Gastroschisis and omphalocele in Singapore: a ten-year series from 1993 to 2002

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ABSTRACT

Introduction: Two of the most common malformations of the anterior abdominal wall include gastroschisis and omphalocele, both of which are associated with high morbidity and mortality. Studies have shown an increase in both conditions worldwide. These two conditions are considered separate entities because of their differences in epidemiology, physical characteristics and associations with other structural anomalies and chromosomal aberrations. This is the first local study to examine these two conditions.

Methods: Data of anterior abdominal wall defect cases of patients born during the period 1993-2002 were retrieved from the National Birth Defects Registry and analysed.

Results: There were a total of 121 cases of anterior abdominal wall defects in the ten-year period from 1993 to 2002, giving an overall incidence of 2.63 per 10,000 livebirths. The individual incidences of gastroschisis (n = 21) and omphalocele (n = 100) were 0.46 and 2.17 per 10,000 livebirths, respectively. 33 percent of women with foetal gastroschisis were younger than 25 years of age, and 31 percent of women with foetal omphalocele were older than 35 years of age. This was statistically significant when compared to the general obstetric population. Incidence of omphalocele was lowest among the Indian population. Total aneuploidy rate was 14.9 percent (18/121 cases), with omphalocele having a higher aneuploidy rate than gastroschisis (17 percent versus 4.8 percent). Omphaloceles are also more likely to be associated with cardiac defects (p-value equals 0.02).

Conclusion: Our studies are consistent with the worldwide trend of an increasing prevalence of anterior abdominal wall defects. The race-specific differences suggest genetic and environmental factors that warrant further studies.

Keywords: aneuploidy risk, anterior abdominal wall defects, birth defects, gastroschisis, omphalocele

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INTRODUCTION

Two of the most common malformations of the anterior abdominal wall include gastroschisis and omphalocele; both are associated with high morbidity and mortality. However, these two conditions are separate entities, due to their differences in epidemiology, physical characteristics as well as association with other structural anomalies and chromosomal aberrations. Studies have shown an increasing trend of gastroschisis worldwide (Japan,[1] Australia,[2] United Kingdom,[3] Ireland,[4] United States[5]) although this is not a universal finding (China,[6] Italy[7]). A consistent finding, however, is an increased prevalence of gastroschisis among young mothers,[1-9] and there have been suggestions that smoking might play an important aetiological role in this phenomenon.[3,7]

Omphalocele has also seen an increasing trend in countries like Japan,[1] although some studies suggest that its incidence has remained stable, in contrast with gastroschisis in countries such as Ireland[4] and North England.[10] Omphalocele is associated with a high proportion of other major congenital anomalies,[1,4,9,11] including chromosomal aberrations.[4,8,9,12,13] In contrast to gastroschisis, there is an increased prevalence of omphalocele among older mothers.[1,3,10] Although studies have been done in other Asian countries, like Japan and China, there has not been any local study performed to examine this phenomenon in Singapore. The aim of this study is to look at the incidence, demographic data and epidemiological pattern of gastroschisis and omphalocele in Singapore over a ten-year period from 1993 to 2002,

and to compare our data with those from other Asian countries, as well as to examine the chromosomal and other birth defects associated with these two conditions.

METHODS

The method of data collection at the National Birth Defects Registry (NBDR) has been previously described.[14] Multiple sources comprising government bodies, public and private medical centres, contribute to the collection of birth defect data. These include the Epidemiology and Disease Control Division of the Ministry of Health, the National Registry of Births and Deaths, as well as cytogenetic and histology laboratories, and nursery wards in both public and private hospitals in Singapore.

Using an in-house database software programme, NBDR Version 1.0, developed with the Information Service Department of KK Women's and Children's Hospital, all notified cases of gastroschisis and omphalocele from 1993 to 2002 were extracted from the registry's database, and the data was then analysed. Care was taken to ensure confidentiality and anonymity of the extracted and analysed data. The population denominators used in computing the rates per 10,000 livebirths shown in the tables were obtained from the Reports on Registration of Births and Deaths.[15]

RESULTS

Between 1993 and 2002, a total of 121 cases of gastroschisis and omphalocele were notified, of which 21 (17.4%) were gastroschisis and 100 (82.6%) were omphalocele. In the same period, there were 460,532 livebirths, giving an overall incidence of 2.63 per 10,000 livebirths. When this was stratified into gastroschisis and omphalocele, the mean total incidences were 0.46 and 2.17 per 10,000 livebirths, respectively. Table I and Figs.1–3 show the changes in total and birth incidences for gastroschisis and omphalocele per 10,000 livebirths for yearly and five-yearly intervals between 1993 and 2002. For gastroschisis, the total incidence in the period from 1993 to1997 was 0.37 per 10,000 livebirths, compared to 0.56 per 10,000 livebirths in the period from 1998 to 2002. Birth incidence between the two periods was 0.25 and 0.19 per 10,000 livebirths, respectively (Fig. 2). The differences were not statistically significant.

