Fetal supraventricular tachycardia diagnosed and treated at twenty-four weeks of gestation and after birth: a case report

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Supraventricular tachycardia is the most common clinically significant fetal tachycardia. The diagnosis is usually made at routine sonographic workup during the second-third trimester of pregnancy. Treatment goals are cardioversion to sinus rhythm and reversal of cardiac dysfunction. We describe a case of fetal supraventricular tachycardia diagnosed at 24 weeks of gestation. The first-line treatment was oral maternal digoxin and sotalol. This therapy was not sufficient for complete control of the tachycardia. Hence, second-line treatment with digoxin and flecainide was started and successfully achieved conversion to sinus rhythm. No adverse maternal side effects were noted during the 14 weeks of therapy. A normal male infant was delivered at elective cesarean section performed for obstetric indications at 38 weeks of gestation. A persistent junctional reciprocating tachycardia with a ventriculo-atrial/atrioventricular ratio > 1 was diagnosed following delivery at transesophageal electrophysiological study. At the age of 8 months the child is on therapy with sotalol (4 mg/kg/day) and flecainide (3 mg/kg/day) and is in good clinical conditions.

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Introduction

Supraventricular tachycardia (SVT) is the most common clinically significant sustained fetal tachycardia[1]. Its basic underlying mechanism is either an automatic focus provoking atrial contractions at a rate faster than the sino-atrial node, or a reentry mechanism characterized by a circular electrical current running in both directions between a fast-conduction accessory pathway, the ventricle, the atrioventricular node and the atria. SVT may be associated with cardiac malformations such as Ebstein's anomaly but in the majority of cases it is the sole pathology[2]. The usual cardiac contraction rate in cases of SVT is 220-280 b/min, but faster rates have been described[3]. When such rates are sustained, diastole is shortened, thus decreasing the atrial and ventricular filling times and increasing the systemic venous volume load and central venous pressure, as previously shown by studies in the fetal lamb[4]. This is accompanied by a reversible systolic dysfunction[5]. These changes have been referred to as "tachycardia-induced cardiomyopathy". The resulting heart failure could manifest in the form of fetal hydrops. The diagnosis of fetal tachycardia or tachycardia-induced cardiomyopathy is generally incidental and is made in the second and third trimesters of pregnancy. The treatment goal is to break the vicious cycle by slowing the heart rate and synchronizing the atrial and ventricular contractions. This may be achieved by blocking the automaticity of the ectopic rapid pace-dictating focus, or by blocking fast conduction via the accessory pathway. Successful treatment will lead to sinus rhythm, with resolution of the hydrops and reversal of the cardiac dysfunction if they are present.

Case report

A 27-year-old healthy woman at her second pregnancy presented at 24 weeks of gestation with an unremarkable medical or obstetric history and severe fetal tachycardia. At echocardiography, a fetal SVT with a rate of 235 b/min was diagnosed (Fig. 1). No structural heart defects were seen. The woman was admitted for 5 days in the Grown-Up Congenital Heart

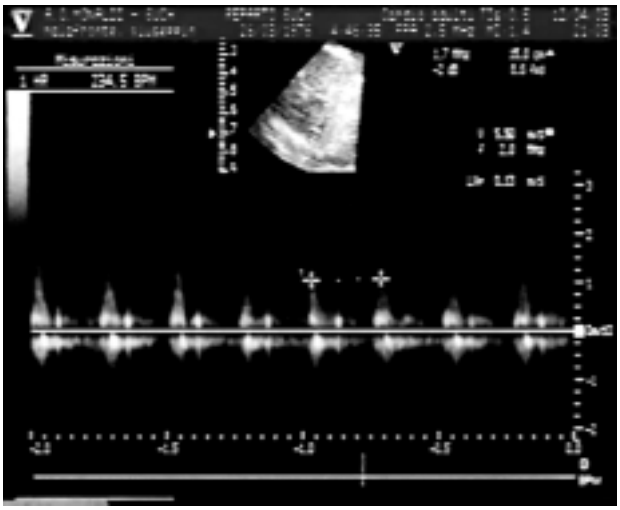

Figure 1. *Fetal echocardiographic examination: fetal supraventricular tachycardia at a rate of 235 b/min.*

