

Clinical application of invasive cardiopulmonary exercise test for dyspnea diagnosis in Chinese people

Yi Gao[#], Tao Wang[#], Chunli Liu, Yi Hong, Wenli Chen, Yanghan Chen, Nuofu Zhang, Shiyue Li, Jingping Zheng, Nanshan Zhong, Cheng Hong

Guangzhou Institute of Respiratory Health, State Key Laboratory of Respiratory Disease, First Affiliated Hospital of Guangzhou Medical University, Guangzhou 510180, China

[#]These authors contributed equally to this article.

Correspondence to: Cheng Hong, MD, PhD. Guangzhou Institute of Respiratory Health, State Key Laboratory of Respiratory Disease, First Affiliated Hospital, Guangzhou Medical University, 151 Yanjiang Road, Guangzhou 510120, China. Email: gyfyyhc@126.com.

Submitted Jul 24, 2018. Accepted for publication Oct 29, 2018.

doi: 10.21037/jtd.2018.10.114

View this article at: <http://dx.doi.org/10.21037/jtd.2018.10.114>

Dyspnea is a common clinical manifestation of subjective sensation and objective signs of breathless. There are multiple organic dysfunction or non-organic causes which may lead to dyspnea. In clinical practice, a lot of laboratory and imaging tests are performed to find the etiology of dyspnea, but some patients still remain undiagnosed, which is called unexplained dyspnea (1). Invasive cardiopulmonary exercise test (iCPET) is a new technique developed in recent years, with the addition of right heart and radial artery catheterization combined with traditional cardiopulmonary exercise test (CPET) (2). During the test, right atrium pressure, pulmonary artery pressure, pulmonary capillary wedge pressure and arterial pressure were measured during exercise and at rest (2). Blood from pulmonary artery and radial artery at different time point were sampled for analysis of hemoglobin oxygen saturation and lactic acid. Since a series of hemodynamic and respiratory index were obtained during exercise, iCPET has been introduced for the diagnosis of some types of exertion-induced dyspnea which including exercise-induced left heart diastolic function, exercise-induced pulmonary hypertension, muscle mitochondrial function obstacle, vascular nerve dysfunction. Because of the relatively technical difficulties, iCPET has been performed only in a few medical centers so far. To best of our knowledge, this is the first report of iCPET in China, we will introduce the experience of the first 7 iCPETs in our center (*Figure 1*). The age of 7 patients receiving iCPET was 27–67 years old with 0.5–5 years history of dyspnea. All the 7 patients received treatment adjusification based on

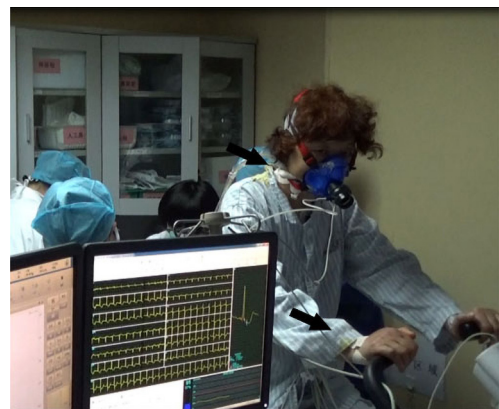


Figure 1 A patient is receiving iCPET in our institute. Black arrows indicate Swan-Ganz catheter and radial artery catheter.

iCPET results. After 3 months follow-up, 5 patients had improved symptoms (*Table 1*).