The total incidence for omphalocele rose significantly from 1.60 per 10,000 livebirths in the period 1993–1997 to 2.82 per 10,000 livebirths in the period 1998–2002 (p = 0.005). The birth incidence for omphalocele was 0.65 and 0.74 per 10,000 livebirths, respectively (p = 0.758) (Fig. 3). The total incidence of anterior abdominal wall defects rose significantly from 1.96 per 10,000 livebirths in the period 1993–1997 to 3.38 per 10,000 livebirths in

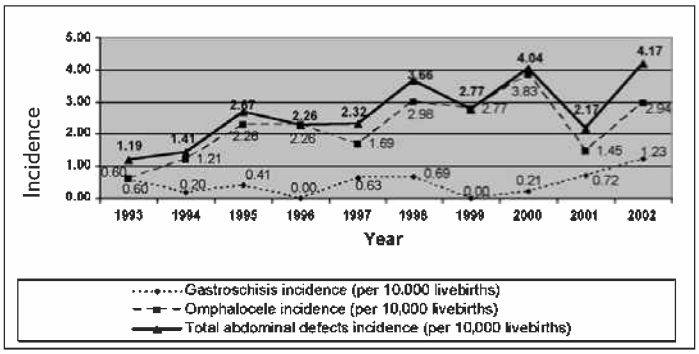

Fig. 1 Graph shows the incidence of abdominal wall defects (gastroschisis and omphalocele) in relation to the number of livebirths from 1993 to 2002.

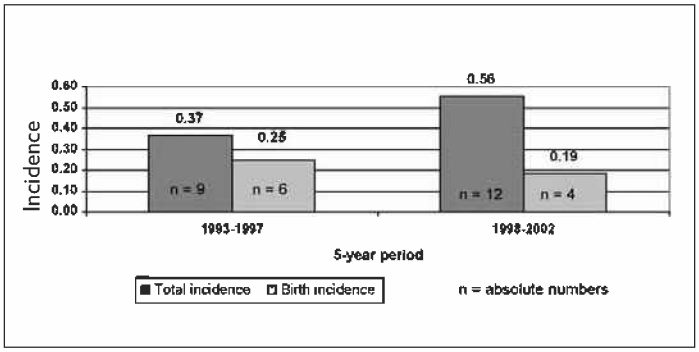

Fig. 2 Bar chart shows the incidence (total vs. birth) of gastroschisis from 1993 to 2002.

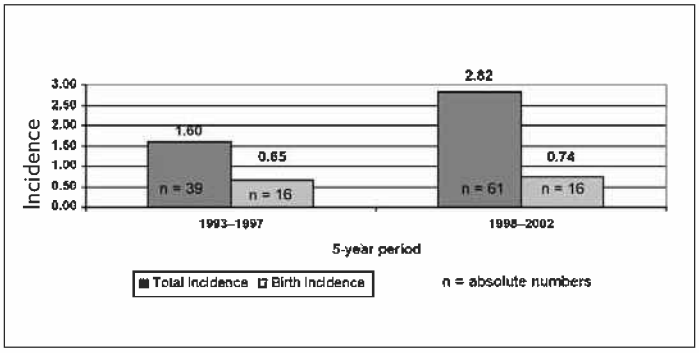

Fig. 3 Bar chart shows the incidence (total vs. birth) of omphalocele from 1993 to 2002.

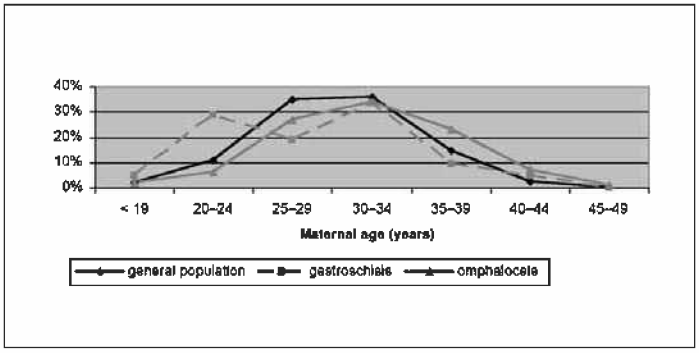

Fig. 4 Graph shows the maternal age group at delivery (gastroschisis and omphalocele vs. general obstetric population) in Singapore, 1993–2002.