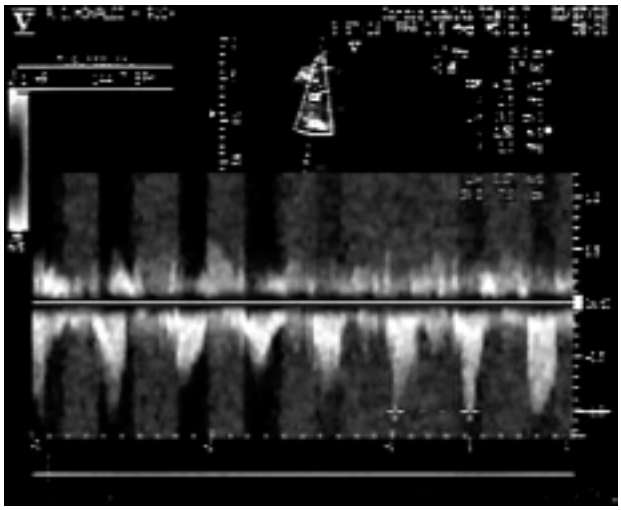

Figure 2. *Fetal echocardiographic examination: fetal sinus rhythm at a rate of 145 b/min after therapy with digoxin and sotalol.*

Disease (GUCH) Unit of the Monaldi Hospital in Naples, Italy. In accordance with the suggestions of other authors[6,7], oral maternal antiarrhythmic therapy including digoxin (0.250 mg bid = 7.14 µg/kg/day) and sotalol (80 mg bid = 2.28 mg/kg/day) was immediately started. Maternal ECG before starting therapy showed a normal sinus rhythm with a heart rate of 66 b/min. During treatment no significant alteration of the maternal heart rate or of the PR, QRS and ST intervals was observed. Five days after hospitalization, pre-discharge examination revealed incomplete control of the tachycardia with a fetal heart rate which had decreased from 235 to 220 b/min and only short intermittent periods of sinus rhythm at a minimum rate of 80 b/min. Seven days after discharge, fetal echocardiography revealed a fetal heart rate of 200 b/min, with short intermittent periods of sinus rhythm, without signs of congestive heart failure or fetal hydrops and with a maternal digoxin level of 0.8 ng/ml. The dose of digoxin was increased to 0.250 mg tid = 10.07 µg/kg/day (digoxin level 1.5 ng/ml) and that of sotalol to 80 mg tid = 3.42 mg/kg/day. Five days after, fetal echocardiography revealed no cardioversion to sinus rhythm. Therefore, whilst continuing therapy with digoxin, sotalol was replaced by flecainide (100 mg bid = 35.7 mg/kg/day)[8,9]. Sinus rhythm was achieved within 5 days (Fig. 2). This therapeutic regimen was continued until delivery. No adverse maternal side effects (arrhythmic events, heart failure, nausea, dizziness or fatigue) were observed. A normal male infant, in sinus rhythm, weighing 2.920 kg and with an Apgar score of 8/9, was delivered at 38 weeks of gestation by elective cesarean section performed for obstetric indications. Following birth, the child was admitted to the Pediatric Cardiology Unit of the Monaldi Hospital where a persistent junctional reciprocating tachycardia was immediately diagnosed with transesophageal electrophysiological study which revealed a ventriculo-atrial (160 ms)/atrioventricular (120 ms) ratio > 1, an RR interval of 261 ms and heart rate of 230 b/min (Fig. 3). Therapy with flecainide (4 mg/kg/day) was immediately started. This regimen was insufficient for complete control of the tachycardia. Hence, therapy with sotalol (8 mg/kg/day) was added and sinus rhythm was achieved. At transesophageal electrophysiological study, very aggressive atrial stimulation did not result in the induction of any arrhythmia. The child is now 8 months old and in good clinical conditions. He is being submitted to periodic non-invasive evaluation including ECG, echocardiography and Holter ECG. To date, no sustained arrhythmias have been detected. The QTc interval is < 440 ms (maximum value 421 ms). He is presently on sotalol 4 mg/kg/day and flecainide 3 mg/kg/day. In our[10] and other authors' experience[11], this therapeutic regimen successfully controlled drug-refractory SVT, including patients with persistent junctional reciprocating tachycardia.

Discussion

In the treatment of fetal SVT, our first-line protocol consisted of digoxin and sotalol delivered to the fetus transplacentally (maternal oral administration). Our second-line treatment, used in case of drug refractoriness, consisted of digoxin and flecainide. These treatments have been shown to be successful in most cases[6,7,10-12]. Digoxin is a cardiac glycoside that partially blocks conduction through the atrioventricular node[13]. It is widely accepted as first-line treatment for the non-hydropic fetus. Unfortunately, it is not very efficacious[14]. What is more, in the hydropic fetus, transplacental drug passage is impaired, and treatment with this drug alone is inade-

