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Adult patients with spina bifida cystica: genetic counselling, pregnancy and delivery

C.C.Th. Rietberg[a], D. Lindhout*[b]

[a]*Department of Obstetrics and Gynaecology,* [b]*MGC-Institute of Clinical Genetics, Academic Hospital Dijkzigt, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, The Netherlands*

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Abstract

With more aggressive surgical management, patients born with spina bifida may now reach adulthood and achieve pregnancies. Any female patient with spina bifida is strongly recommended to have preconceptional genetic counselling. The risk for parents with spina bifida of having affected offspring (approx. 4%) is considerably increased compared with the general population (0.1–0.3%). This risk may be lowered when periconceptional folic acid supplements are given. In pregnancy, special care is needed in the management of urological, obstetric, neurological and anaesthetic problems. Urological complications like neurogenic bladder, incontinence, chronic infection, increased chance of developing bladder carcinoma and impaired renal function are common in the spina bifida patient. In case of urinary diversion, obstruction may complicate the pregnancy. The incidence of premature labour is increased. Clinical assessment of the pelvis is necessary because of a possibly contracted pelvis. If the head engages normally, vaginal delivery should be allowed if possible. Caesarean section should be performed for obstetric reasons only. Cerebrospinal fluid shunts may give neurological problems during pregnancy. In most cases reported, symptoms improved spontaneously after delivery. In case of a shunt, vaginal delivery is preferable, pushing during second stage not contra-indicated, and in case of caesarean section, prophylactic antibiotics and thorough irrigation of the peritoneal cavity are indicated.

Key words: Spina bifida; Pregnancy; Genetic counselling; Delivery; Neurogenic bladder; Cerebrospinal fluid shunt

1. Introduction

Over the last few decades great improvement in management of patients born with meningomyelocele has been achieved based on increased knowledge and improved techniques. As a result patients are now reaching adulthood and reproductive age. The actual number of adult pregnant patients is unknown and very few reports have been made on their pregnancies. Many obstetricians, genetic counsellors and other physicians, frequently confronted with neural tube defects of the newborn and fetus, are unaware of the complications that can be encountered in the adult

* Corresponding author.

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pregnant spina bifida patient. Pregnancy and delivery of a healthy baby can be successfully achieved, but for effective management a multidisciplinary approach is needed.

This paper discusses the genetic counselling and the urological, obstetric, neurological and anaesthetic management of the pregnant spina bifida patient.

2. Genetic counselling

2.1. Risk of neural tube defect in offspring

There are geographical differences in the prevalence of neural tube defects. In Continental Europe the mean prevalence is 1.15 per 1000 newborns [1]; prevalences of more than 3 per 1000 newborns have been registered in the United Kingdom and Ireland [2]. The risk for parents born with spina bifida of having affected offspring will follow, according to the multifactorial threshold model, a pattern of geographical difference parallel to the prevalence of neural tube defects in the general population.

Neural tube defect is regarded as a multifactorial disorder in which multiple genetic factors as well as environmental factors may play a role. A consistent finding in several studies [3–6] has been that more collateral cases of spina bifida are found on the maternal side than the paternal side. Some have ascribed this to ascertainment bias [4,5]. Also, cytoplasmic or mitochondrial inheritance has been invoked as an explanation for more frequent transmission of spina bifida and other neural tube defects through the female line [7]. Chatkupt et al. [8] consider genomic imprinting as the explanation for this difference, although their data cannot prove it statistically. Genomic imprinting is a phenomenon in which the expression of a gene depends on whether it is transmitted through the male or female parent. Thus, the penetrance of a spina bifida gene would be higher in offspring of female gene carriers than of male gene carriers.

Because of a multifactorial inheritance pattern, etiological and genetic heterogeneity, and the relatively small size of the studies performed on spina bifida patients and their offspring, the internal validity of these kinds of epidemiologic studies will be relatively low, i.e. the groups are not derived from a common population by randomization, and there is no assurance that they are similar in relation to other characteristics which may be relevant to the occurrence of neural tube defects.