Table I. Incidences of gastroschisis and omphalocele by five-year periods from 1993 to 2002.

Condition	Five-year period		p-value
	1993–1997	1998–2002	
Gastroschisis			
Total number (incidence)	9 (0.37)	12 (0.56)	0.387
Livebirths (incidence)	6 (0.25)	4 (0.19)	0.758
Omphalocele			
Total number (incidence)	39 (1.60)	61 (2.82)	0.005
Livebirths (incidence)	16 (0.65)	16 (0.74)	0.728
Anterior abdominal wall defects			
Total number (incidence)	48 (1.96)	73 (3.38)	0.003
Livebirths (incidence)	22 (0.91)	20 (0.93)	0.051

Incidence refers to the rate per 10,000 livebirths.

Table II. Incidence of gastroschisis and omphalocele per 10,000 livebirths related to the mother's age, Singapore, 1993–2002.

Age range (years)	No. total births (%)	Gastroschisis		Omphalocele	
		No. (%)	Incidence	No. (%)	Incidence
< 19	8,020 (1.7)	1 (4.8)	1.25	2 (2.0)	2.49
20–24	48,788 (10.6)	6 (28.5)	1.23	6 (6.0)	1.23
25–29	160,807 (34.9)	4 (19.1)	0.25	27 (27.0)	1.68
30–34	165,142 (35.9)	7 (33.3)	0.42	34 (34.0)	2.06
35–39	67,474 (14.6)	2 (9.5)	0.30	23(23.0)	3.41
40–44	10,049 (2.2)	1 (4.8)	1.00	7 (7.0)	6.97
45–49	252 (0.1)	0	0	1 (1.0)	39.68
Total	460,532 (100)	21 (100)	0.46	100 (100)	2.17

Incidence refers to the rate per 10,000 livebirths.

the period 1998–2002 (p = 0.003). Abortion rate for omphalocele was 68.0% (68/100), compared to 52.4% (11/21) for gastroschisis (p = 0.21). Of the remaining births for each condition, mortality (stillbirths and neonatal deaths) was 50.0% (16/32) for omphalocele and 0% (0/10) for gastroschisis (p = 0.006).

Table II shows the incidence of gastroschisis and omphalocele in relation to maternal age and Fig. 4 shows the percentage of births by maternal age groups compared to the general population. About 33% of women (7/21 cases) with foetal gastroschisis were younger than 25 years of age, compared with about 12% of the general obstetric population. This was statistically significant (p = 0.010). On the other hand, 31% of women (31/100 cases) with foetal omphalocele were older than 35 years of age, compared with about 17% of the general obstetric population. This was statistically significant (p < 0.001) (Table II and Fig. 4). The race-specific incidence of abdominal wall defects was 2.90 per 10,000 livebirths and 2.33 per 10,000 livebirths in the Chinese and Malay populations, respectively, compared to 1.31 per 10,000 livebirths in the Indian population. Sub-stratification into gastroschisis and omphalocele shows a lower incidence among Indians in the omphalocele group only (Table III).

Total aneuploidy rate was 14.9% (18/121 cases). In isolated cases (not associated with other structural abnormalities), aneuploidy rate was 5.7% compared to 23.5% (16/68 cases) in non-isolated cases (associated with other structural abnormalities). However, this was not quite statistically significant (p = 0.057). Aneuploidy rate was 4.8% (1/21 cases) in the gastroschisis group, compared to 17% (17/100 cases) in the omphalocele group (p = 0.19). Sub-stratifying these two groups into isolated (not associated with other structural abnormalities) and non-isolated (associated with other structural abnormalities) cases, the differences in the occurrence of aneuploidy between isolated and non-isolated gastroschisis and omphalocele groups were also not statistically significant (Fig. 5). There were three cases of gastroschisis associated with cardiac defects (3/21, 14.3%), compared to 40 cases of omphalocele (40/100, 40%, p = 0.02).

Table III. Incidence of anterior abdominal defect cases by race (1993–2002).

