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Prenatal growth characteristics of lymphatic malformations☆

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ABSTRACT

Purpose: The natural history of prenatally diagnosed lymphatic malformations (LM) remains unknown. The ability to predict growth of a lesion is important to prenatal counseling and any future prenatal intervention. We describe the prenatal growth patterns of LMs as they relate to gestational age, anatomical location, and postnatal management.
Methods: A retrospective review of fetuses prenatally diagnosed with an LM who were followed with serial ultrasounds from 2003 to 2014 was performed with attention to the growth of the lesion as indicated by the lesion volume ratio (LVR).
Results: Thirty patients with LM had serial ultrasound measurements between 19 and 39 weeks gestation. The LVR increased in 53%, decreased in 23%, and remained stable in 23% of fetuses from the initial to the final ultrasound. Unlike other locations that demonstrated both positive and negative growth profiles, axillary lesions only demonstrated increased growth. Lesions with positive growth increased throughout gestation (peak LVR at 35 ± 3 weeks). Twenty-four patients had postnatal interventions, including surgical resection, sclerotherapy, and surgery + sclerotherapy.
Conclusion: LMs have variable prenatal growth profiles. The majority of lesions, especially axillary LMs, will continue to grow throughout gestation and will not reach a growth plateau until the end of gestation.
Level of Evidence: Level III (Retrospective cohort study).

Lymphatic malformations (LM) occur in 1 out of every 2000–4000 live births [1]. They consist of thin-walled irregular vascular spaces lined with lymphatic endothelial cells [2]. Advances in obstetrical care and prenatal imaging have resulted in the antenatal diagnosis and detailed anatomical assessment of most LMs [3–7]. Approximately 50% to 75% of LMs are located in the cervicofacial region with the remainder found in other locations including the axilla, mediastinum, chest, abdomen, retroperitoneum, buttocks, perineum, and extremities [1,8]. The clinical implications of an LM depend on its anatomical location, size, and extension into surrounding structures. Postnatally, the growth of LMs is known to be variable with episodes of expansion in response to inciting events such as infection, inflammation, and trauma as well as regression including complete spontaneous resolution in up to 33% of mildly disfiguring lesions [1,9,10]. However, the natural history of prenatally diagnosed LMs remains unknown. The ability to predict the prenatal growth of a lesion would be valuable in the prenatal counseling of families with affected fetuses who may be considering termination of pregnancy. Additionally, an understanding of the natural history of these lesions would allow for improved delivery planning including the need for a Cesarean section for large lesions or an ex utero intrapartum treatment (EXIT) procedure during which the fetal airway is secured in cases of cervical LMs that invade or distort the airway [7,11]. In the current study, we review the natural growth patterns of LMs and correlate these growth patterns to gestational age (GA) and anatomical location.

1. Materials and methods

This is a retrospective review of women carrying fetuses with a prenatally diagnosed LM who were referred to The Children's Hospital of Philadelphia (CHOP) and followed with serial high-resolution fetal ultrasounds (U/S) from 2003 to 2014. The study was approved by the CHOP Institutional Review Board (IRB 14–011,166). All patients underwent a detailed evaluation and nondirective multidisciplinary counseling. The gestational age (GA) at initial evaluation and all subsequent U/Ss was noted. Serial fetal U/Ss were reviewed for the diagnosis of an LM, its anatomical location, a calculated lesion volume, and the head circumference (HC) of the fetus. The lesion volume was calculated using the formula for a prolate ellipse as follows: LM volume (cm^3) = length (cm) × height (cm) × width (cm) × 0.52 (Fig. 1). A lesion volume ratio (LVR) was calculated based on the volume of the LM and the HC of the fetus to account for the growth of the lesion with respect to the growth of the fetus [LVR (cm^2) = LM volume (cm^3)/HC (cm)]. A positive LM growth pattern indicates an LVR that was greater at the final U/S evaluation compared to the initial U/S evaluation. The perinatal records were reviewed for postnatal management of the LM including

