AATS

AORTIC SYMPOSIUM

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Ex vivo mechanical properties of aortic wall in acute dissection compared to non-dissected aorta

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Background / Study Objective

- Acute aortic syndrome is a catastrophic event still characterized by high mortality even in case of successful prompt surgical treatment.
- Evaluation of biomechanical properties of aortic wall from “ex vivo” specimens has been pursuased by many authors in order to better clarify the physiopathology of aortic diseases thus identifying potential early predictor risk factors for acute aortic complications.
- Results of “ex vivo” biomechanical evaluations, however, have failed, so far, to demonstrate clear risk factors to be translated in clinical practice.
- Significant limitation in many studies presented so far has been the lack of a “control group”, being the majority of specimens harvested during scheduled aortic surgery.
- In this study we report our extensive experience in evaluation of biomechanical properties of aortic wall including specimens from patients experiencing acute aortic dissection and patients without aortic diseases

Patients

113 patients were enrolled for aortic wall harvesting and for mechanical tests according our previously published protocol.

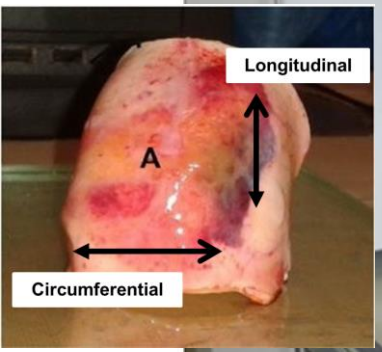
Patient undergoing **ascending aorta replacement** for either **chronic aneurysm** and **acute aortic dissection** were included alongside with specimens from **donor** and **native** ascending aorta harvested during **heart transplantation**

Group	NdAA (n.73)	AAD (n.11)	CG (n.20)	Gen (n.9)	*p*
Age	65±12	70±8	48±11	46±15	***0,001***
Male Female	47 (64) 26 (36)	7 (63) 4 (37)	11 (55) 9 (45)	8 (88) 1 (12)	0,521
BSA	1,86±0,21	1,9±0,2	1,9±0,3	1,97±0,22	0,600
BMI	25±5	27±3	25±2	26±4	0,865
Aortic Dilatation Max (mm) Indexed Area/Height	52±5 28,4±34,2 11,8±2,8	46±6 25,3±3,5 9,3±2,3	32±6 20,8±3,7 8,2±1,6	54±10 27,9±7,8 12,4±6,2	***0,035*** 0,240 0,129
Specimens	339	43	47	16	

NdAA=Non dissecting aortic aneurysm; AAD=Acute aortic dissection; CG=Control group; Gen= Genetic disorders

Methods

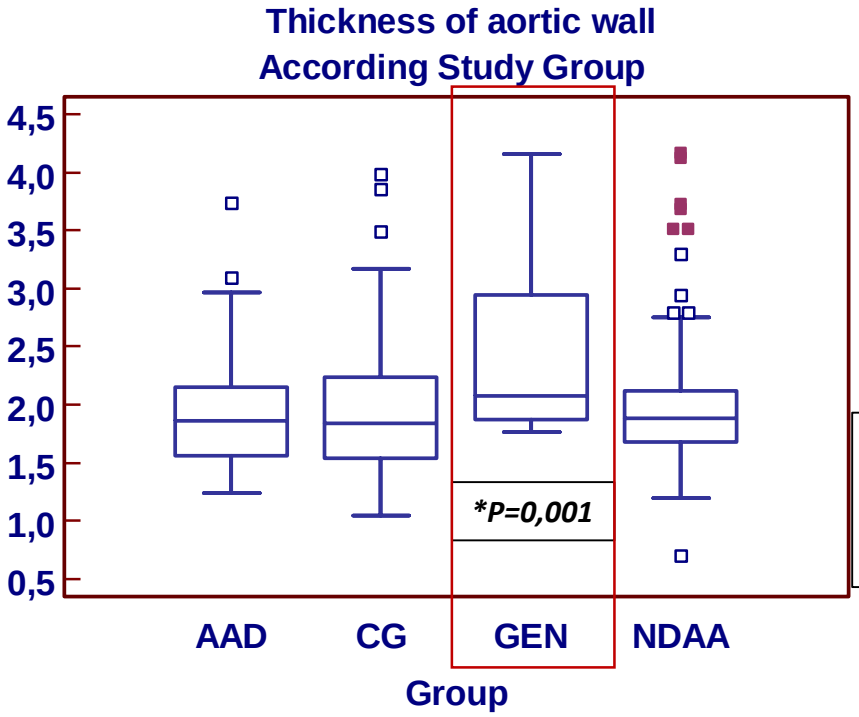
Mechanical uniaxial tensile ultimate stress test were performed on the fresh "ex vivo" sample within 24 hours from the harvesting according our previously published protocol evaluating 3 parameters at specimen's rupture.



<u>Peek strain (Pstr)</u> as the maximum strain before specimen rupture (*<u>marker of aortic wall **elasticity**</u>*);

<u>Peek Stress (PS)</u> as the maximum stress before specimen rupture (*<u>marker of aortic wall **strength**</u>*).

<u>Maximum elastic modulus (MEM)</u> as the maximum slope of stress/strain curve (*<u>marker of aortic wall **stiffness or resistance to deformation**</u>*).

