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Contemporary management of median arcuate ligament syndrome provides early symptom improvement

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Objective: **Optimal diagnosis and management of median arcuate ligament (MAL) syndrome (MALS) remains unclear in contemporary practice. The advent and evolution of laparoscopic and endovascular techniques has redirected management toward a less invasive therapeutic algorithm. This study examined our contemporary outcomes of patients treated for MALS.**
Methods: **All patients treated for MALS at Dartmouth-Hitchcock Medical Center from 2000 to 2013 were retrospectively reviewed. Demographics and comorbidities were recorded. Freedom from symptoms and freedom from reintervention were the primary end points. Return to work or school was assessed. Follow-up by clinic visits and telephone allowed quantitative comparisons among the patients.**
Results: **During the study interval, 21 patients (24% male), with a median age of 42 years, were treated for MALS. All patients complained of abdominal pain in the presence of a celiac stenosis, 16 (76%) also reported weight loss at the time of presentation, and 57% had a concomitant psychiatric history. Diagnostic imaging most commonly used included duplex ultrasound (81%), computed tomography angiography (66%), angiography (57%), and magnetic resonance angiography (5%). Fourteen patients (67%) underwent multiple diagnostic studies. All patients underwent initial laparoscopic MAL release. Seven patients (33%) underwent subsequent celiac stent placement in the setting of recurrent or unresolved symptoms with persistent celiac stenosis at a mean interval of 49 days. Two patients required surgical bypass after an endovascular intervention failed. The 6-month freedom from symptoms was 75% and freedom from reintervention was 64%. Eighteen patients (81%) reported early symptom improvement and weight gain, and 66% were able to return to work.**
Conclusions: **A multidisciplinary treatment approach using initial laparoscopic release and subsequent stent placement and bypass surgery provides symptom improvement in most patients treated for MALS. The potential placebo effect, however, remains uncertain. A significant minority of patients will require reintervention, justifying longitudinal surveillance and prudent patient selection. Patients can anticipate functional recovery, weight gain, and return to work with treatment. (J Vasc Surg 2015;62:151-6.)**

The optimal diagnosis and management of median arcuate ligament (MAL) syndrome (MALS) remains unclear in contemporary practice. Accordingly, variation in the workup and treatment of MALS patients persists, reflecting a myriad of diagnostic studies and therapeutic interventions.[1,2] Furthermore, the optimal surgical approach remains unclear, even in the setting of an established diagnosis of MALS. Recent literature highlights such variation in practice among this often young patient cohort, with some studies still advocating routine diagnostic angiography and the prevalent use of open surgical MAL release. In addition, other studies have documented an ~10% open conversion rate for laparoscopically treated patients, leading to ongoing debate about the optimal surgical approach.[3-12]

The advent and evolution of laparoscopic techniques has also introduced minimally invasive general surgeons into the management fold of MALS patients, who in fact, will often evaluate patients antecedently to vascular surgical consultation. Furthermore, definitive management of recalcitrant symptoms with percutaneous techniques vs the role for definitive mesenteric bypass in this young patient cohort remains unknown.[3,4,12-15] Therefore, the purpose of this study was to better define the optimal diagnostic and management algorithm for patients undergoing MALS treatment and report contemporary clinical and functional outcomes.

METHODS

This study was conducted in compliance with the Dartmouth Geisel School of Medicine Institutional Review Board. All patients were deidentified and thus specific consent for publication was not required by our protocol.

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Table. Patient demographics, diagnostic, and therapeutic details and outcomes

