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Presence of the 'lemon' sign in fetuses with spina bifida at the 10–14-week scan

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ABSTRACT

In three cases of lumbosacral spina bifida diagnosed at 12, 13 and 14 weeks of gestation there was an associated lemon sign, or scalloping of the frontal bones, and in one case the fetal nuchal translucency was increased. In a multicenter ultrasound screening study at 10–14 weeks there were 61 972 singleton pregnancies including 29 cases of spina bifida, none of which was diagnosed at the routine first-trimester scan, but 28 of the 29 cases were detected by ultrasonography at 16–22 weeks; in one case the diagnosis was missed at the 20-week scan and the defect was identified at 32 weeks during a scan for localization of the placenta. The fetal nuchal translucency was above the 95th centile in only one of the cases (3.4%). It is possible that the majority of fetuses with spina bifida have a lemon sign in the first trimester, but the sensitivity of the 10–14-week scan in the diagnosis of spina bifida and the prevalence of the lemon sign at this gestation will only be established by further studies incorporating early systematic examination of the head and spine.

INTRODUCTION

In the 1980s the main method of screening for open spina bifida was by maternal serum α-fetoprotein level at around 16 weeks of gestation and the method of diagnosis was amniocentesis and measurement of concentrations of amniotic fluid α-fetoprotein and acetylcholinesterase. Although it was possible to diagnose the condition by ultrasonographic examination of the spine[1], the sensitivity of this test was low[2]. However, the observation that spina bifida was associated with scalloping of the frontal bones (the 'lemon' sign) and caudal displacement of the cerebellum (the 'banana' sign)[3] has led to the replacement of biochemical assessment by ultrasonography, both for screening and diagnosis of this abnormality.

In the 1990s improvements in quality of ultrasound equipment and the need for earlier diagnosis has led to detection of a wide range of abnormalities, including spina bifida, during the first trimester of pregnancy[4,5]. This study describes the presence of the cranial signs in fetuses with spina bifida at 12–14 weeks of gestation and provides the basis for investigation of the potential value of ultrasonography in first-trimester screening and diagnosis of spina bifida

CASE REPORTS

In three cases of lumbosacral spina bifida diagnosed at 12, 13 and 14 weeks of gestation there was an associated lemon sign, or scalloping of the frontal bones (Figure 1). Additionally, the frontal part of the brain appeared to be sonolucent because the choroid plexuses, that normally fill the lateral ventricles, were confined to the middle and posterior portions. In the first case, the ultrasound scan was carried out because of a previous history of spina bifida. The indications for referral of the other two cases were the detection of severe lumbosacral kyphoscoliosis and increased fetal nuchal translucency thickness during routine ultrasound examination for pregnancy dating (Table 1). In all three cases the crown–rump length (CRL) was appropriate for gestational age and in one case the nuchal translucency thickness was above the 99th centile[6]. Termination of the pregnancy was carried out at the request of the parents and in one case, in which postmortem examination was possible, the diagnosis was confirmed.

The 10–14-week screening study

The finding of increased nuchal translucency thickness in one of the above cases prompted us to examine the prevalence of spina bifida and the possible association with increased nuchal translucency thickness at the 10–14-week scan.

As part of an ongoing multicenter ultrasound study, started in September 1992 and co-ordinated by the Fetal Medicine Foundation[7], women in London and the surrounding areas are offered screening for chromosomal defects by a combination of maternal age and fetal nuchal translucency thickness at 10–14-weeks of gestation. The pregnancy is examined for the number of live fetuses, CRL, nuchal translucency thickness and major defects, such as anencephaly[8]. An ultrasound scan is also offered routinely

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at 16–22 weeks for fetal growth and systematic examination of the fetal anatomy. Demographic details and ultrasound findings are entered into a computer database at the time of the scans and pregnancy outcome is obtained from the patients themselves or the referring hospitals.