Race	Total no. of livebirths	Anterior defect abdominal cases		Gastroschisis		Omphalocele	
		Total no.	Total incidence	No.	Incidence	No.	Incidence
Chinese	310,656	90	2.90	14	0.45	76	2.45
Malay	85,779	20	2.33	3	0.35	17	1.98
Indian	38,187	5	1.31	2	0.52	3	0.79
Others	25,910	6	2.32	2	0.77	4	1.54
Total	460,532	121	2.63	21	0.46	100	2.17

Incidence refers to the rate per 10,000 livebirths.

Table IV. Comparison of the present study with other Asian studies.

	Suita et al (Japan)[1]			Present study		
	Omphalocele (n = 1,785)	Gastroschisis (n = 970)	p-value	Omphalocele (n = 100)	Gastroschisis (n = 21)	p-value
Total incidence (per 10,000 births)	0.54	0.30	< 0.001	2.17	0.46	ns
Mothers aged under 20 years (%)	2.2	13.5	< 0.001	2.0	4.8	ns
With associated anomalies (%)	55.9	21.8	< 0.001	73.0	52.4	0.0726 (ns)
With chromosomal abnormalities (%)	11.6	1.0	< 0.001	17.0	4.8	ns
With antenatal diagnosis (%)	19.7	20.4	ns	46.0	38.1	ns
Survival rate (%)	68.0	81.2	< 0.001	50.0	100.0	< 0.0001

ns: not significant

DISCUSSION

Our data is consistent with other studies that have shown an overall increase in anterior abdominal wall defects. However, our study suggests that this increase is contributed by a statistically significant increase in the total incidence of omphalocele, compared to gastroschisis. This is in contrast to other studies which have suggested an increase in incidence of gastroschisis. This difference is likely to be contributed by decreasing numbers of younger mothers in our local obstetric population. Our study is consistent with others which have shown a similar difference in the incidence of gastroschisis and omphalocele among different age groups. In comparison with the general obstetric population, younger mothers (especially among those < 25 years of age) have a 2.8-fold higher risk of having a baby with gastroschisis, and older mothers (especially among those > 35 years of age) have a 1.8-fold higher risk of having a baby with omphalocele. Various authors have suggested a link between the higher gastroschisis incidence among younger mothers with cigarette consumption[16] and use of recreational drugs like cocaine, marijuana, amphetamines and alcohol.[17,18] However, we were not able to confirm this in our study; we suggest that further studies be done to ascertain this possible association.

The similar abortion rates for the two conditions could be due to similar perceptions by both patient and clinician toward the two conditions, resulting in directed counselling towards termination. The statistically significant differences in mortality rates between the two conditions are likely due to the increased cardiac and chromosomal defects found among omphaloceles, and this has also been suggested by various other studies.[3,9,19] More can be done to ascertain any difference for these conditions in morbidity rates as this will also affect the way patients will be counselled. A Thai study done in 2000 by Suita et al[1] showed significantly higher incidence of associated structural and chromosomal anomalies in omphaloceles. On the other hand, gastroschisis has been significantly associated with younger mothers less than 20 years of age; there is generally a higher survival rate as well. Comparison with our data shows similar trends, although we did not find any statistical significance. This is likely due to the relatively small numbers in our study (Table IV).