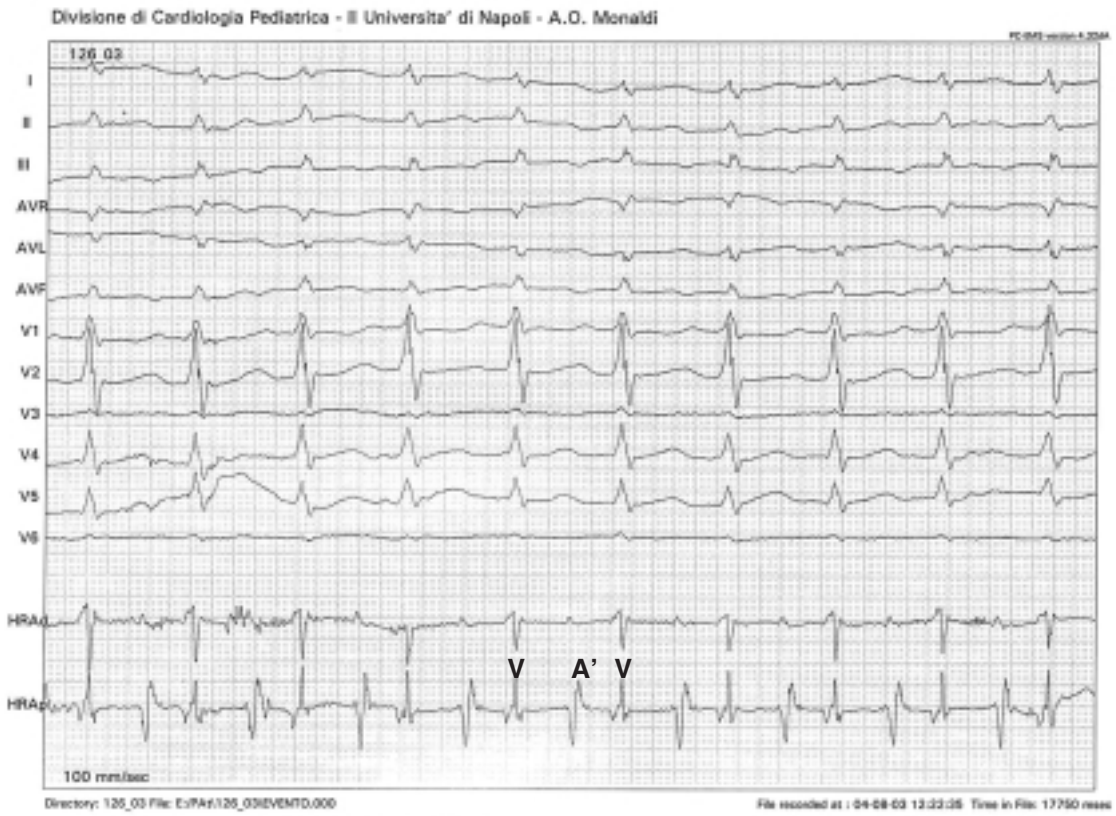

Figure 3. *Transesophageal electrophysiological study: persistent junctional reciprocating tachycardia with a ventriculo-atrial (VA' 160 ms)/atrioventricular (A'V 120 ms) ratio > 1, an RR interval of 261 ms and a heart rate of 230 b/min.*

quate, being only 10-15% effective. In our case, in the absence of fetal hydrops, our first-line approach consisted of digoxin and sotalol. This approach however, was not sufficient for complete control of the tachycardia (the fetal heart rate decreased from 246 to 200 b/min, with only short intermittent periods of sinus rhythm). Flecainide has been suggested as the first-line therapy for fetuses with hydrops or in association with other drugs for fetuses in whom digoxin is inefficacious[13-17]. This drug acts by blocking the sodium channel thus impairing fast conduction. The co-administration of the two drugs (digoxin and flecainide) seems a reasonable strategy to achieve a fast, effective response, and it did produce the desired effect. Recently published data also support this logic[15]. A recent paper by Strasburger et al.[18] showed the safety and effectiveness of orally administered amiodarone (alone or in association with digoxin) for fetal tachycardia complicated by ventricular dysfunction and fetal hydrops. Finally, an alternative approach with a faster effect would have been the administration of the drug to the fetus by direct injection (i.e. adenosine triphosphate)[16]. Nevertheless, whereas this approach could temporarily restore sinus rhythm, it did not ensure the prevention of new episodes of tachycardia.

The optimal duration of treatment of prenatally diagnosed fetal SVT remains undetermined. In most reported cases the treatment, if effective and well tolerated, was continued until birth or even prolonged to infancy[5-8,10-17,19,20]. Postnatal recurrence of arrhythmia has been described in approximately 50% of neonates[20]. Some authors suggest the prophylactic continuation of the drug during the first 6-12 months of life. However, in 10-20% of cases SVT will persist beyond the first year of life[20].