A computer search of the database was carried out to identify all singleton pregnancies with live fetuses at the 10–14-week scan and an estimated date of delivery before June 1996. There were 61 972 singleton pregnancies and these included 29 cases of spina bifida; none of these was diagnosed at the routine 10–14-week scan, but 28 of the 29 cases were detected by ultrasonography at 16–22 weeks; in one case the diagnosis was missed at the 20-week scan and the defect was identified at 32 weeks during a scan for localization of the placenta. The fetal nuchal translucency thickness was above the 95th centile in only one of the cases (3.4%; Table 2).

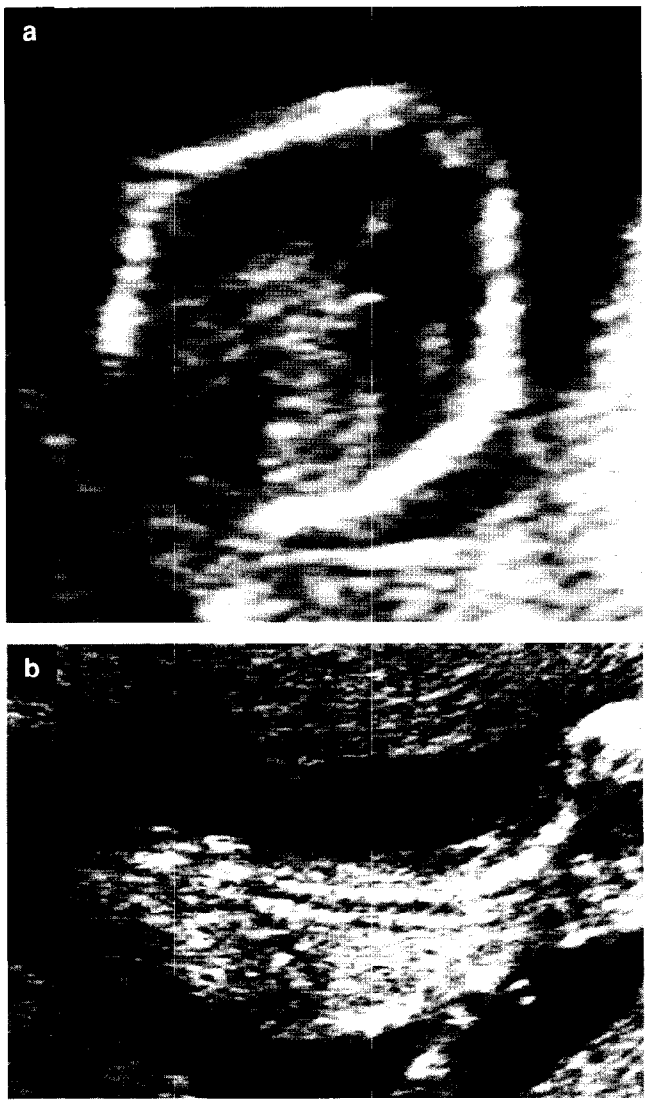

Figure 1 Ultrasound photographs of a 12-week fetus with open spina bifida demonstrating the 'lemon' sign (a) and the spinal defect (b)

DISCUSSION

This report demonstrates that at least in some cases of spina bifida the characteristic scalloping of the frontal bones is present from the first trimester of pregnancy. This 'lemon' sign is thought to be due to tethering of the spinal cord at the site of the spina bifida with subsequent downward displacement of the brain as the fetus grows[3,9,10]. Consequently, it could be expected that the prevalence of the 'lemon' sign would increase with advancing gestation. However, the reverse may be true; a study of 130 fetuses with spina bifida, diagnosed during the second and third trimesters of pregnancy, reported that the 'lemon' sign was present in 98% of those examined before 25 weeks but in only 13% of those diagnosed after this gestation[11].