The largest study on pregnancy and fetal outcome among patients with spina bifida was carried out by Carter and Evans [9], with 104 offspring. Other studies were carried out by Lorber [10], Tünte [11] and Laurens and Beresford [12], with numbers of offspring of affected parents of 68, 29, and 48 children, respectively (see Table 1). These studies combined result in an overall risk for affected parents of having affected offspring of 4.1%, with a 95% confidence interval of 2.8–9.6%, according to Rümke [13]. As the total number of studied offspring increases, the confidence interval will get smaller and the average risk estimate will get more exact.

Since the incidence of affected offspring in patients with spina bifida is known to be higher than in the general population, amniocentesis should be offered to measure the level of alpha-fetoprotein in amniotic fluid. The possible options, including termination of the pregnancy, should be discussed in

Table 1
Risk of neural tube defect in offspring of spina bifida parents

Authors	Study size	Offspring	Affected	Percent	95% C.I.
Carter and Evans [9]	215	104	2	2%	0.24–7.0
Lorber [10]	36	86	3	3.5%	0.8–10.6
Tünte [11]	32	29	2	6%	0.8–22.1
Laurens and Beresford [12]	?	48	4	8%	2.2–19.2
	?	267	11	4.1%	2.8–9.6

detail with the patient before amniocentesis is done. Termination of a pregnancy for a condition from which the mother herself suffers, can be unacceptable to her (as described in two cases [14,15]) and one should be well informed about the mother's wishes to avoid unnecessary exposure of a possibly healthy fetus to miscarriage, in case she rejects termination of the pregnancy.

2.2. Vitamin supplementation/therapy

The possibility that dietary folic acid might be involved in the causation of neural tube defects was first raised in 1964 [16]. Two studies published in 1980 and 1981 [17,18] showed a significantly lower recurrence rate in women with previous affected pregnancies who received folic acid supplements. The first study was not randomised; the second study was randomised but corrected for non-compliance, which introduced the possibility of bias. Therefore, a large randomised double-blind prevention trial was conducted at 33 centres in 7 countries to determine whether supplementation with folic acid or a mixture of seven other vitamins around the time of conception could prevent neural tube defects in pregnancies of women who had a previous affected child or fetus [16]. From this study it was concluded that folic acid can prevent neural tube defects. It became clear that it is folic acid, rather than any of the other vitamins, that is responsible for the preventive effect and folic acid supplementation can be recommended for all women who have had a previously affected pregnancy.

There is, however, no formal proof that folic acid supplementation in women with spina bifida themselves will also decrease the risk to the offspring. It seems wise to supplement these women with a physiologic dose of 0.4 mg/day rather than the pharmacologic dose of 4–5 mg/day. Also, the medication for intercurrent bladder infection, which frequently yields anti-folate properties, as well as anti-epileptic drugs in case of complicating epilepsy, should be taken into account when avoiding folic acid deficiency.

3. Urological problems

Neural tube defects are associated with congenital or functional urinary tract abnormalities. The most common congenital malformation is unilateral renal agenesis. Also, abnormalities in fusion or migration of renal tissue are common, resulting in renal abnormalities like a horseshoe kidney, pelvic kidney or crossed ectopia. Less common, but more frequently seen than in the general population, are congenital abnormalities of the lower urinary tract [19].

Since a neurogenic bladder is a frequent complication of spina bifida, many patients suffer from urological problems such as urinary incontinence, urinary stasis and recurrent urinary tract infections. Over the last 15 years, urological management of spina bifida has changed dramatically with the introduction of clean intermittent catheterization and advanced surgical techniques such as bladder augmentation, bladder neck reconstruction and application of an artificial urinary sphincter [20]. However, before the development of these techniques many patients underwent urinary diversion to treat urinary incontinence or prevent upper urinary tract deterioration.

As a consequence of hypertonicity of the neurogenic bladder, vesicoureteric reflux may develop, which can cause hydronephrosis. Another consequence is urinary stasis due to poor emptying, accompanied by chronic cystitis, and a 20-fold increased risk of bladder carcinoma [21].

