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Research letter

Pulmonary function testing is safe in patients with thoracic aortic aneurysms

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Pulmonary function testing is safe in patients with thoracic aortic aneurysms.

To the Editor,

Thoracic aortic aneurysms (TAA) occur in up to 16 per 100,000 of the population and are increasingly amenable to surgical correction. (1) However, low lung function is associated with poor post-operative outcomes, and a pre-operative assessment of pulmonary function is therefore important for prognostication. (2)

The American Association of Respiratory Care (AARC) 1996 Spirometry Clinical Practice Guidelines listed thoracic, abdominal and cerebral aneurysms as relative contraindications to forced respiratory manoeuvres due to the perceived danger of rupture from increased thoracic pressure. (3) Despite this caveat, there is little evidence for this and a recent study found lung function testing is safe in the presence of abdominal aneurysms <6cm. (4) The AARC guideline has now been retired, however little is known about the risk of rupture in TAA following forced expiratory manoeuvres and hence the AARC contra-indications are still often referred to. (5)

To assess the true risk of rupture following TAA surgery and the effect of spirometric measurement, we reviewed the outcomes of all patients who had undergone TAA surgery between 2010 and 2017. Our institution is a tertiary cardiothoracic centre providing regional elective, urgent and emergency surgical management of TAA, where it is routine practice to obtain pulmonary function testing for patients undergoing surgery where possible. Spirometry is performed by an accredited respiratory physiologist according to ATS/ERS guidelines. (6) The local protocol is uniform across indications and all patients are instructed to perform at least three repeatable forced expiratory manoeuvres.

Baseline demographics, lung function, TAA characteristics and post-operative outcomes including 30-day mortality and length of stay (LOS) were recorded from our institutional surgical and pulmonary function laboratory databases. We then investigated associations between pre-operative spirometry and mortality as well as operative outcomes including length of stay and 30 day mortality. We also investigated whether any subjects with planned

elective TAA required unplanned urgent/emergent operative intervention in the time period following spirometry. Finally, hospital records of medical emergency team/cardiac-arrest alerts were examined. All predicted lung function values are presented as calculated from the Global Lung Initiative reference equations. (7) Data are presented as median (IQR) or count (%).

Between January 2011 and March 2017, 519 patients underwent open surgical management of TAA at our institution (427/519 [82.2%] elective, 69/519 [13.3%] urgent and 23/519 [4.4%] emergency). Median aneurysm size was 5.6cm [5.0-6.3] (5.5 cm [5.0-6.0], 6.5 cm [5.0-8.0], and 5.0 cm [5.0-8.0], for each surgical group respectively). Baseline characteristics are presented in Table 1. Spirometry was performed in 426/519 (82.1%) with an average forced expiratory time of 9 seconds [7-12 seconds] and ATS/ERS acceptability criteria were met in 325/426 (82.2%). Average FEV1 and FVC were 88.3 %pred [75.8-100.0] and 95.0 %pred [83.8-105.6] respectively, airway obstruction was present in 145/426 cases (33.9%) and time to operation was 35 days [7.2-57.4]. Post-operative LOS was inversely related to FEV1 ($r=-0.2$ $p<0.01$). There were no events of sudden deterioration requiring medical emergency team or cardiac-arrest team in the pulmonary function lab events records or amongst the hospital medical emergency team records.

In the elective group 387/427 (90.1%) patients had pre-operative spirometry and there was no difference in 30 day post-operative mortality or LOS compared to the remainder (5.4% vs. 7.5%, $p=0.32$; and 16.2 days vs. 16.3, $p=0.96$). Similarly, in the urgent group, the 39/69 (55.1%) with pre-operative spirometry had no difference in 30 day mortality or LOS to those who did not have spirometry (4/38 [10.5%] vs. 2/31 [6.4%], $p=0.769$; and 18.2 days vs. 17.4 days, $p=0.97$). No patient in the emergency group (30 day mortality 8.7%; LOS 13.8 days) had spirometry immediately prior to surgery.

Of those with TAA >6cm, 175/217 (81%) underwent spirometry: there was no difference in 30 day mortality compared to the remainder (16/175 [9.1%] vs.8/42 [19.5%], p=0.6 respectively).

We have shown that the forced respiratory manoeuvre necessary for spirometric measurement was not associated with adverse outcomes in patients undergoing the surgical management of TAA and there was no increase mortality, LOS or the need for unplanned urgent/emergency surgery in patients having undergone spirometry. Our findings were similar across all sizes of TAA. However, we found lung function is an important predictor of post-operative LOS, underlining the value of its assessment.

Aneurysms were first listed as a relative contra-indication due to the theoretical risk of rupture and hence testing may understandably cause concern for patients, clinicians and physiologists alike.(3) However to our knowledge there are no reported cases of aneurysmal rupture following pulmonary function testing.

Pre-operative spirometry is routinely performed in the work-up for thoracic aortic aneurysm surgery at our centre, other centres and also in clinical trials where it has been well validated as a predictor of post-operative outcomes. (2, 8, 9) More recently, the safety of spirometry in abdominal aortic aneurysms has been demonstrated. (4) To our knowledge, ours is the largest study to date investigating the safety of spirometry in TAA. Other workers have investigated spirometry in terms of risk-stratification for aortic surgery without reports of any significant adverse events, further supporting its utility. (10) In conclusion, we found no evidence of acute rupture of TAA or poorer outcomes in patients with TAA following spirometry.

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Tables

Table 1: Baseline characteristics
Data are presented as median (IQR) or count (%)

FET=Forced expiratory time; FEV1=Forced expiratory volume in 1 second; FVC=Forced vital capacity; TAA=Thoracic aortic aneurysm. In the elective group 387 out 427 underwent spirometry and in the urgent group 39 out of 69 underwent spirometry.

	All	**Elective**	**Urgent**	**Emergency**
n	519	427 (82.2)	69 (13.3)	23 (4.4)
Age, *years*	66.9 (54.7-73.4)	66.9 (55.3-73.5)	67.6 (52.0-74.7)	62.2 (46.6-73.2)
Sex, *female*	188 (36.2)	161 (37.7)	29 (36.2)	2 (8.7)
FEV1, *litres*	2.5 (1.9-3.1)	2.5 (1.9-3.2)	2.1 (1.7-2.7)	n/a
FEV1, *%pred*	88.4 (75.8-100.0)	88.9 (76.6-100.6)	80.5 (69.5-93.3)	n/a
FVC, *litres*	3.3 (2.6-4.1)	3.3 (2.6-4.2)	2.9 (2.2-3.7	n/a
FVC, *%pred*	95.0 (83.8-105.6)	95.8 (85.1-107.5)	87.3 (79.8-98.6)	n/a
FET, seconds	9 (7-12)	9 (7-12)	10 (7-13)	n/a
Size of TAA, *cm*	5.6 (5.0-6.3)	5.5 (5.0-6.0)	6.5 (5.0-8.0)	5.0 (5.0-8.0)