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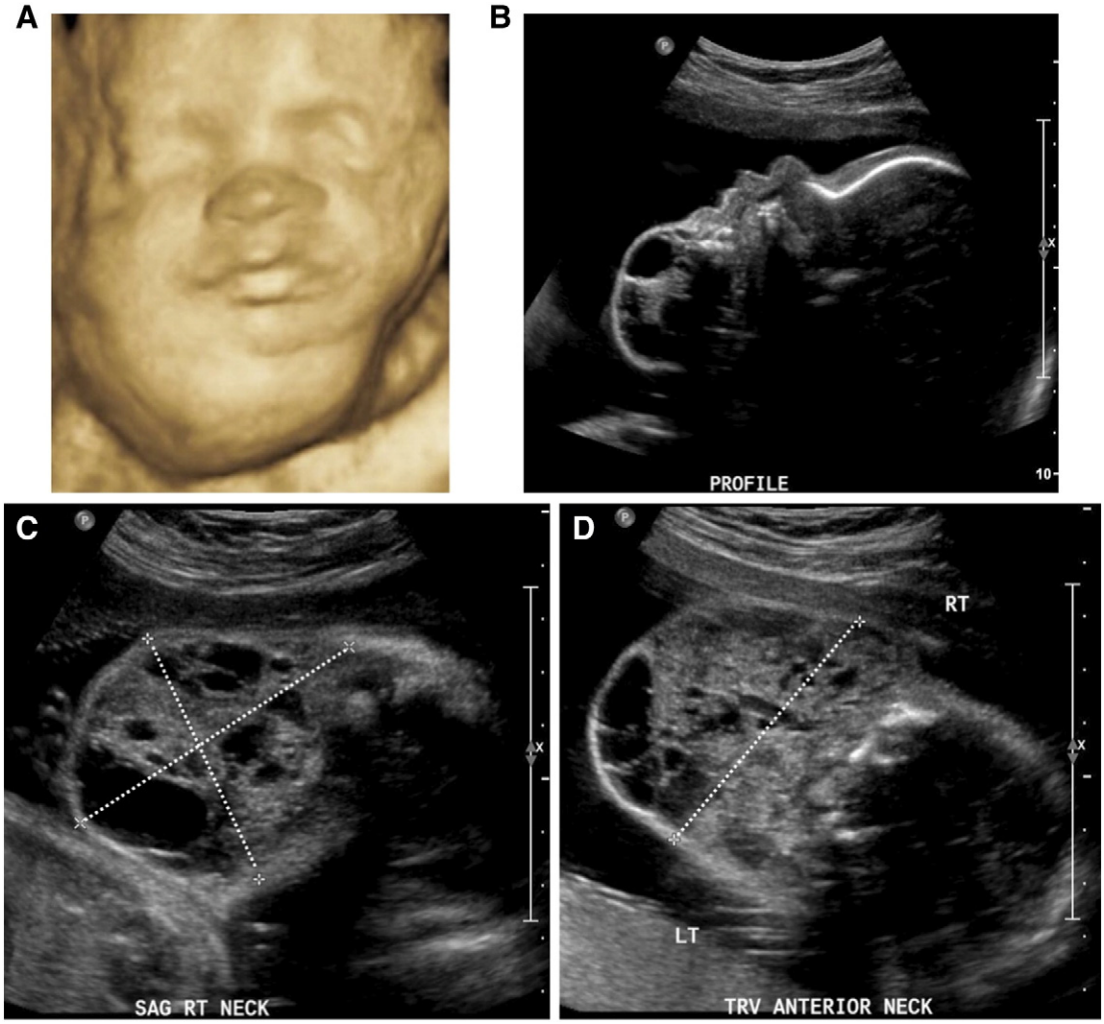

Fig. 1. Sonographic evaluation and measurement of LMs. U/S evaluation of a 27 week fetus with a large cervical LM depicted following 3 dimensional reconstruction (A) and in the profile view (B). The volume of the LM is calculated using the formula for the volume of a prolate ellipse after obtaining the maximum length, height, and width measurements in the sagittal and transverse views (volume = L × H × W × 0.52) (C & D). The LM volume ratio (LVR) is subsequently calculated by dividing the LM volume by the HC to normalize for gestational age. The depicted fetus had an HC of 25 cm and an LM volume of 84 mL (5 cm × 5.4 cm × 6 cm × 0.52) resulting in an LVR of 3.4.

surgical resection, sclerotherapy with doxycycline, a combination of surgical resection and sclerotherapy, and no intervention. Values are represented as the mean ± one standard deviation. Statistical comparisons were performed using the Student *t* test for 2 samples assuming unequal variance. Fisher's exact test was used to compare factors expressed as categorical values.

Table 1
Patient population.

Location	GA @ initial U/S	LVR @ initial U/S	Postnatal management
Intraabdominal (n = 3)	27.4 ± 3.6	0.64 ± 0.5	Surgery (n = 2) None (n = 1)
Mediastinal (n = 4)	26.6 ± 6	0.53 ± 0.5	Surgery (n = 4)
Lower extremity (n = 1)	32.3	0.35	None (n = 1)
Axillary (n = 7)	24 ± 4	2.4 ± 3	Surgery (n = 4) Sclero (n = 1) Surg + sclero (n = 1) None (n = 1)
Cervical (n = 15)	27.1 ± 5	4.1 ± 6.8	Surgery (n = 4) Sclero (n = 6) Surg + sclero (n = 2) None (n = 3)
Total (n = 30)	26.6 ± 4.6	2.8 ± 5.2	Surgery (n = 14) Sclero (n = 7) Surg + sclero (n = 3) None (n = 6)

GA measured in weeks; U/S = ultrasound; sclero = sclerotherapy.