In pregnancy there is a physiological predisposition to urinary stasis and ureteric dilatation. Subsequently, the incidence of urinary tract infection in the pregnant spina bifida patient is higher. As a result of these chronic and intercurrent conditions, renal function can be impaired in patients with spina bifida. Renal failure can even progress to end-stage renal disease, which necessitates renal replacement therapy [22]. Any abnormal renal function is aggravated by the pregnancy. Therefore, the renal status must be monitored closely and treated accordingly [15]. In one case report [23], therapeutic abortion had been considered because of the severely affected renal status.

Pregnancy in patients with previous urinary diversion procedures may be complicated by several problems. Patients with a ureteric-bowel

anastomosis are at greater risk of developing pyelonephritis [23–25]. Also, ureteric obstruction [24], obstruction of the ileal conduit [26] and mechanical bowel obstruction secondary to adhesions and the growing uterus [14] have been reported. In 50% of patients, faecal incontinence is present, which has made an ileostomy or colostomy necessary. This may also result in bowel obstruction during pregnancy [23,27], which sometimes urged both obstetricians and surgeons to consider the need for a revision of the stoma [14,23].

Urinary calculi in spina bifida patients usually have an infectious etiology [20]. Two cases have been reported of patients developing urolithiasis after a successful pregnancy. One patient had an ileal loop bladder and needed nephrectomy 2 years postpartum and one had an uretero-ileostomy and needed bilateral ureterolithotomy 2 months postpartum.

4. Obstetric management

4.1. Premature labour

Congenital abnormalities of the genital tract may predispose the mother to premature labour and other complications of pregnancy and delivery. There is an increased risk for patients with a neural tube defect to have a congenital anomaly of the genital tract, such as a bicornuate uterus.

No evidence is available on the incidence of premature labour in patients with spina bifida. Robertson [28] reports an increased incidence of premature labour in spinal cord injury patients with a lesion above T_{10}. Of the 20 pregnant patients with spina bifida found in the literature, there were nine spontaneous deliveries before 37 completed weeks gestation among seven patients: one patient delivered at 26 and 33 weeks [29], two patients delivered at 33 weeks [14,24], one delivered at 35 weeks [30], one delivered at 36 and 37 weeks [15], and two delivered at 37 weeks [25,29].

From these findings the suspicion arises that pregnant spina bifida patients have an increased risk of premature labour.

4.2. Pelvic assessment

Patients with spina bifida suffer from varying degrees of muscular weakness which, over the years, may result in secondary developmental skeletal abnormalities. The effects of muscular paralysis on the pelvis are pelvic asymmetry, lumbo-sacral scoliosis, and the possible further effects of reconstructive surgery and the need to wear appliances [27]. Therefore, it is not unlikely that the spina bifida patient will have an abnormal pelvis, which could make a vaginal delivery difficult or impossible. Abnormal pelvic dimensions can result in abnormal presentation of the fetus, such as breech or persistent parietal presentation [29]. Careful clinical assessment of the pelvis is therefore necessary. Wynn et al. [14] found a surprisingly spacious pelvic cavity in two spina bifida patients. The sacrum was found to be poorly developed, thus enlarging the pelvic cavity and shortening the birth canal. They state that if the head is capable of engaging normally in the pelvis, vaginal delivery should be successfully achieved.

4.3. Vaginal delivery or caesarean section

When pelvic assessment shows reduced measurements, a caesarean section should be planned. Sometimes other maternal complications can be a reason for planning a caesarean section, such as abnormalities and impaired movement of the lower extremities, described in one mother (impossibility of abduction of the legs) [23]. Also, urological problems, such as renal impairment or recurrent renal infection, may be a reason to perform a caesarean section [23]. Spina bifida patients are prone to complications, necessitating the performance of a caesarean section, and yet maternal spina bifida does not make a caesarean section inevitable. Some patients suffer from paraplegia; however, paraplegia as such is not an indication for delivery by caesarean section. The uterus has the capacity to contract normally in labour when the nerve supply has been severed [28]. Robertson [28] reports that in a series of 39 paraplegic pregnant patients, all patients with a lesion above the tenth thoracic segment had painless labour and normal polarised contractions. Therefore, spina bifida patients can have normal labour and delivery and a caesarean section should be done only for obstetric reasons [28]. As patients with spina bifida have an increased risk of developing postoperative complications — such as deep venous

thrombosis and thromboembolism as a result of their relative immobility — caesarean section should be avoided whenever possible [14,30].

