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Trends in Prenatal Sonography Use and Subsequent Urologic Diagnoses and Abortions in the United States

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Abstract

Objectives—Prenatal sonography has enabled fetal diagnosis of urologic conditions and is now commonly used in the US. The impact of this technology on the incidence of pediatric urological diagnoses is unknown. We sought to assess trends in prenatal sonography and resulting urologic diagnoses and/or abortions.

Methods—Using administrative codes in Ingenix, a claims database of individuals with employer-based insurance, we identified women undergoing prenatal ultrasounds (1998–2005). These were linked to claims for subsequent abortions, live births, and postnatal urologic diagnoses in resulting offspring.

Results—99.07% women underwent ultrasound and childbirth. Ultrasound use among women whose pregnancies proceeded to birth increased from 90,568 to 96,866 per 100,000 mother-infant pairs from 1998 to 2005. Of women who did or did not undergo ultrasounds, 1.25% and 0.66% had infants with urologic diagnoses, respectively. The rates of prenatal ultrasound-detected urinary tract anomalies increased from 1032.26 per 100,000 live births in 1999 to 1225.71 per 100,000 live births in 2005.

Conclusions—Prenatal ultrasound is widely used, but increased utilization of this diagnostic modality did not seem to be associated with abortions. The rate of pediatric urologic diagnoses in infants who had received prenatal ultrasound did not rise significantly over time.

Keywords

ultrasonography, prenatal; urologic diseases; abortion, induced

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The authors declare no conflicts of interest for the described study.

Introduction

Prenatal ultrasonography began to be widely used in the United States in the 1980s and is generally felt to have become more prevalent with time[1]. The postnatal consequences of this technologic trend are unclear, however. For example, rates of infants born at low birth weight and preterm birth have not decreased significantly in the past 25 years[1]. Since ultrasound can detect fetal hydronephrosis, ureterectasis, bladder dilatation, exstrophy, and other findings consistent with urologic disorders, this imaging modality may be altering the profile and presentation of children seen by pediatric urologists[2]. Specifically, prenatal diagnoses may lead to earlier referral of children to pediatric urologists. Some have speculated that rates of severe urologic abnormalities have decreased in newborns, due to ultrasound diagnosis and subsequent abortion. Little is known about the prevalence of these abnormalities in newborns. We sought to describe the epidemiology of these conditions, as well as determine any association of trends in postnatal diagnosis with changing rates of ultrasound use over time. To accomplish this we turned to the Ingenix database, a claims database of individuals with employer-based insurance. In particular, we hypothesized that the rate of newborn urologic diagnoses has risen over time in parallel with prenatal ultrasound use (due to early identification) and that the rates of severe urologic conditions such as exstrophy have decreased due to abortion of fetuses with recognized diagnoses.

Materials and Methods

Data were obtained from Ingenix, Inc., a healthcare information company that provides cost management and benefit consulting services to employers, health plans, pharmaceutical manufacturers, and others. Specifically, the Ingenix database, which contains medical claims data for approximately 75 large employers of 1–4 million privately insured individuals for each year from 1998 to 2006, was queried for all delivery- and abortion-related claims in girls and women (14–55 years of age). Race and geographic information was not available for individuals. Pregnancies were tabulated as resulting in abortion only when abortion-related claims data was available for a given woman. Claims for prenatal ultrasound use were examined and, using family structure codes in the database, mother-montinfant pairs were created. Urologic diagnoses given to infants (during the first year of life) of women who did and did not have ultrasounds were tabulated. The ICD-9 codes used to perform queries for urologic diagnoses are listed (see Electronic Supplemental Material). The incidence and rates of specific urologic diagnoses, and all urologic diagnoses in aggregate, were calculated by year.

Results

The average age of mothers who had prenatal ultrasounds was 29.9 years (95% CI 22–38 years), similar to the average age of mothers who did not undergo prenatal ultrasounds (29.6 years; 95% CI 22–37 years). Of 324,638 women, 3027 (0.93%) underwent abortion after prenatal ultrasound (Table 1). Hence, 321,611 of 324,638 (99.07%) women underwent ultrasound and subsequent childbirth. In 1998, 966.76 per 100,000 pregnant women (95% CI 836.63–1096.89) who had a prenatal ultrasound subsequently underwent abortion. This varied non-significantly from a peak in 2001 at 1005.09 per 100,000 women (95% CI 898.15–1112.02), to a nadir of 879.67 per 100,000 women in 2005 (95% CI 819.1–940.25) (Table 1). Out of 38,332 women whose pregnancies proceeded to birth and for whom claims data were able to be linked to those of their infants, 36,206 (94.45%) underwent prenatal ultrasound (Table 2). The overall rate of ultrasound use was 94,454 per 100,000 mother-infant pairs, and increased from a nadir of 90,568 per 100,000 mother-infant pairs in 1998 (95% CI 88,788–92,348 per 100,000 pairs) to 96,866 per 100,000 mother-infant pairs in

2005 (95% CI 96,513–97,219 per 100,000 pairs). The mean number of ultrasounds per pregnancy increased steadily over the study period, rising from 2.7 in 1998 to 4.2 in 2005.

