

ABSTRACT

Implantable left ventricular assist devices (LVAD) have dramatically changed the face of mechanical circulatory support of patients with advanced heart failure. With increased durability, reliability and safety these devices have extended the horizon of functional improvement, life quality and survival. Beyond crucial pre-operative and intra-operative issues, several device-host interface issues are important for successful outcomes. Among these are clear understanding of intravascular volume status, red blood cell volume status and early, often subclinical inflammation. Blood volume analysis (BVA) is a blood test that measures these 3 metrics with rapid personalized and actionable results. We used BVA to evaluate 24 consecutive stable ambulatory patients supported with LVAD.

Results: The patients were nineteen men and five woman aged 32-72 years. Duration of LVAD support at the time of outpatient BVA ranged from 46-1460 days. 2/24 patients had LVAD implanted as bridge to transplant, all others as destination therapy. 13/24 patients were obese with deviations from normal body weight of 22-117% and average BMI of 31.1. All patients were felt to be improved and stable compared to pre-LVAD and none had evidence of device malfunction or drive line infection. All patients had variations in total blood volumes, plasma volume and red cell volume.

Conclusions: In summary, BVA and its individualized, unique metrics is a valuable test when used in patients with LVAD's. Despite improved functional status and adequate device performance wide variations are still present in patients being supported with LVAD's. Additionally, measurement of red blood cell volume is helpful in determined variations (anemia or polycythemia) that might not be noted clinically and might presage future hemolytic and/or thrombotic events despite adequate anticoagulation.

OBJECTIVES

1. Understand individual blood volumes (total blood volume and red blood cell volume) for patients with LVADs.
2. Describe variations in blood volume status in stable ambulatory patients with LVAD.
3. Define ways to optimize patients total blood volume and red blood cell volume for patients with LVAD based on blood volume analysis results.

METHODS

Twenty-four patients, who had undergone LVAD insertion for advanced heart failure at Baptist Heart Institute, Memphis, TN were re-evaluated from 46 to 1460 days following LVAD implantation. The patients were aged 35-72 years. From a clinical perspective and from LVAD device monitoring there was no awareness or suspicion of significant alterations in intravascular volumes, or significant anemia or polycythemia. BVA results were obtained in all patients studied. Data collected at the time of BVA included age, gender, body mass index, type of LVAD, intention of implant, and results of blood volume analysis.

RESULTS

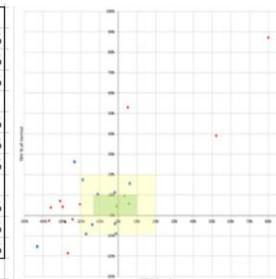
Table 1. Patient blood volume analysis results

LVAD #	TBV (+/-)	RBCV (+/- TBV)	RBCV
1	-5%	-14% Hypo	Anemic
2	39%	52% Hyper	Poly
3	4%	-1% Normo	Normo
4	17%	-19% Hyper	Anemic
5	-4%	-2% Hypo	Normo
6	87%	80% Hyper	Poly
7	10%	-11% Hyper	Anemic
8	-3%	-28% Hypo	Anemic
9	-19%	-27% Hypo	Anemic
10	6%	6% Normo	Normo
11	4%	-36% Normo	Anemic
12	5%	-20% Normo	Anemic
13	16%	6% Hyper	Normo
14	53%	5% Hyper	Normo
15	-9%	-17% Hypo	Anemic
16	-9%	-1% Hypo	Normo
17	7%	-31% Normo	Anemic
18	-2%	-24% Hypo	Anemic
19	4%	-29% Normo	Anemic
20	11%	-2% Hyper	Normo
21	10%	4% Normo	Normo
22	-3%	-37% Hypo	Anemic
23	-15%	-43% Hypo	Anemic
24	26.2	-23.2 Hyper	Anemic

RESULTS

Table 2. Summary (Left panel) and Graph (Right panel) of BVA Phenotypes in 24 Patients with LVAD

Phenotypes	Count	%
Hypovolemic Anemic	7	29%
Normovolemic Anemic	4	17%
Hypervolemic Anemic	3	13%
Hypovolemic Normocytic	2	8%
Normovolemic Normocytic	3	13%
Hypervolemic Normocytic	3	13%
Hypovolemic Polycythemic	0	0%
Normovolemic Polycythemic	0	0%
Hypervolemic Polycythemic	2	8%
Total	24	



CONCLUSIONS

BVA and its individualized, unique metrics is a valuable test when used in patients with LVAD's.

Despite improved functional status and adequate device performance wide variations are still present in patients being supported with LVAD's. Measurement of red blood cell volume is helpful in determined variations (anemia or polycythemia) that might not be noted clinically and might presage future hemolytic and/or thrombotic events despite adequate anticoagulation.

Patient and clinician acceptance and adoption of BVA was excellent and adoption of BVA was excellent and BVA phenotypes add significant value to centers implanting LVADs.

REFERENCES

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- Hanke, JS, et al. J Thorac and Cardiovasc Surg. 2018; 156:662-669