Of the 20 reported pregnancies in patients with spina bifida, nine patients had 12 vaginal deliveries (one patient 3 times, one patient 2 times, one patient 1 vaginal and 1 caesarean), and eight patients had a caesarean section. Four caesarean sections were performed because of pelvic disproportion, 1 because of breech presentation, 1 because of recurrent renal infection and impossibility of abduction of the lower extremities in the mother, and 2 because of unclear reasons.

4.4. Complications at caesarean section

Previous multiple abdominal surgery (such as ureteric diversion with intestinal conduit formation, formation of a uretero-cutaneous stoma, ileostomy or colostomy), with possible adhesions as a consequence, are the most important cause of surgical complications during caesarean section.

Before planned caesarean section is performed, a ureterogram should be obtained to outline the exact nature of the urinary diversion and its relationship to the uterus. Great care is required at operation to avoid trauma to the urinary tract.

Abdominal complications of a ventriculoperitoneal shunt during caesarean section are discussed below.

5. Neurological problems

5.1. Complications from cerebrospinal fluid shunts

Complications are seen in 25% of patients with ventriculoperitoneal shunts [31], most commonly mechanical shunt malfunction, catheter tip occlusion and shunt infection. Less usual complications are abdominal cerebrospinal fluid loculations and pseudocysts formation, intestinal perforation, migration of shunt tip in the right pleural cavity and intractable ascites.

Shunt malfunction may occur in pregnancy. Nineteen cases of pregnant patients with CSF shunts have been reported (see Table 2), of whom 15 had a ventriculoperitoneal shunt (VP) [32–40] and 4 had a ventriculoatrial shunt (VA) [32,41]. Nine of 15 patients with a VP had complaints of shunt malfunction. They presented with headaches, nausea and vomiting, with or without gaze palsy and sometimes impaired consciousness. In all patients, problems occurred in the third trimester of pregnancy. On shunt revision there was no demonstrable obstruction of the shunt which could explain the increased CSF pressure. All patients improved postpartum and foetal outcome was excellent. It appears that the enlarging uterus, possibly through the impedance of CSF flow through the shunt due to relatively increased intra-abdominal pressure, is largely responsible for the symptoms of shunt obstruction [35,40]. Another possibility is that the peritoneal catheter becomes compressed between the enlarged uterus and other viscera, such as the stomach and liver [35]. In most cases symptoms of shunt malfunction were managed conservatively until delivery, i.e. shunt pumping or aspiration of the proximal shunt reservoir. If conservative measures fail, converting the ventriculoperitoneal shunt to a ventriculoatrial shunt should be considered [35].

To avoid exposure of the fetus to radiation, the number of diagnostic techniques for evaluating the malfunctioning shunt will be limited. Magnetic resonance imaging is now preferred because of its non-ionizing nature and its ability to detect minute quantities of CSF flow in patients with ventriculomegaly [40].

Vaginal delivery in patients with a VP shunt is preferable and caesarean section should only be performed for obstetric reasons [32,37,41]. Pushing during second stage of labour is not contra-indicated. Backflow in ventriculoperitoneal shunts is prevented by the simultaneous increase of intracranial and intraperitoneal pressure with the Valsalva manoeuvre and by the one-way valves present in the shunts [33,34,36,40].

Approximately half of the pregnant patients with CSF shunts received prophylactic antibiotics; none suffered from postpartum febrile morbidity. Opening of the peritoneal cavity at caesarean section carries the risk of septicemic infection of the CSF shunt. Although not of proven benefit, it seems justifiable to give prophylactic antibiotics to these patients undergoing caesarean section. If antibiotics are given, they should be directed against common genital tract pathogens and should be able to penetrate the blood-brain barrier [36,39–41]. Kleinman et al. [34] recommend an extraperitoneal approach at caesarean section to protect the shunt from infection.