Of women who did or did not undergo ultrasounds, 453 of 36,206 (1.25%) and 14 of 2126 (0.66%) had infants with claims for urologic diagnoses after birth, respectively (Table 3). Because there were very few women (<5%) who did not undergo ultrasounds during pregnancy, we did not calculate abortion rates for this subgroup. The rates of urinary tract anomalies in newborns who had undergone prenatal ultrasound trended higher from 956.43 per 100,000 live births in 1999 to 1225.71 per 100,000 live births in 2005 (95% CI 333.44–1579.4 vs 999.05–1452.4, respectively) (Table 3). The rates of urinary tract anomalies detected in infants who did not undergo prenatal ultrasound increased from 431.03 per 100,000 live births in 1999 to a peak of 1176.47 per 100,000 live births in 2000, and subsequently decreased to 682.59 per 100,000 births in 2005 (Table 3). The number of cases and rates per 100,000 live births for categories of urologic diagnoses are shown in graphical format in Fig. 1.

Discussion

Prenatal ultrasound has become commonly used in the United States[1]. We sought to use the Ingenix database to provide a descriptive epidemiology of urological abnormalities diagnosed in the first year of life in the setting of increased prenatal ultrasound use. Our study had several significant findings.

First, prenatal ultrasound was used in a higher proportion of pregnant women and a greater number of ultrasounds were performed per pregnancy over time. This would suggest that, at least for our cohort, pregnancies are being followed more closely by ultrasound, and prenatal diagnoses are being recognized and monitored more carefully. However, this indicates that prenatal ultrasound is being over-utilized for some fetal diagnoses with little clinical significance, such as isolated mild hydronephrosis, resulting in unnecessary health care expenditures and increased parental anxiety.

Second, rates of pediatric urologic diagnoses in infants who underwent prenatal ultrasound did not rise significantly during the period examined (1999–2005). This was contrary to our hypothesis that increasing ultrasound use may be associated with more prenatally diagnosed urologic anomalies. It is unclear why ultrasound utilization trends did not correlate with rates of urologic diagnoses in newborn infants. It is possible that the low number of such diagnoses limited our ability to identify a significant trend. Because we do not have the indications for the performance of abortions in these patients, it is also possible that fetuses with urological abnormalities were more likely to be selectively aborted, mitigating any trend towards increased diagnosis. Alternatively, it is possible that prenatally diagnosable urologic diseases have been recognized at birth due to clinical stigmata, even during the period of less antenatal ultrasound use. This is a particularly appealing explanation given the relatively stable rates of severe genitourinary abnormalities in the Ingenix database over the period examined. However, the absolute number of cases of anomalies such as exstrophy was quite low, making it difficult to be confident about this potential explanation. This may reflect miscoding or insufficient coding of these diagnoses. Furthermore, many prenatal and postnatal diagnoses were missing (88,450–95,679 per 100,000 and 3112–10,077 per 100,000, respectively, from 1998 to 2005). These issues are also likely due to inaccurate or incomplete ICD-9 coding. We were intrigued that the rates of genitourinary abnormalities among children of women who did not undergo prenatal ultrasonography was approximately half that of women who did undergo prenatal ultrasonography. It is possible that the children of women who did not undergo prenatal ultrasonography have similar rates of urogenital anomalies and presented to the healthcare system after the period of observation in this study. If this were true, these children could potentially present with more severe disease sequelae later in life. Conversely, hydronephrosis may be recognized *in utero* on ultrasound but may resolve spontaneously, potentially increasing healthcare costs without improving the health of some of the children identified using prenatal ultrasound. Further work is required to elucidate this point.

Finally, abortion rates among our patient cohort have remained stable. Individual attitudes towards abortion are subject to many influences, which usually arise in social, religious and economic contexts. However, it is possible that advances in the care of infants born with genitourinary abnormalities have influenced patient perceptions on the advisability of continuing a pregnancy when a congenital abnormality has been identified.

