Real-Time and Power Doppler Imaging of Fetal Adrenal Hemorrhage

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Adrenal hemorrhages are not uncommon in newborns, but they may occur before birth. The incidence of adrenal hemorrhages based on extensive necropsy has been estimated as about 1.7 per 1000 births. With the increasing use of ultrasonography, prenatal recognition of fetal adrenal hemorrhages has become more common in recent years. We report an echogenic abdominal mass, which was found at 36 weeks of gestation using real-time ultrasound, and was enlarged during the 2-week follow-up period. No trauma history was noted during the pregnancy. Since the mass was close to the kidney, we performed power Doppler imaging to localize the lesion and tried to make a differential diagnosis. The left adrenal mass was posterior to the stomach and was without pulsatile blood flow inside. After birth, sonography confirmed a solid homogenous adrenal mass in the newborn. Seven days after birth, the persistent adrenal echogenic mass without resolution by computerized tomography led to a diagnosis of neuroblastoma. The mass was removed by surgery and adrenal hemorrhage diagnosed. The outcome of the adrenal hemorrhage was excellent. The differential diagnosis in unilateral adrenal mass is difficult from the images of 2-D ultrasound since similar pictures may occur among them. In this case, accurate localization of an adrenal mass is feasible using power Doppler imaging (PDI) before birth by determining its blood supply from the middle suprarenal artery. At the same time, fetal adrenal hemorrhages can be demonstrated as an avascular mass, which is the major difference from adrenal tumors. In conclusion, PDI offered more information to localize the adrenal glands from other lesions by separating the blood supply. In addition, the avascular adrenal mass favors the prenatal diagnosis of adrenal hemorrhage. *(Chang Gung Med J 2005;28:860-5)*

Key words: adrenal hemorrhage, power Doppler image, fetus, prenatal ultrasound.

Definite diagnosis of fetal adrenal hemorrhage is rather difficult before birth because the condition presents variable ultrasonographic pictures, from cystic,[1-3] complex cystic, and solid[4] to solid mass.[5] Resolution of an adrenal mass with a decrease in its size or calcification of the lesion over time is considered diagnostic; however, without pathological proof, differentiation from a spontaneously resolved neuroblastoma is not possible.[6-8]

Power Doppler image (PDI), sometimes referred to as "ultrasound angiography", has a high sensitivity and a signal-to-noise ratio for low velocities and weak Doppler signals. Because PDI is independent of angle and direction of flow and it is also able to display extremely low tissue perfusion states, we used this mode in the differential diagnosis using

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the vascularity of the mass. We present a case of fetal adrenal hemorrhage in which lack of blood flow through the mass was suggestive of an adrenal hemorrhage instead of a tumor.

CASE REPORT

A 30-year-old nulliparous Taiwanese woman who presented with a normal pregnancy until the 36th gestational week when a ovoid homogenous echogenic mass was noted in the fetus during routine real-time ultrasonography. The mass was measured as 4.03 x 3.54 cm and located behind the stomach (Fig. 1). From the longitudinal view, it had a pyramidal structure with a central stripe as the character of a normal adrenal gland but with greater thickness, and its position was just above the left kidney (Fig. 2). Using PDI, the blood supply of the lesion was demonstrated to be from the aorta, while the renal artery was shown to supply the left kidney (Fig. 3). Separation by a clear echolucent area was noted between the mass and the kidney. Otherwise, there was no vascular pattern detectable inside the mass. Both kidneys were of normal size, but the left kidney was downward and laterally displaced by this mass. Fetal biometrics revealed adequate fetal growth corresponding to the gestational age. The survey of other fetal structures was otherwise normal, as was the amniotic fluid index.

Two weeks after noting the mass, extension of the mass to the posterior aspect of the stomach and the anterior aspect of the left kidney was detected using ultrasound. In the 2 weeks just before delivery, the adrenal solid mass persisted without any significant changes.

