprosencephaly.

Pulmonary anomalies were significantly more common in the multiparity group (17.6% vs. 5.8%, $p=0.027$; OR, 3.47) (Table 2). In addition, there was no significant difference in the rate of involved organ systems of ultrasonography-found anomalies according to maternal age, maternal parity, and fetal sex.

3. Clinical course of fetal anomalies detected by targeted ultrasonography

Among the 137 cases of fetal anomalies detected by targeted ultrasonography, there were 24 cases (17.5%) of artificial abortion, 81 cases (59.1%) of postpartum follow-up, and 32 cases (23.4%) that could not be traced after being transferred to other medical centers. The postpartum follow-up group was divided into three types: 23 cases (16.8% of 137 cases) diagnosed as normal after birth, five cases (3.6%) as requiring follow-up with age, and 53 cases (38.7%) as anomalies (consistent with the prenatal diagnosis or other additional anomalies) (Table 3).

In 24 cases of artificial abortion, four (16.7%) were CNS anomalies, four (16.7%) were face anomalies, four (16.7%) were cardiac anomalies, three (12.5%) were pulmonary anomalies, and one (4.2%) was a musculoskeletal anomaly. Regarding face anomalies, in four of nine cases (44.4%) the mother opted for artificial abortion, the highest rate for a single anomaly.

For a normal postpartum diagnosis, the prenatal ultrasonography-found diagnosis was ventriculomegaly, muscular ventricular septal defect, dilatation of the renal pelvis, and hydronephrosis. The five cases that required follow-up with age were mild ventriculomegaly and hydronephrosis. The group with anomalies requir-

Table 2. Involved organ system of fetal anomalies according to the maternal age, maternal parity, and fetal sex

Involved organ system	Total	Maternal age (yr)		*p*-value	Maternal parity		*p*-value	Fetal sex		*p*-value
		≤ 35	> 35		Nulli	Multi		Male	Female	
CNS anomaly	17 (12.4)	14 (12.4)	3 (12.5)	> 0.999	12 (14.0)	5 (9.8)	0.476	11 (13.1)	6 (11.3)	0.759
Face anomaly	9 (6.6)	6 (5.3)	3 (12.5)	0.193	6 (7.0)	3 (5.9)	> 0.999	6 (7.1)	3 (5.7)	> 0.999
Cardiac anomaly	26 (19.0)	21 (18.6)	5 (20.8)	0.779	17 (19.8)	9 (17.6)	0.760	15 (17.9)	11 (20.8)	0.674
Pulmonary anomaly	14 (10.2)	13 (11.5)	1 (4.2)	0.463	5 (5.8)	9 (17.6)	0.027*[a]	7 (8.3)	7 (13.2)	0.359
Gastrointestinal anomaly	5 (3.6)	5 (4.4)	0 (0)	0.586	3 (3.5)	2 (3.9)	> 0.999	3 (3.6)	2 (3.8)	> 0.999
Genitourinary anomaly	17 (12.4)	14 (12.4)	3 (12.5)	> 0.999	8 (9.3)	9 (17.6)	0.152	11 (13.1)	6 (11.3)	0.759
Musculoskeletal anomaly	25 (18.2)	19 (16.8)	6 (25.0)	0.385	18 (20.9)	7 (13.7)	0.291	15 (17.9)	10 (18.9)	0.881
Skin and soft tissue anomaly	4 (2.9)	4 (3.5)	0 (0)	> 0.999	3 (3.5)	1 (2.0)	> 0.999	1 (1.2)	3 (5.7)	0.298
Multiple anomalies	10 (7.3)	8 (7.1)	2 (8.3)	0.688	9 (10.5)	1 (2.0)	0.090	8 (9.5)	2 (3.8)	0.316
Other anomalies	10 (7.3)	9 (8.0)	1 (4.2)	> 0.999	5 (5.8)	5 (9.8)	0.500	7 (8.3)	3 (5.7)	0.740

Values are presented as number (%).
CNS, central nervous system.
The *p*-values are analyzed by chi-square test or Fisher exact test as appropriate.
[a]Odds ratio, 3.47 (95% confidence interval, 1.09–11.02).
*$p<0.05$.

Table 3. Clinical course of fetal anomalies detected by targeted ultrasonography

Anomaly	Clinical course					Total
	Termination	Normal on postpartum FU	Required to FU	Anomaly on postpartum FU	FU loss	
CNS anomaly	4 (23.5)	5 (29.4)	1 (5.9)	1 (5.9)	6 (35.3)	17 (100)
Face anomaly	4 (44.4)	0 (0)	0 (0)	2 (22.2)	3 (33.3)	9 (100)
Cardiac anomaly	4 (15.4)	5 (19.2)	0 (0)	13 (50.0)	4 (15.4)	26 (100)
Pulmonary anomaly	3 (21.4)	5 (35.7)	0 (0)	3 (21.4)	3 (21.4)	14 (100)
Gastrointestinal anomaly	0 (0)	1 (20.0)	0 (0)	2 (40.0)	2 (40.0)	5 (100)
Genitourinary anomaly	0 (0)	4 (23.5)	4 (23.5)	9 (52.9)	0 (0)	17 (100)
Musculoskeletal anomaly	2 (8.0)	3 (12.0)	0 (0)	15 (60.0)	5 (20.0)	25 (100)
Skin and soft tissue anomaly	0 (0)	0 (0)	0 (0)	2 (50.0)	2 (50.0)	4 (100)
Multiple anomalies	4 (40.0)	0 (0)	0 (0)	3 (30.0)	3 (30.0)	10 (100)
Other anomalies	3 (30.0)	0 (0)	0 (0)	3 (30.0)	4 (40.0)	10 (100)
Total	24 (17.5)	23 (16.8)	5 (3.6)	53 (38.7)	32 (23.4)	137 (100)

