Open versus endovascular repair of traumatic aortic rupture: A systematic review

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There have been several case reports, retrospective series, and registry data describing treatment of patients with traumatic aortic rupture (TAR) using endovascular stents (ES).[1] Most are single-center studies with a limited number of patients. Few studies compare conventional surgical repair (SR) with ES. We performed a systematic review of these studies in an attempt to quantify the benefits of ES for TAR.

METHODS

A systematic search of MEDLINE, EMBASE, and the Cochrane Library was undertaken. The key words used were ''aortic rupture,'' ''traumatic aortic rupture,'' ''thoracic aorta,'' and ''endovascular.''

To maximize the sensitivity, we identified all published and unpublished articles comparing SR with ES of TAR. Where available, abstracts from major cardiology and cardiothoracic scientific meetings were hand-searched. For all articles, references were checked for relevant articles to ensure that a complete data set was obtained.

Only articles that specifically addressed TAR were included. Articles describing acute aortic rupture, in which cases of type B dissection, ruptured thoracic aneurysms, and other acute aortic pathologies were described, were only included if data for TAR patients were presented separately. Articles in which TAR was not treated as an emergency were excluded.

RESULTS

Ultimately, 10 articles with 262 patients, 153 undergoing SR and 109 undergoing ES, were identified. The articles and major outcomes are presented in Table 1.

Operative mortality and postoperative paraplegia rates were significantly less for ES compared with SR (7% vs 19%, $P = .01$) and (1% vs 6%, $P = .01$), respectively.

Major morbidity was more common in SR patients, with 2 patients having acute respiratory distress syndrome (ARDS), 3 patients with acute renal failure, and 9 patients with major neurologic complications, including damage to the left recurrent laryngeal and the phrenic nerve. Major morbidity for ES were as follows: 3 cases (3.5%) of conversion to SR due to technical failures or acute hemodynamic instability, 2 cases of stent collapse resulting in severe aortic outflow obstruction, 1 fatal case of iliac artery rupture reported, and 1 case of left main bronchus compression caused by the stent. This was treated by a bronchial stent. Other major complications included 1 case of ARDS and 1 case of a pulmonary embolism.

Long-term data were poorly reported, included in only 5 of the 9 studies. In these studies, duration of follow-up was a median of 36 months. A primary endoleak was the most common complication, observed in 6 (5.5%) cases. Five of these patients required additional endovascular stenting or balloon dilation of the original stent. In 11% of patients, the origin of the subclavian artery was covered by the stent. Complications attributed to this were rare, although 2 patients required left subclavian to carotid artery grafts. There were 2 cases of late coarctation of the aorta, 1 within the stent itself.

CONCLUSIONS

TAR carries a high mortality at the scene of the injury. For patients who survive the initial period, early intervention offers the best hope of a successful outcome. SR has traditionally been the mainstay of treatment of TAR.[2] This systematic review demonstrates that ER can be performed with much lower mortality and morbidity that conventional SR.

LIMITATIONS

Overall, the quality of the literature was poor. All were retrospective series. There were no randomized controlled trials. There is a possibility of bias in the selection of treatment modalities for patients. For example, ''less sick'' patients may have been more likely to be treated with endovascular therapy. The low number of complications reported with ES is surprising and certainly less than complications reported in the registry data.

Critically, only 5 studies provide any data on long-term durability of ES. Although we agree that for this pathology, long-term durability is likely to be of secondary concern due the lifesaving nature of the surgery, the absence of underlying aortic disease, and the age of the patient population, some data on long-term stability of ES are required to assess the technique more fully.

Nevertheless, this review suggests that ES significantly reduces the mortality and morbidity associated with conventional SR for TAR. Our own experience is that ES is technically feasible in most patients. It takes less time, and the requirement for transfusion of blood and blood products is significantly reduced. It also simplifies the management of other injuries in these patients in whom multiple injuries are common.[3]

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TABLE 1. Early and late outcome of ER and SR

	No. of patients		Operative mortality		Paraplegia		Early complications		%	Mean FU duration	Late complication	
Reference	SR	ES	SR	ES	SR	ES	SR	ES	FU	(mo)	ER	OR
Kokotsakis et al[4]	10	22	1/10	2/22	1	1	1 ARF, 1 phrenic nerve palsy	2 endoleak, 1 ARF	NR	NR	NR	NR
Akowuah et al[3]	8	7	1/8	0	1	0	0	0	NR	NR	Non	1 coarctation
Lebl et al[5]	10	7	2/10	1/7	0	0	2 ARDS, 2 ARF	1 ARDS, 1 PE	NR	NR	NR	NR
Adrassy et al[6]	16	15	3/16	2/13	2	0	3 Neuro	3 converted to OR	100	117	Non	2 LSA to carotid artery graft, 3 endoleak
Kuhne et al[7]	36	5	6/36	0/5	NR	NR	NR	NR	NR	NR	NR	NR
Amibile et al[8]	11	9	1/11	0	0	0	1 tamponade, 1 RLN palsy, 3 phrenic nerve palsy	0	100	15	Non	Non
Rosseau et al[9]	28	29	6/28	2/28	3	0	0	1 iliac artery rupture, 1 LMB compression	100	46	Non	1 endoleak
Ott et al[10]	12	6	2/12	0/6	2	0	1 RLN	0	100	36	Non	Non
Kasirajan et al[11]	10	5	5/10	1/5	0	0	0	1 coarctation	100	10		Non
Doss et al[12]	12	4	2/12	0/4	0	0	0	0	NR	NR	Non	1 coarctation
Total	153	109	29/153 (19%)	8/109 (7%)	9/153 (6%)	1/109 (1%)						

ES, Endovascular stents; *SR,* surgical repair; *FU,* follow-up; *NR,* not reported; *ARDS,* acute respiratory distress syndrome; *ARF,* acute renal failure; *PE,* pulmonary embolism; *RLN,* recurrent laryngeal nerve; *LSA,* left subclavian artery; *LMB,* left main bronchus.

ES appears widely applicable as an emergency treatment and simplifies the treatment of other injuries. ES should be viewed as the treatment of choice for TAR.

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