

# Usefulness of Transesophageal Echocardiography in the Assessment of Aortic Dissection

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The acute dissection of the ascending aorta requires prompt and reliable diagnosis to reduce the high risk of mortality; in addition, prognosis is influenced by long-term complications. The aim of this article is to discuss transesophageal echocardiography (TEE) and (1) its diagnostic accuracy in the presurgical evaluation of patients, (2) its role in reducing time of diagnosis and surgery, and (3) its ability to reduce hospital mortality. TEE has also been tested as a screening method in the postsurgical follow-up of these patients. The retrospective investigation concerns a sample of 80 cases of acute dissection of the aorta, submitted for surgical intervention from April 1986 to February 1999. TEE has allowed a precise estimation of aortic diameters and optimal visualization of intimal flap and tear entry with a fine distinction between true and false lumen. A direct comparison of the results of TEE and of transthoracic echocardiography has demonstrated that some elements (visualization of flap and diameters in descending aorta, sites of entry and reentry, direction of jet through intimal tears, phasic intimal flap movement, diastolic collapse of flap on the valvular plane, false lumen thrombosis, coronary involvement, intramural hematoma, and aortic

fissuration) were identified only by TEE, whereas other additional diagnostic elements (cardiac tamponade, aortic valve insufficiency, left ventricular function) show a similar pattern of significance. Routine employment of this method has confirmed a reduction of hospitalization time (about 1.5 hours of waiting time), and hospital mortality has changed from 42.8% to 17.3%. In the follow-up of patients operated on for aortic dissection, fundamental information may be obtained from TEE (assessment of the progression of thrombosis in the false lumen with its complete obliteration and modifications in aortic diameter with a consequent, possible worsening of aortic valve insufficiency). In conclusion, our study demonstrated that TEE may provide fast and efficient detection of acute aortic dissection. In the postsurgical follow-up, TEE has confirmed detection of major complications that can influence long-term prognosis and may be proposed as a method with easy access—one that is repeatable and inexpensive for the screening of aortic dissection surgical patients. ©2000 by Excerpta Medica, Inc.

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**T**he acute dissection of the ascending aorta leads to an extremely precarious clinical condition, in which the risk of mortality increases dramatically in patients who do not undergo early surgical intervention. In patients not receiving immediate surgical treatment, mortality is 38% on the first day and 70% after 1 week; 86% of deaths may be attributed to aortic rupture.<sup>1</sup> The surgical intervention prevents aortic rupture and allows the regression of organ ischemia and valvular aortic incompetence; however, it should be performed before the onset of major complications or before complications become irreversible.<sup>2</sup>

For this reason, it is necessary to define the best technical approach to diagnosis of acute aortic dissection. Retrograde aortography is nowadays considered obsolete because it is potentially risky and has a long

execution time.<sup>3,4</sup> Computed tomography (CT) scan is quick and easy to obtain for the patient, but has a reduced sensitivity.<sup>5,6</sup> However, CT scan cannot detect the involvement of collateral branches and acute aortic failure.<sup>7</sup> Magnetic resonance imaging is an emerging, noninvasive technique with optimal diagnostic resolution. The main problem with magnetic resonance imaging is that it is not available in all centers and it is difficult to perform on unstable or critical patients.<sup>8</sup> Today, transesophageal echocardiography (TEE) may be regarded as the first-level instrumental modality in acute aortic dissection diagnosis.<sup>9–12</sup>

After surgical intervention, long-term prognosis is influenced by complications such as redissection, pseudoaneurysms, progression of aortic valve insufficiency, or dilatation of the false lumen that may often occur without any symptoms. For this reason, TEE may also be proposed as an adequate instrumental technique to detect the main modifications in the aorta.<sup>13</sup>

In our clinical experience, TEE is employed as first-level instrumental modality in the diagnosis of aortic dissection and in postsurgical follow-up.<sup>14</sup> The

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aim of this study is to show the diagnostic accuracy of this method in the pre- and postsurgical evaluation of patients affected by acute aortic dissection. Moreover, we tried to ascertain if routine use of a flexible technique might lead to the reduction of surgical time and hospital mortality. Our retrospective analysis concerns a sample of 80 cases of acute aortic dissection, submitted to surgical intervention from April 1986 to February 1999. All patients underwent a transthoracic echocardiography examination. Starting in May 1993, TEE was added to this preliminary diagnostic approach. Waiting times for patients, before surgical intervention, were distinguished in prehospitalization and intra-hospitalization time. The prehospitalization time represents the interval between symptom onset and hospital admission, whereas the intra-hospitalization time is the interval between hospital admission and operating room admission. The sum of these 2 intervals has been termed "total time."