Previous literatures report that complications of iCPET are similar to non-invasive CPET, such as aortic stenosis, decompensated congestive heart failure, acute coronary syndrome, inability to walk, severe pulmonary hypertension, and unstable arrhythmia. However, compared to CPET, patients receiving iCPET are displayed with Swan-Ganz and radial artery catheters, so catheter-related complications, such as complications of internal jugular vein and radial artery puncture access (3), needs to be considered. In clinical practice, the overall safety of iCPET is acceptable. But during the test, patients reach their maximum exercise

Table 1 Index for the 7-patient receiving iCPET

Variables	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
VO ₂ max (%)	78	82	71	70	69	76	68
VE _{max} : MVV (%)	46.5	47.9	42.5	34.6	34.7	64	66
mPAPmax (mmHg)	35	18	19	43	29	39	27
PAWPmax (mmHg)	15	12	8	14	9	14	12
RAPmax (mmHg)	10	10	5	10	10	12	9
PVR (WoodU)	4.1	1.2	2.1	5.4	2.3	4.6	2.1
ECG	ST _{II, III, avF, V5-6} ↓; 0.1–0.2 mv	No obvious ST changes; occasional APB	Same as case 2	ST _{V5-6} fla↓; 0.1–0.2 mv	ST _{V5} flat; ↓0.3 mv	Same as case 2	Same as case 2
Diagnosis	ExiPH	Normal	Preload limitation	ExiPH	CAD	ExiPH	Mitochondria dysfunction
Complication	Edema in right arm	None	Anxiety	None	None	Syncope	None
Management	Introduce another PH drug	Psychological consultation	Neurologist treatment	ASD treatment	PCI	Introduce another PH drug	Psychological consultation
Follow up	Dyspnea relieved	Dyspnea relieved	Loss of follow up	Dyspnea relieved	Dyspnea relieved	No change of dyspnea	Loss of follow up

↓, ST suppression. ST, segment of electrocardiography; APB, atrial premature beat; ExiPH, exercise induce pulmonary hypertension; PH, pulmonary hypertension; ASD, atrial septal deflection; CHD, coronary atherosclerotic heart disease; PCI: percutaneous coronary angioplasty; MVV, maximal voluntary ventilation; PVR, pulmonary vascular resistance; ECG, electrocardiography.

state which may trigger sudden cardiac death, therefore the rescue equipment should be prepared. Physicians, sports physiologist and nursing staff must be trained before performing iCPET. In our test, a young female patient was anxious before the exercise, after psychological consultation her anxiety gradually improved, and finally completed the examination. This patient complained that she wore breathing mask for the first time, which makes her nervous. Since then, we routinely asked the patient to perform a rehearsal test before the iCPET. After the introduction of rehearsal test, no patient complained feeling of excessive tension or anxiety in our center. We also had a young male patient experienced syncope during the test, an instant blood glucose was 3.2 mmol/L, and glucose infusion lead to an immediate recover. The patient told us he did not take breakfast. Since then, patients in our center were asked to take meals 2–3 hours before the test.

At present, the criteria for iCPET index are based on western population, there is a lack of data on Chinese people. We are planning to conduct a multicenter cooperative study to obtain the Chinese population's iCPET index and criteria.

Acknowledgements

Funding: This work was supported by the grants from the Science Foundation Guangzhou Ministry of Health (20131A011140), and the Young Scholar Foundation of State Key Laboratory of Respiratory Disease (SKLRD-QN-201707 to HC, SKLRD-QN-201714 to TW).

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References

- Liew ZH, Kalyanasundaram G, Ong TH, et al. Cardiopulmonary Exercise Testing for Evaluating Patients with Unexplained Exertional Dyspnoea: Potential Role in Risk Stratification? *Ann Acad Med Singapore* 2018;47:169-71.
- Maron BA, Cockrill BA, Waxman AB, et al. The invasive cardiopulmonary exercise test. *Circulation* 2013;127:1157-64.

- Berry NC, Manyoo A, Oldham WM, et al. Protocol for exercise hemodynamic assessment: performing an invasive

cardiopulmonary exercise test in clinical practice. *Pulm Circ* 2015;5:610-8.

Cite this article as: Gao Y, Wang T, Liu C, Hong Y, Chen W, Chen Y, Zhang N, Li S, Zheng J, Zhong N, Hong C. Clinical application of invasive cardiopulmonary exercise test for dyspnea diagnosis in Chinese people. *J Thorac Dis* 2018;10(Suppl 33):S4176-S4178. doi: 10.21037/jtd.2018.10.114