Our findings about congenital antenatal diagnosis are supported by other literature. Mandel *et al*. found that 1 in 100–500 prenatal ultrasound studies demonstrate urinary tract anomalies, with the majority being hydronephrosis [3, 4], similar to our findings. Anumba *et al*. observed that 2.2 out of 10,000 births were complicated by fetal lower urinary tract obstruction [5]. Similarly, we observed that 1.9–6.3 out of 10,000 infants were diagnosed with congenital urethral stenosis. The comparison, however, assumes that this ICD-9 code accurately captured all cases of fetal lower urinary tract obstruction. We acknowledge that this is unlikely. In addition, our findings regarding the stability of major congenital genitourinary diagnoses differ from other studies of the results of prenatal testing. Cromie *et al*. reported that prenatal diagnosis of congenital defects leads to elective abortions by some women[2]. Furthermore, the Hawaii Birth Defects Program reported that from 1987 to 1996 prenatal diagnosis and elective pregnancy terminations had a significant impact on the birth prevalence rates of spina bifida and other congenital anomalies [6]. In contrast, data from Europe indicated that termination rates for prenatally diagnosed spina bifida were stable from the 1980s to 1990s [7]. These discrepancies may reflect, in part, patient perceptions regarding disease prognosis as well as religious and ethical beliefs.

Utilization of abortions did not appear to be on the rise in this population during the period of observation in this study. This is in contrast to the general trend seen in the US. The overall induced abortion rate in the United States has fallen from 27.4 per 1000 women in 1990 to 19.7 by 2004 [8]. This rate is higher than in our cohort, possibly because the Ingenix population has a different mix of maternal age, race, and marital status, socioeconomic factors which have been reported to be associated with abortion rates [8]. Consequently, trends in use of abortion may reflect greater societal trends. This hypothesis needs to be tested in future studies.

Our study has limitations. We did not have data on fetal diagnoses in those pregnancies that did end in termination. Hence, the abortions that did occur may have been due, in part, to ultrasound-diagnosed urologic conditions. Further study using other datasets will be necessary to determine whether this occurs in a significant proportion of relevant pregnancies. In addition, the Ingenix cohort represents an insured patient population that on average may be more affluent and better educated. These demographic differences likely contribute to utilization of prenatal ultrasound and abortions. Given that 14.8% of American adults were uninsured as of 2006 [9], future studies will be needed to examine this important sector of society.

Conclusions

Our findings suggest that although prenatal ultrasound is increasingly used in the United States, the associated rates of urologic diagnoses have not sharply increased, and abortion rates overall have remained stable. The anecdotal impression that severe pediatric urologic diseases have decreased in prevalence is either incorrect or due to other factors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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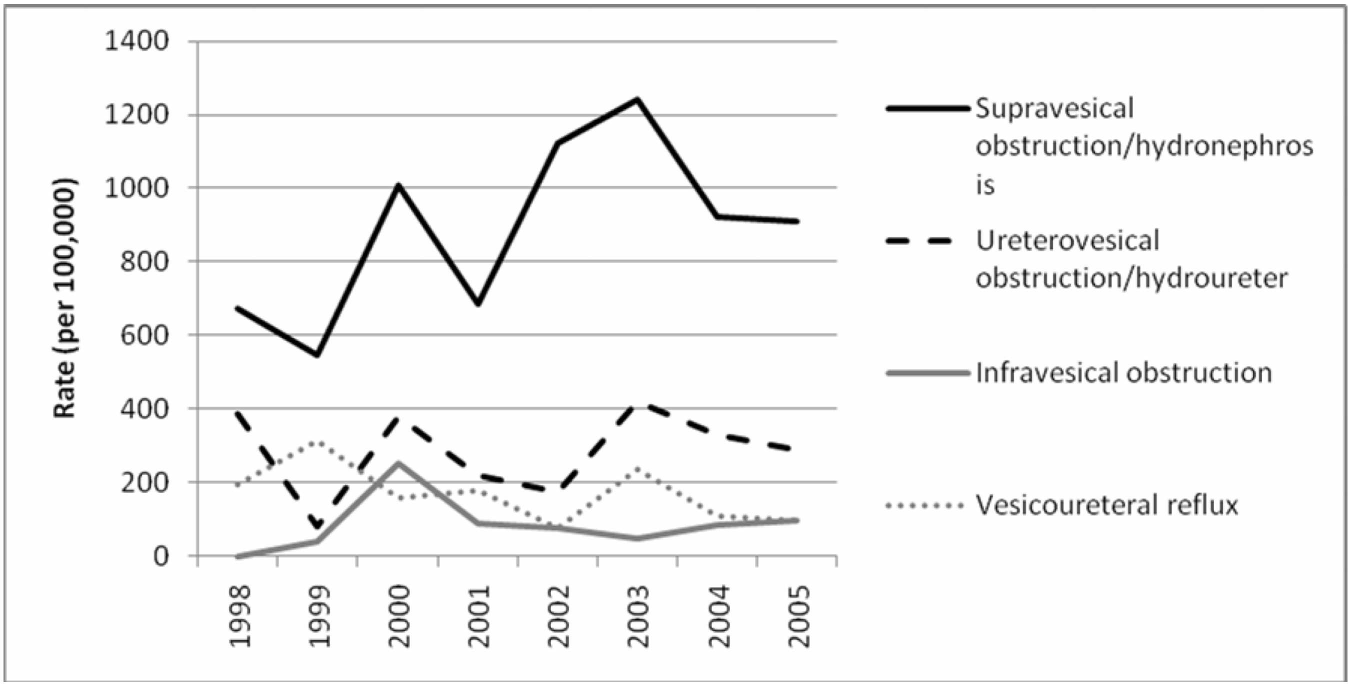