In our case, therapy was continued even after delivery. At birth, oral flecainide was not sufficient for complete control of the tachycardia. For this reason, sotalol was added, achieving total resolution of the tachycardia. This therapeutic association (sotalol and flecainide) is a valuable therapeutic option in the management of apparently intractable pediatric arrhythmias. The combination of flecainide and sotalol was both safe and effective for the control of SVT in children < 1 year of age. The use of this combination may obviate the need for transcatheter radiofrequency ablation in infants or allow postponement of such therapy until the patient is of an age and size at which morbidity and mortality are decreased. Despite the absence of proarrhythmia effects, inpatient monitoring of these children is indicated until more experience with the combination of these two drugs is gained[11].

References

1. Trigo C, Macedo AJ, Ferreira M, Bernandino L, Agualusa A, Lima M. Fetal arrhythmia. A case load of 4 years and a half. Acta Med Port 1995; 8: 73-9.
2. Van Engelen AD, Weijtens O, Brenner JI, et al. Management outcome and follow-up of fetal tachycardia. J Am Coll Cardiol 1994; 24: 1371-5.
3. Hochberg HM, Poppers PJ, George ME. Fetal paroxysmal supraventricular tachycardia recorder by intrauterine scalp electrocardiography. J Perinat Med 1976; 4: 51-4.
4. Gembruch U, Krapp M, Baumann P. Venous blood flow velocity waveforms in fetuses with supraventricular tachycardia. Ultrasound Obstet Gynecol 1995; 5: 394-9.
5. Gembruch U, Krapp M, Germer U, Baumann P. Venous Doppler in the sonographic surveillance of fetuses with supraventricular tachycardia. Eur J Obstet Gynecol Reprod Biol 1999; 84: 187-92.
6. Oudijk MA, Michon MM, Kleinman CS, et al. Sotalol in the treatment of fetal dysrhythmias. Circulation 2000; 101: 2721-6.
7. Oudijk MA, Ruskamp JM, Ambachtsheer BE, et al. Drug treatment of fetal tachycardias. Paediatr Drugs 2002; 4: 49-63.
8. Frohn-Mulder IM, Stewart PA, Witsenburg M, Den Hollander NS, Wladimirroff JW, Hess J. The efficacy of flecainide versus digoxin in the management of fetal supraventricular tachycardia. Prenat Diagn 1995; 15: 1297-302.
9. Krapp M, Baschat AA, Gembruch U, Geipel A, Germer U. Flecainide in the intrauterine treatment of fetal supraventricular tachycardia. Ultrasound Obstet Gynecol 2002; 19: 158-64.
10. Calvanese R, Sarubbi B, Vergara P, et al. Sotalol-flecainide: an uncommon valuable association in the treatment of paediatric arrhythmias. (abstr) Ital Heart J 2003; 4 (Suppl 5): 23S.
11. Price JF, Kertesz NJ, Snyder CS, Friedman RA, Fenrich AL. Flecainide and sotalol: a new combination therapy for refractory supraventricular tachycardia in children < 1 year of age. J Am Coll Cardiol 2002; 39: 517-20.
12. Stewart PA, Wladimiroff JW. Cardiac tachyarrhythmia in the fetus: diagnosis, treatment and prognosis. Fetal Ther 1987; 2: 7-16.
13. Goodman DJ, Rossen RM, Cannom DS, Rider AK, Harrison DC. Effect of digoxin on atrioventricular conduction. Studies in patients with and without cardiac autonomic innervation. Circulation 1975; 51: 251-6.
14. Simpson JM, Sharland GK. Fetal tachycardias: management and outcome of 127 consecutive cases. Heart 1998; 79: 576-81.
15. Maxwell DJ, Crawford DC, Curry PV, Tynan MJ, Allan LD. Obstetric importance, diagnosis, and management of fetal tachycardias. BMJ 1988; 297: 107-10.
16. Leiria TL, Lima GG, Dillenburg RF, Zielinsky P. Fetal tachyarrhythmia with 1:1 atrioventricular conduction. Adenosine infusion in the umbilical vein as a diagnostic test. Arq Bras Cardiol 2000; 75: 65-8.
17. Oudijk MA, Ruskamp JM, Ververs FF, et al. Treatment of fetal tachycardia with sotalol: transplacental pharmacokinetics and pharmacodynamics. J Am Coll Cardiol 2003; 42: 765-70.
18. Strasburger JF, Cuneo BF, Michon MM, et al. Amiodarone therapy for drug-refractory fetal tachycardia. Circulation 2004; 109: 375-9.
19. Kleinman CS, Copel JA. Electrophysiological principles and fetal antiarrhythmic therapy. Ultrasound Obstet Gynecol 1991; 1: 286-97.
20. Hansmann M, Gembruch U, Bald R, Manz M, Redel DA. Fetal tachyarrhythmias: transplacental and direct treatment of the fetus - a report of 60 cases. Ultrasound Obstet Gynecol 1991; 1: 162-70.