We have also attempted to examine the influence of

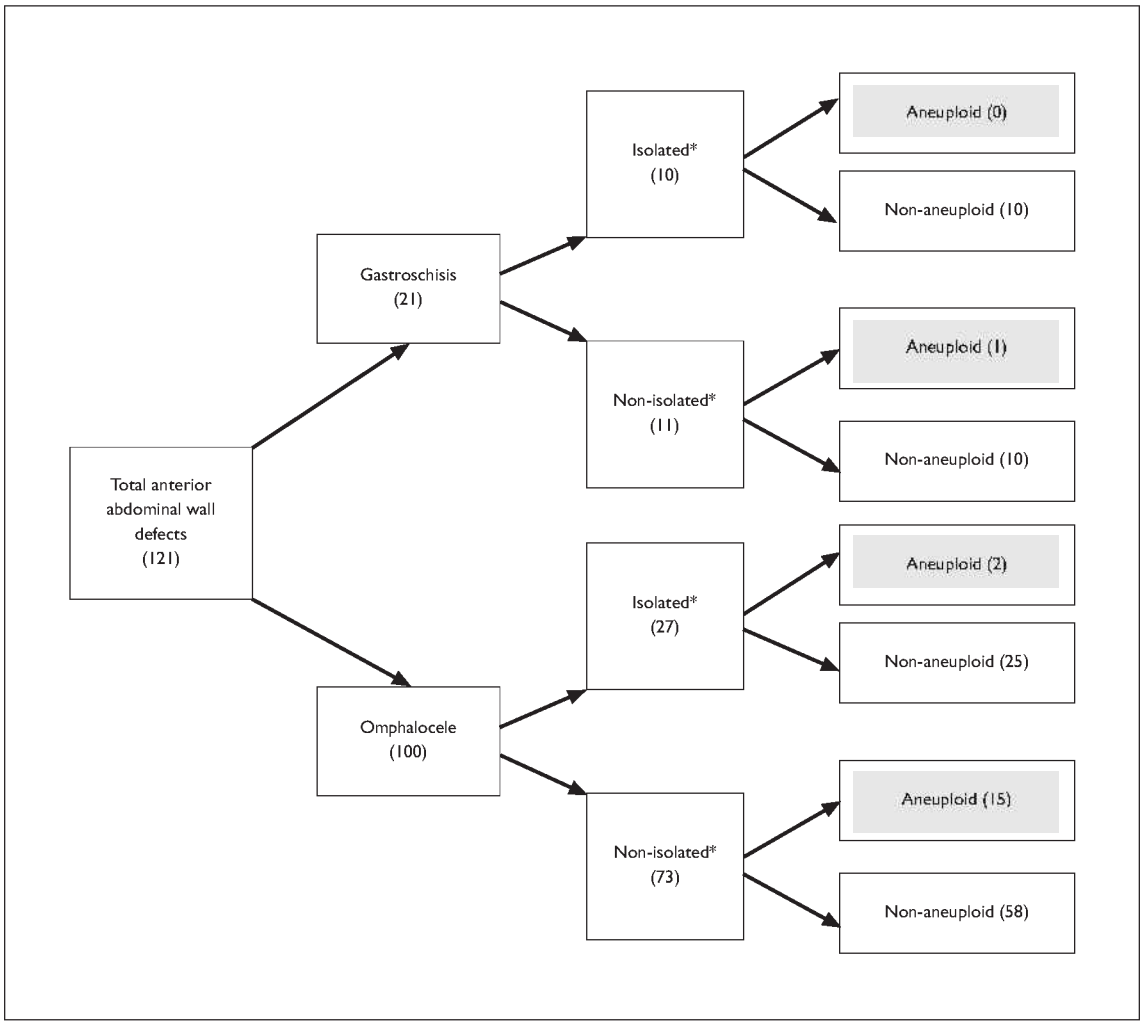

Fig. 5 Aneuploidy among isolated and non-isolated cases of gastroschisis and omphalocele.
* Isolated: not associated with other structural anomalies; non-isolated: associated with other structural anomalies

race on the incidence of abdominal wall defects. The differences in incidence between the races suggest dietary or genetic factors; these require further study. The lack of statistical significance is likely due to the small numbers involved in our study. There appears to be a difference in trend between gastroschisis and omphalocele. Indians have the lowest incidence of omphalocele. Our study is consistent with other studies that have shown a higher incidence of cardiac anomalies with omphalocele compared to gastroschisis.[20]

Our data is also consistent with other studies that have shown a greater association of omphalocele with aneuploidy. We also looked at the differences between isolated and non-isolated cases. In gastroschisis, the only case with aneuploidy occurred in the non-isolated group (1/11 or 9.1%). In contrast, for omphalocele, there were two cases of aneuploidy among the isolated group (2/27 or 7.4%) and 15 cases of aneuploidy among the non-isolated group (15/73 or 20.5%). It appears that non-isolated cases of anterior abdominal wall defects are more likely to be associated with aneuploidy, with a two-fold higher risk for omphalocele.

In conclusion, our study is consistent with world-wide trends in showing the increasing incidence of anterior abdominal wall defects. However, our study suggests that only omphalocele is on the rising trend. Our results are consistent with other studies that show younger mothers are associated with gastroschisis and older mothers are associated with omphalocele. We have similarly shown, consistent with previously published reports, a higher proportion of aneuploidy among omphaloceles compared with gastroschisis, although our data did not reach statistical significance. This is likely due to our smaller numbers. There is a suggestion of higher aneuploidy rates among non-isolated cases of anterior abdominal wall defects. Our study also suggests racial differences in these defects, particularly between the Indian community and the rest of the population. However, more studies should be done to elucidate this association.

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