Table 2
Reported cases of pregnant women with cerebrospinal fluid shunts

Authors	Age (years)	Shunt type[a]	G.A.[b] at admission	Symptoms[c]	Treatment[d]	Delivery[e] (type and no. weeks)	Disc. obstr.[f]	Prophylaxis
Monfared	25	VA	27	none	none	forc, 41	—	no
et al. [32]	19	VP	33	none	none	forc, 40	—	no
Howard and	24	VP	33	none	none	vag, 33	—	no
Herrick [33]	25	VP	16	none	none	vag, 41	—	yes
Kleinman	20	VP	29	H,V,G	SP	forc, 40	no	no
et al. [34]	30	VP	29	H, V	SP	forc, 36	no	no
Hanakita	25	VP	32	H, V, G, C	SP, VA-rep	forc, 40	no	unstated
et al. [35]								
Fröhlich	23	VP	34	none	none	CS, 42	—	no
et al. [36]	15	VP	38	none	none	vacu, 38	—	no
	26	VP	32	none	none	vag, 34	—	no
Samuels	20	VP	37	H, G, C	SA	CS	no	unstated
et al. [37]	30	VP	34	H, V, G	SP+SA	CS	no	unstated
Hassan and	21[g]	VP	16	Abd, H	none	vag, 39	no	yes
El Moumani	23[g]	VP	16	Abd, H, D	none	vag, 38	no	yes
[38]								
Houston and	26	VP	33	H, V	SA	vag, 38	no	unstated
Clein [39]								
Cusimano	21	VP	30	H, V, D, C	SP+SA	CS, 36	no	no
et al. [40]								
Gast et al.	25	VA	?	none	none	forc,	—	yes
[41]	21	VA	28	V,H,C,A	none	vag, 39	no	yes
	22	VA	?	CA	SA, rev,	vag, 38	yes	yes

[a]VA, ventriculoatrial shunt; VP, ventriculoperitoneal shunt.
[b]G.A., gestational age in weeks.
[c]H, headache; V, vomiting; A, ataxia; G, gaze palsy; C, consciousness impaired; Abd, abdominal pain; D, dizziness.
[d]SP, shunt pumping; SA, shunt aspiration; rev, revision; VA-rep, replacement.
[e]forc, forceps; vag, vaginal; vacu, vacuum; CS, caesarean section.
[f]Obstruction discovered during period of symptoms.
[g]Same patient.

If a caesarean section needs to be performed, thorough irrigation of the peritoneal cavity should be performed at the end of the operation to minimize the risk of future shunt obstruction due to fibrin deposition on the end of the shunt [40].

6. Anaesthetic complications

6.1. Problems with regional anaesthesia due to spinal malformations

Regional anaesthesia can be achieved in patients with spina bifida. For successful achievement of spinal or epidural block clinical judgement, anatomical considerations and carefully applied techniques are essential.

Spinal anaesthesia bears a slight risk of nerve root or spinal cord trauma and postdural puncture headache. Raised intracranial pressure is an absolute contraindication to spinal anaesthesia and must therefore be carefully excluded [42]. Vertebral column abnormalities may require puncture at a site other than usually applied [43]. In one case report [43] a spinal catheter was used to overcome the lack of versatility of spinal anaesthesia as compared with epidural.

Only few reports have been published on regional anaesthesia in spina bifida patients: one case of epidural anaesthesia for vaginal delivery [44], one case of spinal anaesthesia [42] and one case of spinal catheter anaesthesia [43], both for caesarean

section. In all three cases, satisfactory pain relieve was achieved. Epidural block in one case [44] was technically difficult and gave inadequate analgesia during the third stage of labour. Moreover, it is not unlikely that the subdural space will be inadvertently punctured because of the severely distorted spine.

Broome [42] reports that in case of kyphosis, general anaesthesia should be avoided whenever possible, because it could lead to postoperative chest conditions in patients who often have poor pulmonary function [45].

7. Conclusions

Because of improved antenatal management and more aggressive surgical techniques, the survival rate of infants born with spina bifida has greatly increased. Consequently, more patients are reaching adulthood and reproductive age and more women with spina bifida will present themselves with pregnancy. These patients deserve careful obstetric care by doctors who are aware of the possible complications during pregnancy and labour. Careful consideration is needed in the fields of genetic counselling and urological, obstetric, neurological and anaesthetic management.

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