Figure 1.

Trends in rates of prenatally diagnosed urologic disorders. 'Supravesical obstruction/ hydronephrosis' signifies aggregate rates of hydronephrosis, ureteropelvic junction obstruction, and other causes of supravesical obstruction. 'Ureterovesical obstruction/ hydroureter' indicates aggregate rates of ureterovesical obstruction, megaureter/hydroureter, and additional etiologies of obstruction at the ureterovesical junction. 'Infravesical obstruction' denotes aggregate rates of ectopic ureters, ureteroceles, PUV, and other causes of infravesical obstruction. Rates of postnatally diagnosed urologic conditions (all causes) and prenatally diagnosed cystic renal diseases, congenital adrenal hyperplasia, vascular disorders of the kidney, neurogenic bladder, other disorders of the bladder, unspecified disorder of urethra and urinary tract, exstrophy, and urachal anomalies are not shown due to low numbers (less than five cases per year over multiple years).

Table 1

Temporal trends in abortions

	Year 1998	1999	2000	2001	20002	2003	2004	2005	Total
No abortion performed	21512	19870	22612	33094	35315	44334	54393	90481	321611
Abortion performed	210	180	199	336	357	450	492	803	3027
Total	21722	20050	22811	33430	35672	44784	54885	91284	324638
Rate per 100,000 (CI)	966.76 (836.63–1096.89)	897.76 (836.63–1096.89)	872.39 (767.18–1028.33)	1005.09 (898.15–1112.02)	1000.7 897.49–1104.08)	1004.82 (912.45–1097.2)	896.42 817.56–974.28)	879.67 (819.1–940.25)	

Table 2

Temporal trends in rates of prenatal ultrasound use by pregnant women

Prenatal ultrasound Performed?	1998	1999	2000	2001	2002	2003	2004	2005	Total
No	98	232	255	257	246	432	313	293	2126
Yes	941	2325	2919	4279	4925	3845	7916	9056	36206
Total	1039	2557	3174	4536	5171	4277	8229	9349	38332
Rate of ultrasounds per 100,000 mother-infant pairs	90568	90927	91966	94334	95243	89899	96196	96866	94454

Table 3

Rates of urologic anomalies among children of women who underwent prenatal ultrasound

Prenatal ultrasound?	Urologic diagnosis?	1998	1999	2000	2001	2002	2003	2004	2005	Total
Yes	**No**	932	2301	2880	4238	4856	3783	7818	8945	35753
Yes	**Yes**	9	24	39	41	69	62	98	111	453
	Total	941	2325	2919	4279	4925	3845	7916	9056	36206
	Rate per 100,000 (CI)	956.43 (333.44–1579.4)	1032.26 (621.11–1443.4)	1336.07 (919.32–1752.8)	958.17 (666.17–1250.2)	1401.02 (1072.65–1729.4)	1612.48 (1214.18–2010.8)	1238 (994.36–1481.6)	1225.71 (999.05–1452.4)	
No	**No**	98	231	252	254	245	431	310	291	2112
No	**Yes**	0	1	3	3	1	1	3	2	14
	Total	98	232	255	257	246	432	313	293	2126
	Rate per 100,000 (CI)	0	431.03 (−418.23–1280.3)	1176.47 (−155.9–2508.84)	1167.32 (−154.68–2489.31)	406.5 (−394.18–1207.19)	231.48 (−223.49–686.45)	958.47 (−126.85–2043.78)	682.59 (−265.72–1630.91)	