The patient did not experience any pregnancy-induced hypertension, proteinuria, headache, nausea, vomiting, thrombocytopenia, autoimmune disease or any other obstetric complications. No trauma was encountered during this pregnancy. Maternal urine vanillylmandelic acid (VMA) was checked at the 36th gestational week and again during labor, both tests results were within reference ranges. The patient delivered a male baby with a birth weight of 3458 g at the 40th gestational week with an uneventful course of labor. The Apgar scores at 1 and 5 minutes were 6 and 9, respectively. The physical examination of the newborn was unremarkable without a palpable mass. Clinical laboratory data of the newborn including the complete blood counts, platelet count, prothrombin time, and partial thromboplastin time were within reference ranges. Postnatal computerized tomography scanning and abdominal ultrasonography revealed a 3.5 x 4.2 x 3.0 cm adrenal tumor, most likely a neuroblastoma. Follow-up ultrasound on the 7th day after birth did not show any decrease in tumor size. Adrenal hemorrhage was considered unlikely given the lack of liquefaction, failure to decrease significantly in size during the 5 weeks of observation and the persistent echogenic sonographic appearance.

An exploratory laparotomy under general anes-

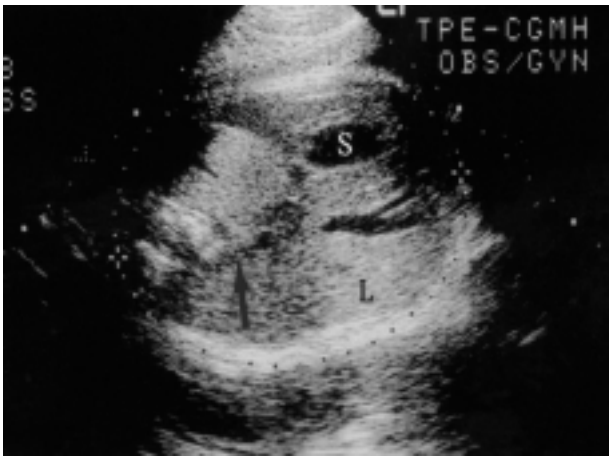

Fig. 1 Transverse section of abdominal circumference (circle), showing an echogenic adrenal mass (arrow) behind the stomach; S: stomach, L: liver.

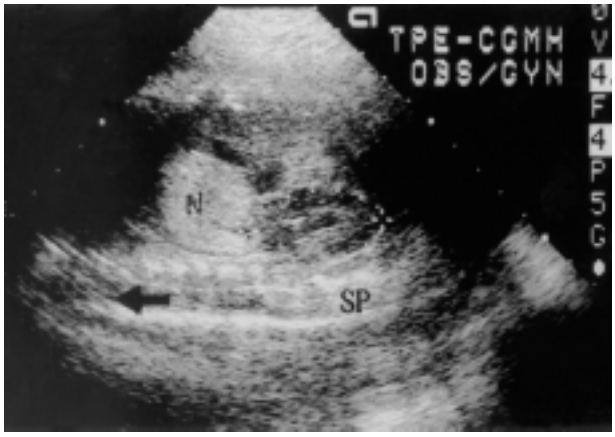

Fig. 2 Longitudinal scan of the adrenal mass (N), superior to and separated from the kidney (circle); arrow indicating caudal part of the fetus.