Values are presented as number or number (%).
FU, follow-up; CNS, central nervous system.

ing treatment included cases of cardiac anomalies (such as TOF, complete transposition of the great arteries, and ventricular septal defect) and cases of polydactyly.

The rate of requiring surgery or treatment for the same postpartum anomaly as identified by the prenatal ultrasonography or for additional anomalies was high at 38.7% (53 cases). Categorizing by organ system the anomalies detected via targeted ultrasonography, 60% of musculoskeletal anomalies, 52.9% of genitourinary anomalies, and 50.0% of cardiac anomalies were also diagnosed postpartum.

Discussion

Congenital anomalies are the three leading causes of spontaneous abortions and perinatal deaths. According to data from 1998 to 2011 provided by the European Surveillance of Congenital Anomalies, among 73,337 cases of perinatal mortality, the rate of congenital anomaly was 1.27 per 1,000 births [10]. In Korea, according to an online publication on 'infant, maternal and perinatal mortality statistics' provided by the Korean Statistical Information Service (KOSIS), 'congenital anomalies, deformities, and chromosomal abnormalities' was the third leading cause of infant mortality in 2020, accounting for 16.2% of all infant deaths [11].

However, the association between maternal age and congenital malformations remains controversial. Most experts agree that the rate of congenital malformations increases with increasing maternal age and that malformations also occur in mothers younger than 20 years [12]. In a large prospective cohort study, Hollier et al. [13] demonstrated that women aged 25 years or older at delivery had significantly and progressively greater risk of having fetuses with nonchromosomal malformations compared with women aged 20 to 24 years. By 35 years of age, the additional age-related risk of having infants with nonchromosomal malformations was approximately 1%, and for women aged 40 years or older, the increase in risk was approximately 2.5% over that of women younger than 25 years. In this study, no fetal anomalies were detected by targeted ultrasonography in women younger than 20 years, and the highest rate of 2.8% was found in women who were older than 40 years. Statistically significant differences were only found in the case of female fetuses, with a higher rate in women of advanced maternal age.

The association between fetal sex and obstetric complications has rarely been studied and remains controversial. The emerging concept of differences according to fetal sex focuses on sexual dimorphism in maternal-fetal-placental interplay. A recent meta-analysis strengthened the hypothesis that pregnancies with a male fetus are more susceptible to abnormal placental development, which is associated with obstetric complications such as gestational hypertension, preeclampsia, gestational diabetes, and placental abruption [14]. In the case of congenital anomalies, there was a recent meta-analysis on the association between fetal sex and surgically correctable anomalies. The authors found that esophageal atresia, anorectal malformation, Hirschsprung disease, congenital diaphragmatic hernia, omphalocele, malrotation, congenital pulmonary airway malformation, intestinal atresia, and gastroschisis were significantly more common in males, and biliary atresia and choledochal cysts were significantly more common in females [15]. However, previous studies differ from the present study because they analyzed anomalies among neonates, not those found before birth or abortion. The results of our study are consistent with those of other studies that advocate considering male fetuses as a risk factor for congenital anomalies.

In our study, nulliparity and twins significantly increased the rate of ultrasonography-found anomalies only in the male fetus group. In several previous studies, the risk of congenital anomalies has been shown to be higher in twins than in singletons [16]. In a statewide population-based study in Florida, male fetuses had a 29% higher risk of congenital anomalies than their twin sisters [17]. In terms of the association between maternal parity and congenital anomalies, some studies have indicated an increased risk of specific categories of congenital anomalies among women with their first child. In contrast, other studies have shown a protective effect in the first child in a few categories [18]. In our study, among the organ systems involved in ultrasonography-found anomalies, only pulmonary anomalies were found to have a significantly different rate according to parity, being higher for multiparity (5.8% vs. 17.6%, $p=0.027$; OR, 3.47). However, we do not yet understand the mechanism underlying the association between congenital anomalies and fetal sex, parity, and twin pregnancies.