The findings of the multicenter screening study demonstrate that first, the prevalence of spina bifida in a population in and around London is about 1 in 2000; and second, the sensitivity of a routine scan at 16–22 weeks in the diagnosis of spina bifida is more than 95%. Although none of the cases was diagnosed at the 10–14 week scan, the main aim of this examination was to measure the fetal CRL and nuchal translucency thickness and the sonographers were not specifically instructed to examine the fetal spine and search for the cranial signs of spina bifida. In a previous study we reported that in the first phase of the multicenter project for chromosomal abnormalities, 25% of cases with anencephaly were not detected at 10–14 weeks but subsequently all cases were identified following specific instruction of the ultrasonographers as to the characteristic features of anencephaly at this gestation[8]. Similarly, systematic examination of the head and spine will determine both the sensitivity of the 10–14-week scan in the diagnosis of spina bifida and the prevalence of the lemon sign at this gestation. A transvaginal ultrasound study of detailed examination in 8011 pregnancies at 12–17 weeks of gestation reported that all five cases of lumbosacral spina bifida were detected and they all had the 'lemon' sign[5]. The detection rate by routine examination at 10–14 weeks remains to be established.

Early diagnosis of spina bifida could have potentially important implications in the future management of this condition. Animal studies have suggested that much of the neurological handicap associated with spina bifida may be

Table 1 Gestation at diagnosis, indication for referral and ultrasound findings in three cases of spina bifida. CRL, crown–rump length; NT, nuchal translucency thickness

Case	*Gestation* (weeks)	*Indication*	*Ultrasound findings*
1	12	previous spina bifida	'lemon' sign, lumbosacral spina bifida, CRL 56 mm, NT 1.6 mm
2	13	kyphoscoliosis	'lemon' sign, lumbosacral spina bifida, CRL 62 mm, NT 1.9 mm
3	14	increased NT	'lemon' sign, lumbosacral spina bifida, CRL 82 mm, NT 4.8 mm

Table 2 Fetal crown–rump length (CRL), nuchal translucency thickness (NT), gestation at diagnosis, presence or absence of the 'lemon' sign and pregnancy outcome in 29 fetuses with spina bifida

Case	*CRL* (mm)	*NT* (mm)	*Diagnosis* (weeks)	*Site of detection*	*Lemon sign*	*Outome*
1	58	0.9	16	LS	yes	termination at 16 weeks
2	60	2.4	16	TL	yes	termination at 16 weeks
3	52	0.8	16	LS	yes	termination at 16 weeks
4	62	2.0	16	LS	yes	termination at 17 weeks
5	82	2.6	17	S	yes	neonatal death at 41 weeks
6	54	1.5	17	LS	yes	termination at 17 weeks
7	51	1.0	18	L	yes	termination at 18 weeks
8	45	1.5	18	LS	no	termination at 19 weeks
9	60	1.7	19	LS	yes	termination at 19 weeks
10	53	1.2	20	LS	yes	termination at 21 weeks
11	83	1.6	20	S	yes	termination at 21 weeks
12	44	1.7	20	LS	yes	termination at 20 weeks
13	56	1.0	20	LS	yes	termination at 20 weeks
14	51	3.2	20	L	yes	termination at 20 weeks
15	59	1.4	20	LS	yes	termination at 20 weeks
16	45	1.3	20	L	no	termination at 21 weeks
17	45	1.3	20	L	yes	termination at 20 weeks
18	65	1.3	20	LS	yes	termination at 21 weeks
19	52	1.9	20	TL	yes	termination at 20 weeks
20	57	1.3	20	L	yes	termination at 21 weeks
21	65	1.2	20	L	yes	termination at 21 weeks
22	55	1.8	20	S	yes	termination at 21 weeks
23	52	1.3	21	S	yes	termination at 21 weeks
24	63	2.0	21	S	yes	livebirth at 38 weeks
25	42	1.5	21	L	no	termination at 21 weeks
26	54	2.3	21	LS	yes	termination at 22 weeks
27	57	0.7	21	TL	yes	termination at 21 weeks
28	43	1.9	21	L	yes	termination at 21 weeks
29	77	2.7	32	L	no	livebirth at 37 weeks

L, lumbar; TL, thoracolumbar; S, sacral; LS, lumbosacral

the result of progressive damage of neural tissue from exposure to amniotic fluid and this could be prevented by intrauterine closure of the defect[12–14]. The relevance of these animal experiments to human fetuses remains uncertain, but earlier prenatal diagnosis potentially improves the prospects of successful intrauterine surgery.

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