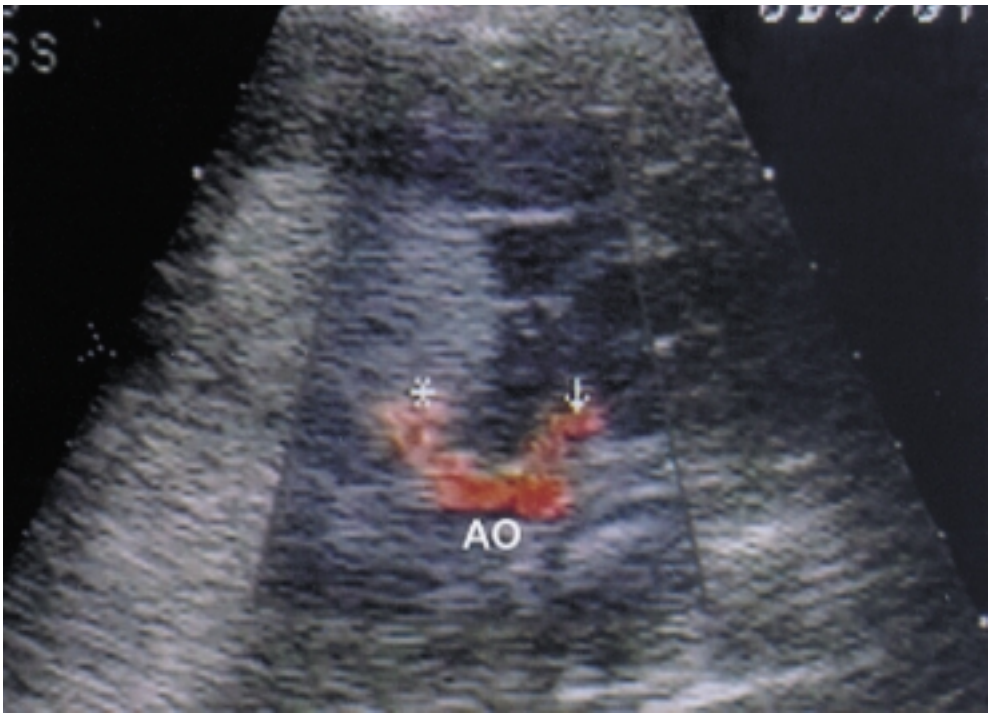

Fig.3 Adrenal artery (*) from the aorta (AO) as shown using power Doppler image; arrow indicating renal artery.

thesia was performed 8 days after birth by a pediatric surgeon. During surgery, however, a left adrenal hemorrhage rather than a neuroblastoma was found. It appeared as a grayish red mass, which was excised during the operation. The pathological report indicated diffuse hemorrhage over the whole adrenal gland without evidence of a neoplasm. After 5 years of follow up, we found the somatic and mental developments of the child were normal for his age.

DISCUSSION

Adrenal hemorrhages are not uncommon in newborns, but they may also occur before birth.[1-4] The incidence of adrenal hemorrhages based on extensive necropsy has been estimated as about 1.7 per 1000 births.[9] The outcomes of adrenal hemorrhages are excellent with resolution in most cases and the clinical diagnosis depends upon the serial scanning of this phenomenon.[1-5,7] Sometimes adrenal calcifications are noted as additional evidence of intrauterine adrenal hemorrhages and may be the only reliable sign for differentiating from them neuroblastomas.[6,8,10]

Adrenal hemorrhages may be entirely echogenic, mixed echogenic, or echolucent when first imaged. A more echolucent area appears after the evolution of the hematoma with a decrease in the size. In general, development of the lesion over time is routine and calcification of the adrenal gland is usually noted approximately 2 weeks after the hemorrhage[1] or even as early as 1 week after hemorrhaging begins.[11] The diagnosis of an adrenal hemorrhage has been made when an echolucent mass was found and then disappeared on follow-up ultrasound studies.[1,7] Our case was different in that the clinical manifestation was a persistent homogenous echogenic adrenal mass without any resolution during serial ultrasonographic scanning for more than 1 month. The mass, posterior to the stomach, was first found incidentally during the 36th gestational week when the first time adrenal hemorrhage occurred. Secondary adrenal hemorrhage might possibly have occurred at 38th gestational week when extension of the lesion was scanned using ultrasound. The whole clinical course of our case reminded us that all of the pictures we found were during the initial stage of the adrenal hemorrhage.

According to their report, Cohen et al. indicated there were three types of adrenal hemorrhage: (1) central hematoma formation, in which the hematoma distorts the medulla and attenuates the overlying cortex; (2) total necrosis of either or both sides, in which the gland (or glands) is enlarged but maintains its shape, and (3) segmental lesions in which Normal adrenal tissue can be seen adjacent to the lesion.[12] The case we presented was of the second type with diffuse enlargement as a homogenous echogenic mass. Although the adrenal hemorrhage occurred on the left side in our case, the right side is affected three to four times more often than the left side due to the right adrenal's position between the liver and the spine.[11,13]

Because we used the PDI in this case, we were able to differentiate the adrenal gland from the kidney by their separate blood supplies. Typically, three arteries supply the adrenal glands: the superior, the middle and the inferior suprarenal arteries. Both the renal and middle suprarenal arteries come from the abdominal aorta, and this relationship makes a crucial difference. From this point, we can accurately locate an adrenal mass using PDI before birth according its blood supply from the middle suprarenal artery. In the case we presented, we ascertained that the abnormal adrenal mass was present before birth. Being able to locate an adrenal lesion allows for differential diagnosis between adrenal hemorrhage, neuroblastoma, and pheochromocytoma.