Pt.	*Sex*	*Age, years*	*OR date*	*Presenting symptoms*	*Psych diagnosis*	*Study*	*Interventions*		*Symptoms at last visit*
							Total	*Final*	
1	M	26	Aug '04	Pain, N, D	No	CA	2	CS	Improved
2	F	42	Sep '08	Pain, weight loss	No	DUS, CTA, CA	4	MB	Improved
3	F	49	Jan '09	Pain, N, weight loss	Yes	DUS, CTA, CA	4	MB	Improved
4	F	20	Feb '09	Pain, N, D	Yes	DUS, CTA, CA	1	LMR	Improved
5	F	43	Apr '09	Pain, N, D, weight loss	Yes	DUS	1	LMR	Improved
6	F	20	May '09	Pain, D, weight loss	No	DUS, CTA, CA	1	LMR	Improved
7	M	29	Mar '10	Pain, N, D	Yes	DUS, CA	2	CS	Improved
8	M	59	Dec '10	Pain, N, D, weight loss	No	DUS, CTA, CA	2	CS	Improved
9	F	23	Jun '12	Pain, N, weight loss	No	MRA	1	LMR	Improved
10	F	21	Sep '12	Pain, N, weight loss	No	DUS	1	LMR	Unchanged
11	F	49	Jan '13	Pain, N, weight loss	Yes	DUS, CTA, CA	2	CS	Improved
12	F	27	Jan '13	Pain, N, weight loss	No	DUS, CTA, CA	1	LMR	Improved
13	M	49	Mar '13	Pain, N, D, weight loss	Yes	DUS	1	LMR	Unchanged
14	F	60	Apr '13	Pain, N, weight loss	Yes	DUS, CTA, CA	1	LMR	Unchanged
15	F	46	Apr '13	Pain, D, weight loss	Yes	DUS, CTA, CA	1	LMR	Improved
16	F	26	May '13	Pain, N, weight loss	Yes	DUS, CTA	1	LMR	Improved
17	F	36	Jul '13	Pain, N, weight loss	No	DUS, CTA	1	LMR	Improved
18	F	69	Jul '13	Pain	No	CTA, CA	1	LMR	Improved
19	F	51	Aug '13	Pain, N, D, weight loss	Yes	CTA	2	CS	Improved
20	F	16	Sep '13	Pain, N	Yes	DUS	1	LMR	Improved
21	M	50	Oct '13	Pain, N, D, weight loss	Yes	DUS, CTA	1	LMR	Improved

CA, Conventional angiography; *CS,* celiac stenting; *CTA,* computed tomography angiography; *D,* diarrhea; *DUS,* duplex ultrasound; *F,* female; *LMR,* laparoscopic median arcuate ligament release; *M,* male; *MB,* mesenteric bypass; *N,* nausea; *OR,* operating room; *pain,* intermittent abdominal pain; *Pt,* patient.

Subjects and data collection. All patients treated for MALS at Dartmouth-Hitchcock Medical Center from 2000 to 2013 were identified from the Section of Vascular Surgery and Section of Minimally Invasive Surgery databases (n = 21). Patient demographics and comorbidities were collected. Presenting symptoms and the presence or absence of weight loss was recorded. Preoperative imaging protocols and laparoscopic vs open surgical MAL release practice patterns were assessed. Celiac artery stenosis was defined as peak systolic velocity >200 cm/s or end diastolic velocity >55 cm/s.[16]

Outcomes and end points. The primary study end points included freedom from symptoms, freedom from reintervention, and return to work or school as a broad proxy for functional quality of life. Postoperative return to work or school was determined at the time of the follow-up clinic visit or by telephone interview. Mean values were reported where data were normally distributed, and median values were incorporated in the setting of potential variance.

Statistical analysis. Kaplan-Meier life-table analysis was used to determine freedom from symptoms and freedom from reintervention. Statistical analyses were performed using Stata software (StataCorp LP, College Station, Tex).

RESULTS

We retrospectively identified 21 patients who were treated for MALS during the study interval. This represented the entire institutional operative experience for MALS. All laparoscopic procedures were performed by a single minimally invasive surgeon. The distribution of procedures was weighted toward the latter half of the study interval (Table). The median age at diagnosis was 42 years (range, 16-69 years), and 16 patients (76%) were female. Given their relative young age, few conventional vascular risk factors and comorbidities were observed, including diabetes mellitus, coronary artery disease, congestive heart failure, chronic renal insufficiency, or chronic obstructive pulmonary disease. Six patients (29%) had a history of smoking. No patients had evidence of superior mesenteric artery disease. Interestingly, 12 patients (57%) maintained a coexisting psychiatric diagnosis at the time of presentation, and six (29%) were taking antidepressants at the time of diagnosis.

All patients uniformly complained of abdominal pain at presentation, which was postprandial in nature in 18 of 21 (86%). Also common was concomitant nausea in 17 (81%) and diarrhea in 10 (47%). Observed weight loss was both prevalent (16 of 21 [76%]) and variable among patients, ranging from 2.7 to 27 kilograms during the year before presentation. Quantifiable absolute weight loss was known in 14 patients (67%) and had a median value of 9 kilograms. Nine patients had weight loss of ≥9 kilograms. Median body mass index (BMI) was generally low in this cohort at 20 kg/m^2 (range, 14.5-33.8 kg/m^2) and available in 20 patients (95%). BMI and weight loss, when known, did not appear to be predictive of reintervention or postoperative symptom improvement.

Preoperative imaging studies varied among patients. Duplex ultrasound imaging was the most common (17 of 21 [81%]) first-line modality over time. Multiple imaging