Effects of Changes in Volume Status in Patients with May-Thurners

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Introduction

Venous compression disorders rely on invasive imaging via venogram or intravascular ultrasound (IVUS) for both diagnosis and surgical planning [1,2]. When diagnosing chronic venous compression that involves the pelvic vessels or the lower extremities, common practice involves utilizing the 200-150-125 rule [3] as a standardized guide for normal diameters of the common iliac veins, external iliac veins, and the common femoral veins as variation between patients is usually ≤10% however when utilizing this guide, the overall volume status of the patient is not usually taken into account which can lead to improper intervention such as under sizing a stent[3,4] or cases where intervention may not be indicated. This study seeks to determine if there are changes in the overall diameter of the left common iliac vein (LCIV), the left external iliac vein (LEIV), and the left common femoral vein (LCFV) when a patient is pre-hydrated, whether a patient's volume status should be considered when performing invasive diagnostic imaging when evaluating for an planning for management of a venous compression disorder, and elucidate a possible additional component in the formation of deep vein thromboses (DVT) in patients being evaluated for May-Thurners syndrome.

Methodology

Between August 2021 and April 2022, a total of 26 diagnostic venograms with IVUS were performed on patients with an average body mass index of 21 with the most reported symptom being abdominal pain (Table 1.) . For this procedure, and initial venogram was performed followed by hydration with a 500 mL normal saline bolus, a 20-minute waiting period, then a post-hydration venogram with IVUS was performed where measurements of the LCIV, LEIV, and LCFV were obtained both before and after the bolus was given. Through extensive chart review, measurements obtained from the IVUS studies were compiled (Table 2.) The changes in the diameter of these veins in addition to the stenotic segment pre and post-hydration were calculated as a percent change (Table 3 and 4) with statistical analysis performed utilizing a paired t-test.

		N=26	Percent of patients
Gender	Female	26	100.0%
	Male	0	0.0%
BMI	< 18.5	5	19.2%
	18.5-24.9	9	34.6%
	25-29.9	3	11.5%
	≥30	1	3.8%
	not recorded	8	30.8%
Age	<15	1	3.8%
	16-25	9	34.6%
	26-35	5	19.2%
	36-45	5	19.2%
	>45	6	23.1%
Signs and Symptoms	Left flank pain	14	54%
	L back pain	13	50.00%
	abdominal pain	18	69.20%
	hematuria	2	7.60%
	L groin pain	2	7.60%
	L pelvic pain	5	19.20%
	L lower extremity pain	2	7.60%

(Table 1.) Patient population demographics including sex, BMI, age, and reported signs and symptoms.

Results

For the LCIV, LEIV, and the LCFV all of the patients that received a 500cc fluid bolus had a statistically significant increase in the diameter of the veins measured with 40% of patients having a worsening of the stenotic segment within the LCIV. For the LCIV, the change in diameter ranged from +14.2-53.9% (p value: 0.002) with 70% having improvement on no change in the stenotic segment. Measurements for the LEIV and the LCFV ranged from +11.5-68.4% (p value:0.004) and +15.8-64.6% (p-value:0.021) respectively.

	LCIV		LEIV		LCFV	
Patient	Pre-hydration	Post-hydration	Pre-hydration	Post-hydration	Pre-hydration	Post-hydration
1	146.6	131.2	129		92	
2	81.2	99.1	121.5			
3	180.4	183	101.2		83	
4	216.6	300.6	166.6	218		
5	114.5	125.7	103.9		78.8	
6	121	115.9	104.3	118.7	93.8	117.4
7	74.9	141	62.4	85.7		
8	119.5	127.2				
9	49.9	95.1	20.2	44.4	25.6	30.6
10	175.2	223.5	207.1	214.7	110.3	78.9
11	130.1	119.7	81.4	89.4	74.9	70.4
12	126	155.6	114.9	88.2	73.5	124
13	132.3	152.3	87.8	76.8	73	64.3
14	194.1	186	107.7	137.2		
15	119.3	135.7	86.2	99	67.6	85.1
16	230.7		103		64	
17	87.5		82.4	86	26.5	74.9
18	158.5		90.2		75.1	
19	129.8		78.9	97.1	57.5	93.3
20	61.9		85.9	87.8		
21	84		42.5	42.7	64	
22	163.7	194.4	117.3	116.4		
23	139.6		80.2			
24	129.4	168.3	91.5	102.4	109	
25	142.6	181.9	107.5	136.1		
26	104.9	92.8	62.8	63.5	59	67.1