Elevation of VMA and homovanillic acid (HVA) levels in the maternal urine could help in the differentiation of neuroblastoma and pheochromocytoma from adrenal hemorrhage.[10,14] We did not detect any elevation of these levels in the maternal urine prenatally or during labor. The data did not favor a catecholamine-secretion adrenal tumor perse. Neuroblastomas may be sonographically entirely echogenic, mixed echogenic or anechoic. The cystic formation associated with a neuroblastoma may be related to a hemorrhage or necrosis of the tumor.[15] Our case of adrenal hemorrhage resembled the pictures of a neuroblastoma described by Goldstein et al.,[16] and the only difference was the absence of pulsatile flow through the mass when using the PDI in the case we presented.

Based on the theory of neovascularization in tumors with large growth potential, color Doppler sonography allows for rapid visualization of the tumor vessels.[16] The tumor growth associated with its tremendous blood flow can be detected using highly sensitive PDI inside the mass. Our case, on the other hand, showed no blood flow inside the mass. We also found the mass had significant growth during the 2 weeks after the initial diagnosis, a phenomenon very unusual for a non-cystic neoplasm. However, an adrenal hemorrhage, whether arising in an otherwise normal adrenal or in a tumor, can indeed enlarge very rapidly.[17]

We could not identify a specific cause for the adrenal hemorrhage in this fetus before birth because neither thrombocytopenia nor coagulopathy was found. Adrenal hemorrhages have been seen in newborns who have experienced sepsis, renal vein thrombosis, asphyxia, hemorrhagic disorders, preterm labor, maternal autoimmune disease or even a difficult delivery.[13] However, no definite causes for fetal adrenal hemorrhages have been reported in the literature.[1-3] In the case we presented, it seemed that spontaneous adrenal hemorrhaging may have occurred without any trauma or intrauterine complications because of susceptibility to hemorrhage due to the fetus' relatively large size and vascularity.[11]

In conclusion, PDI offers more information to locate adrenal lesions from other lesions using the separated blood supply. As in the case we presented, the lack of vascularity inside the mass as well as the demonstration of the middle suprarenal artery from the aorta to the adrenal mass allowed us to recognize adrenal hemorrhaging during the fetal stage.

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胎兒腎上腺出血之實時間及能量都卜勒超音波影像

謝景璋 趙安祥 徐振傑 詹耀龍 羅良明

新生兒之腎上腺出血並非少見，其發生率約爲 1000 個生產數中約有 1.7 位，而胎兒於子宮內發生腎上腺出血也陸續被發現。本文描述一位孕婦於 36 週例行產檢經超音波發現胎兒腹部有一全面高密度性腫塊，其影像再經能量都卜勒灌注血流檢查，確定腫塊位之位置爲腎上腺，且類似腎上腺全面腫大之影像。經過 2 週後此胎兒再度接受檢查，發現腫塊變大並往腹部前方擴散；再經 2 星期後，此產婦經陰道順產下一男嬰，外觀正常，生命跡象穩定。但此腎上腺腫塊於出生後，經小兒科醫師超音波及電腦斷層檢查，一星期後仍無明顯變化，無法完全排除腎上腺神經芽瘤之可能性，於是經由小兒外科腹部探勘手術，移除此腫塊，病理報告顯示爲腎上腺瀰漫性出血。胎兒腎上腺出血預後相當好，而且經過長期追蹤後都會消失，有時候會留下鈣化現象，於產前超音波檢查有可能是囊狀、混合型或硬塊影像，如何和腎上腺神經芽瘤區分，則有賴能量都卜勒超音波影像來定位及測量腫塊內是否有灌注血流而定，一般而言腎上腺神經芽瘤之腫塊中心應有血流經過。能量都卜勒超音波影像可提供幾項產前資訊，一爲經由血管顯像，可以顯示確實之位置，如本文顯示腎上腺之血液供給來自於主動脈，和腎臟動脈分屬不同分支。二爲經由血管顯像，可以依腫塊內部之血流之多寡或有無，來區分血流豐富之腎上腺腫瘤或血流稀少之腎上腺出血。(長庚醫誌 2005;28:860-5)

關鍵字：腎上腺出血，能量都卜勒，胎兒，產前超音波。

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