In this study, the organ system with the highest rate of anomalies detected by targeted ultrasonography was cardiac, with 26 of 137 cases (19.0%). Among them, 15.4% of pregnancies were terminated due to abortion. Of the remaining births, 50.0% were diagnosed with anomalies after birth. According to the online publication on 'infant, maternal and perinatal mortality statistics' provided by KOSIS, in 2020, there were 115 infant deaths due to 'congenital malformations, deformations, and chromosomal abnormalities,' and the most common anomalies were cardiac-related in 41 cases [11]. Furthermore, in the case of infant death in Korea, autopsies are often not performed; therefore, it can be estimated that the mortality rate due to congenital malformations is much higher. Accordingly, in particular, it is necessary to accurately diagnose cardiac anomalies during antepartum evaluation, provide mothers with accurate and complete information about prognosis and treatment, and then actively consult with them.

The proportion of births from multicultural families among all births was 6.0% in 2020, an increase of 1.7% from 4.3% in 2010. According to recent statistics on multicultural families, the age of pregnant women in multicultural families is increasing similarly to that of Korean pregnant women. The proportion of those aged 30 to 34 was highest at 32.3%, and the average age of childbirth was 30.7 years, an increase of 2.7 years from 2010. The average age of first childbirth increased to 29.6 years, the second childbirth to 31.7 years, and the third childbirth to 33.5 years [19]. Furthermore, several studies have indicated that advanced paternal age is associated with many congenital anomalies [20]. According to the 2020 Statistics Korea report, in the case of multicultural families, the proportion of husbands aged 45 years or older was 28.6%, followed by 19.4% in their early 30s, and 17.9% in their late 30s [19]. As a result, the need for antenatal examinations has increased in pregnant women from multicultural families; however, there are restrictions on the use of medical services due to lack of communication, lack of information, and cost burdens. Therefore, there is a need for greater concern and diverse social support in antenatal medical services for multicultural families.

In a recent retrospective study in Nigeria, abortion was performed in 32.8% of major anomalies detected on prenatal ultrasonography [21]. In the present study, among the 137 cases, 24 (17.5%) involved artificial abortions. In terms of the ratio of abortion cases to the total number of diagnosed cases for each single organ involved, the abortion rate was highest in the following order: 44.4% for face anomalies (4 of 9 cases), 23.5% for CNS anomalies (4 of 17 cases), 21.4% for pulmonary anomalies (3 of 14 cases), and 15.4% for cardiac anomalies (4 of 26 cases). Relatively mild anomalies, such as cleft lip and cleft palate or TOF with a relatively good prognosis for postpartum treatment, were included.

Losing hope for having a healthy child and making the decision to terminate the pregnancy is a traumatic event that could have long-term psychological outcomes such as posttraumatic stress, severe grief, and depression. In a qualitative content analysis through interviews, most women who had experienced pregnancy termination because of fetal anomalies expressed the need to receive information about the advantages and disadvantages of terminating the pregnancy, or the outcomes of keeping the fetus and continuing the pregnancy. The authors described that counseling, which can satisfy these needs and empower parents to intervene in their choices, can avoid long-term undesirable psychological outcomes, facilitate the conditions for their return to normal life, and ultimately promote their health [22]. However, counseling is difficult due to the lack of actual data in Korea, such as the actual concordance between prenatal ultrasonographic diagnosis and postpartum diagnosis, the common clinical course of pregnancies with ultrasonography-diagnosed fetal anomalies, and the outcome of each type of anomaly after birth.

This study has limitations, such as the small number of independent variables that can be analyzed due to record-based analysis, and the small number of mothers from multicultural families, which was too low to obtain statistical significance among races. In addition, there was a limitation because of follow-up data loss in the patient group transferred to a tertiary hospital after an anomaly was detected by targeted ultrasonography.

As artificial abortion was illegal in South Korea until 2021, it is estimated that the actual rate of artificial abortion was higher than the reported rate. While a large number of terminations have been performed in primary and secondary medical centers, most studies are published with data from tertiary medical centers; therefore, it

is difficult to collect actual data about the clinical course after diagnosis. In this respect, the results of this study are noteworthy. To our knowledge, this is the first study on the rates, types of involved organs, and outcomes of anomalies detected by targeted ultrasonography at a single secondary obstetrical medical center in Korea.

Through this study, we identified some associations between ultrasonography-found anomalies and several variables, such as fetal sex, maternal parity, and number of fetuses. Moreover, we realized that artificial abortions were performed at a high rate in anomalies diagnosed with targeted ultrasound, even with relatively mild anomalies or anomalies with a good prognosis. The lack of information about postnatal confirmed rates or postnatal outcomes can cause fear and anxiety in patients and may lead to pregnancy termination. Furthermore, in the case of artificial abortions, accurate and sufficient information in the decision-making process plays an important role in the psychological health of patients. Therefore, it is necessary to analyze the prognosis of anomalies identified by ultrasonography through a nationwide study, and based on it, establish policies and guidelines including indications for artificial abortion.

Notes

Conflicts of interest

Joon Sakong has been an editorial board member of *Journal of Yeungnam Medical Science* since 2004. He was not involved in the review process of this manuscript. There is no conflict of interest to declare.

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Author contributions

Conceptualization: HC, HSK, JS; Investigation: HC; Data curation: HC, HSK; Formal analysis, Supervision: HSK, JS; Methodology, Validation: JS; Writing-original draft: HC; Writing-review & editing: HSK.

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