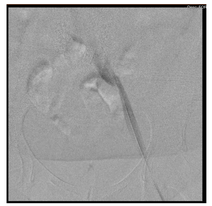
(Table 2.) IVUS measurements pre and post-hydration with 500cc NS bolus in the LCIV, LEIV, and LCFV.

LCIV			LEIV			LCFV		
%Change in Diameter	n	% total patients	%Change in Diameter	n	% total patients	%Change in Diameter	n	% total patients
<-10	2	10.5%	<-10	2	11.1%	<-10	2	20.0%
-10 to 0	2	10.5%	-10 to 0	2	11.1%	-10 to 0	1	10.0%
1 to 10	3	15.8%	1 to 10	6	33.3%	1 to 10	0	0.0%
11 to 20	4	21.1%	11 to 20	4	22.2%	11 to 20	2	20.0%
21 to 30	4	21.1%	21 to 30	4	22.2%	21 to 30	2	20.0%
31 to 40	0	0.0%	31 to 40	0	0.0%	31 to 40	1	10.0%
> 40	2	10.5%	> 40	1	5.6%	> 40	2	20.0%

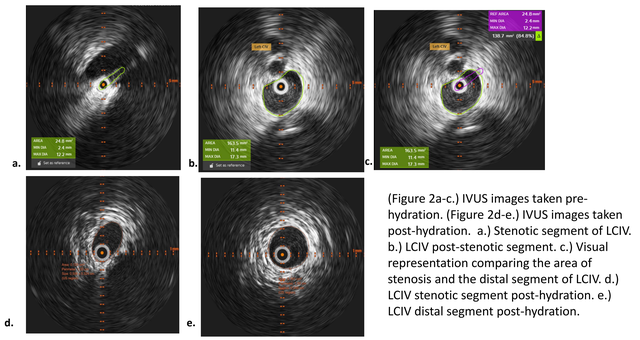
LCIV stenosis		
%Change in Diameter	n	% total patients
<-10	4	40.0%
-10 to 0	3	30.0%
1 to 10	2	20.0%
11 to 20	1	10.0%
21 to 30	0	0.0%
31 to 40	0	0.0%
> 40	0	0.0%

Table 3a. and 3b.) Change in diameter represented as percent change utilizing IVUS measurements pre and post-hydration with 500cc NS bolus in the LCIV, LEIV, and LCFV as well as the % change across the stenotic segment of the LCIV.

Diagnostic Imaging



(Figure 1.) Diagnostic venogram of LCIV highlighting stenotic segment.



(Figure 2a-c.) IVUS images taken pre-hydration. (Figure 2d-e.) IVUS images taken post-hydration. a.) Stenotic segment of LCIV. b.) LCIV post-stenotic segment. c.) Visual representation comparing the area of stenosis and the distal segment of LCIV. d.) LCIV stenotic segment post-hydration. e.) LCIV distal segment post-hydration.

Conclusion

This study shows that pre-hydration prior to invasive vascular imaging simulating euvolemia or hypervolemia, in this case venogram and IVUS, causes an increase in the intraluminal diameter of the measured vein resulting in a significant underestimation of the degree of stenosis measured when evaluating patients for venous compression disorders. This shows that a patients overall fluid status should be considered prior performing these studies as well as provides additional reasoning for the development of DVTs in this patient population.

Recommendations

Volume status of the patient prior to invasive venous imaging is important and should be taken into consideration in order to appropriately plan for intervention when managing venous compression disorders.

References

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