## DISCUSSION

From data analysis, it appears that the introduction of TEE in the diagnostic evaluation of acute aortic disease was a breakthrough. Diagnostic accuracy of TEE is due to its ability to identify the intimal flap and the tear entry with a fine distinction between the true and false lumen. Further, this instrumental technique can also identify the involvement of branch vessels, left ventricular function, and signs of penetration (pericardial, pleural or periaortic effusion, and mediastinal hematoma).

Transthoracic echocardiography has allowed the visualization of the intimal flap in 60 of 80 dissected patients examined with surgery, reaching 75% sensitivity in accordance with the data of Nienaber et al.<sup>15</sup> These investigators reported a 78.1% sensitivity for type A aortic dissection.<sup>15</sup> TEE allows a more precise estimation of intimal flap and aortic diameters as underlined by the good correlation with the surgical data ( $p = 0.0001$ ). The technique allows a diagnosis of certainty reaching 100% sensitivity in accordance with the results of Simon et al.<sup>16</sup> In 1 case, the surgical flap origin did not correspond to the point where TEE identified it in the ascending aorta; the surgical examination found it on the arch. This finding confirms the presence of the "blind spot" in the echocardiographic examination of the aortic arch.<sup>17,18</sup> For this reason, and also to reduce the duration of the TEE scan to the shortest time, the aortic arch was explored only if there was evidence of its involvement from a previous transthoracic echocardiography: The extension of the flap to the aortic arch was recognized using transthoracic echocardiography in 21 of 24 cases identified at surgery, justifying the use of this method in conjunction with TEE in the exploration of the aortic arch.<sup>19</sup>

Moreover, TEE did not show the presence of tear entry in 9 of 52 cases, with an 82.6% sensitivity, according to Adachi et al (Table I).<sup>20</sup> This parameter is quite undetectable with transthoracic echocardiography, except for the arch where only 1 case was missed in comparison with the surgery.

The conclusions drawn by the analysis of the

parameters for the definition of acute aortic dissection are strengthened by a direct comparison of TEE with transthoracic echocardiography (Table II). From this comparison, it is evident that some elements were identified only by TEE (flap visualization and diameters in the descending aorta, sites of entry and reentry, direction of jet through intimal tears, phasic intimal flap movement, diastolic collapse of flap on the valvular plane, false lumen thrombosis, coronary involvement, intramural hematoma, and aortic fissuration) while it can predict a similar pattern of significance for 3 additional diagnostic elements (i.e., cardiac tamponade, aortic valve insufficiency, and left ventricular function). The exploration of the descending aorta is exclusively obtained with TEE, which succeeded in detecting lumen diameter, flap extension in this part of the aorta, and the likelihood of spontaneous echo-contrast or thrombosis of the false lumen. The discrepancy in the identification of the flap extension in the ascending aorta between the 2 methods is only apparent because the 32 cases detected by transthoracic echocardiography also include those cases with flap extension in the descending aorta that cannot be detected with this method and are interpreted as located in the ascending aorta. One should note the flap pulsation that coincides with the movement of the membrane intimal flap. This explains why TEE often allows a dynamic analysis of the functional mechanism causing aortic insufficiency, due to diastolic collapse of the flap and the involvement of an aortic (coronary) cusp. The last 2 points are often overestimated in comparison to the surgery. In 1 case, the coronary vessels involved had not been signaled, in comparison with the surgical exam. Even if limited to 4 cases, these data underline the optimal basal short-axis resolution of TEE in comparison with that of transthoracic echocardiography, which is often affected by the poor quality of the thoracic window. Intramural hematoma and aortic fissuration still remain difficult to detect.

In the follow-up of patients who have had surgery for aortic dissection, fundamental information may be obtained from a TEE exam. Some important observations can be derived from the assessment of the false lumen. If it is not filled up by a large entry tear, there may be a long-term progression of thrombosis with its complete obliteration (in our experience, this event occurred in about half the patients with postsurgical presence of patent lumen). Apart from the false lumen, another important point is aortic dilatation, because this is the main risk factor for the consequent rupture of the aorta.<sup>21</sup>

## CONCLUSIONS

It appears that the fundamental diagnostic role of TEE may provide adjunctive information important in the presurgical evaluation of patients with aortic dissection. In this way, TEE not only provides certain diagnosis but also leads to the choice of the best surgical option.<sup>22</sup>

<b>TABLE I</b> Comparison of Variables Detected by Transesophageal Echocardiography (TEE) with Surgical Findings			
	TEE	Surgical Findings	p Value
Aortic root diameter (cm)	3.72 ± 0.60	3.75 ± 0.58	NS
Ascending aorta diameter (cm)	5.05 ± 0.82	5.10 ± 0.84	NS
Intimal flap (%)	52 (100)	52 (100)	NS
Origin of dissection (%)			
Ascending aorta	50 (96.1)	49 (94.2)	NS
Aortic arch	2 (3.8)	3 (5.7)	NS
Tear entry (%)			
Ascending aorta	40 (76.9)	46 (88.4)	NS
Aortic arch	3 (5.7)	3 (5.7)	NS
Descending aorta	0 (0.0)	2 (3.8)	NS
Undetectable	9 (17.3)	1 (1.9)	NS
Extent of dissection (%)			
Ascending aorta	12 (23.1)	9 (17.3)	NS
Aortic arch	5 (9.6)	17 (32.7)	NS
Descending aorta	27 (51.9)	25 (48.1)	0.008
Branch vessels involvement (%)	3 (5.7)	6 (11.5)	NS
Pericardial effusion (%)			
Absent	34 (65.3)	28 (53.8)	NS
Present	13 (25)	21 (40.4)	NS
Tamponade	5 (9.6)	23 (5.7)	NS
Aortic insufficiency (%)			
Absent	10 (19.2)	24 (46.1)	0.007
Slight	15 (28.8)	9 (17.3)	NS
Moderate	11 (21.1)	11 (21.1)	NS
Severe	16 (30.7)	8 (15.3)	NS

NS = not significant.

<b>TABLE II</b> Comparison Between Transthoracic (TTE) and Transesophageal (TEE) Echocardiographic Findings			
	TEE	TTE	p Value
Aortic root diameter (cm)	3.72 ± 0.60	3.62 ± 0.57	NS
Ascending aorta diameter (cm)	5.05 ± 0.82	4.87 ± 0.89	NS
Intimal flap (%)	52 (100)	35 (67.3)	0.0001
Origin of dissection (%)			
Ascending aorta	50 (96.1)	35 (67.3)	0.0001
Aortic arch	2 (3.8)	3 (5.7)	NS
Tear entry (%)			
Ascending aorta	40 (76.9)	4 (7.6)	NS
Aortic arch	3 (5.7)	4 (7.6)	NS
Extent of dissection (%)			
Ascending aorta	12 (32.1)	32 (61.5)	0.0001
Aortic arch	5 (9.6)	14 (26.9)	0.042
Branch vessel involvement (%)	3 (5.7)	12 (15)	NS
Pericardial effusion (%)			
Absent	34 (65.3)	29 (55.7)	NS
Present	13 (25)	23 (44.2)	NS
Tamponade	5 (9.6)	8 (15.3)	NS
Aortic insufficiency (%)			
Absent	10 (19.2)	11 (21.1)	NS
Slight	15 (28.8)	10 (19.2)	NS
Moderate	11 (21.1)	13 (25)	NS
Severe	16 (30.7)	13 (25)	NS
Ventricular function depressed (%)	8 (15.3)	8 (15.3)	NS

NS = not significant.

Tear entry localization is important for the evaluation of the part of the aorta to be changed. When the ascending aorta is involved, a substitution must always take place to avoid valvular incontinence complications. Substitution must involve the aortic arch only if tear entry is present, or when involvement of the epiaortic vessels is reported; this is necessary

because operative risk increases from 5–10% to 10–15% in the case of combined substitution.<sup>23</sup>

Aortic valve failure must be considered when deciding on the best surgical approach (resuspension vs substitution), in the presence of degenerative disease. If the pathology is functional and there is no distortion of the valve plane, the valve does not have to be

**TABLE III** Waiting Time for Diagnosis of Aortic Dissection and In-hospital Mortality Before and After Introduction of Transesophageal Echocardiography (TEE)

	TEE (1993–1997)	TTE (1985–1992)	p Value
Intrahospitalization time (hr)	1.29 ± 0.73	8.84 ± 26.9	0.045
Prehospitalization time (hr)	18.62 ± 30.56	43.49 ± 64.09	0.016
Total time (hr)	19.90 ± 30.56	52.37 ± 65.02	0.003
Hospital mortality, n (%)	9 (17.3)	12 (42.8)	0.03

TEE = transthoracic echocardiography.

repaired because functional valve failure may be due only to flap diastolic collapse.

The execution time of TEE allows the achievement of a good diagnosis in a short time (Table III). This statement is validated by our study, because we noticed a reduction in the hospitalization time from 8.84 ± 26.9 hours in the pre-TEE period (1985–1992) to only 1.29 ± 0.73 hours after the introduction of TEE (1993–1997). The total waiting time from symptom onset to surgery-influenced mortality was reduced from 12 deaths in 28 patients (42.8%) in the pre-TEE period to 9 deaths in 52 patients (17.3%) after TEE introduction.

In conclusion, in accordance with the literature, our study demonstrated that TEE is a technique that is able to detect aortic dissection quickly and efficiently.<sup>24</sup> For this reason, in the case of acute aortic dissection with typical precordial chest pain, TEE may provide the indications for surgery. More expensive methods, such as CT scan or magnetic resonance imaging, must be reserved only for complex cases in which clinical symptoms cannot be confirmed with TEE. For a long-term surveillance program of patients who have had surgery for aortic dissection, TEE may be also proposed as an easy access, repeatable, and less expensive method.

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