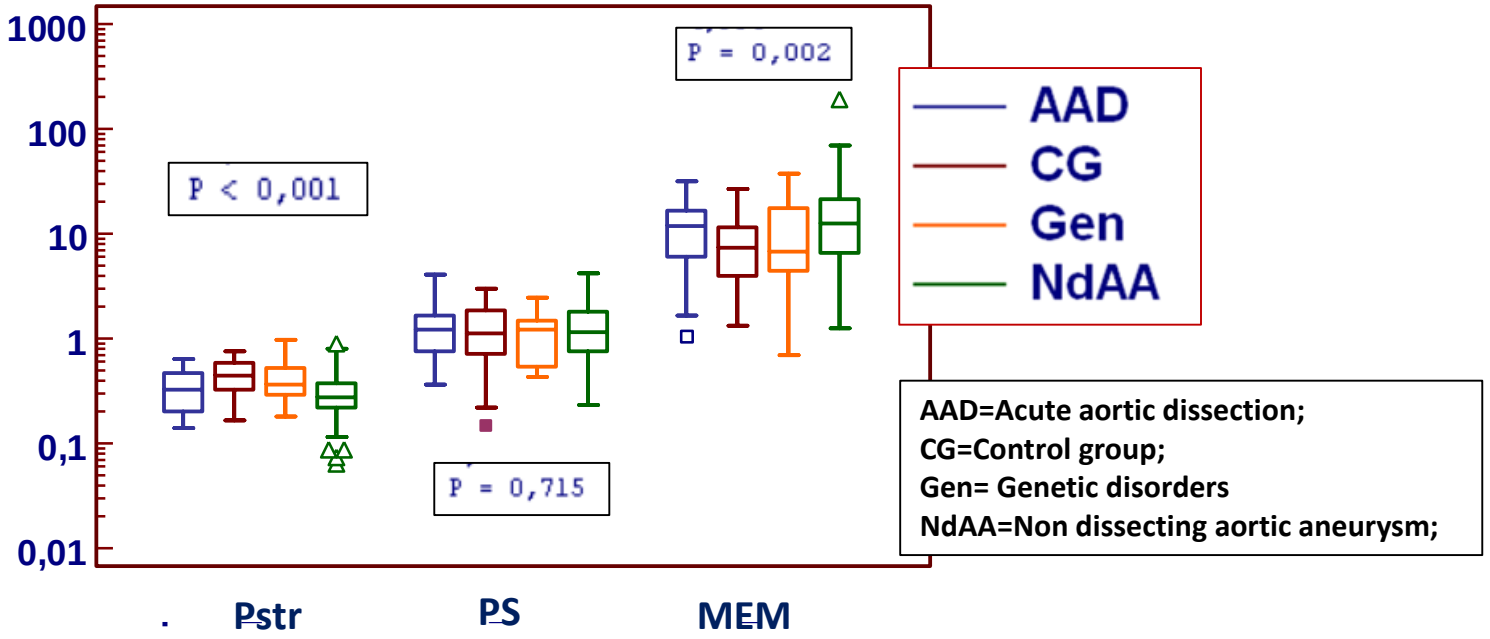


AAD=Acute aortic dissection;
CG=Control group;
Gen= Genetic disorders
NdAA=Non dissecting aortic aneurysm;

Comparative analysis of thickness of aortic wall between groups showed significant differences only in the group with genetic disorders.

Results 2

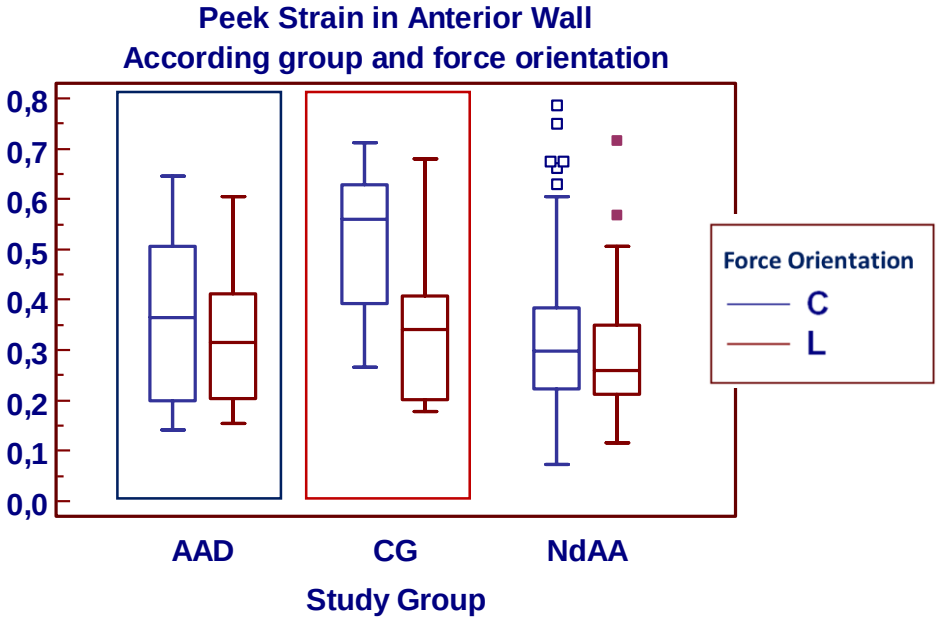
Overall Mechanical Properties According study group

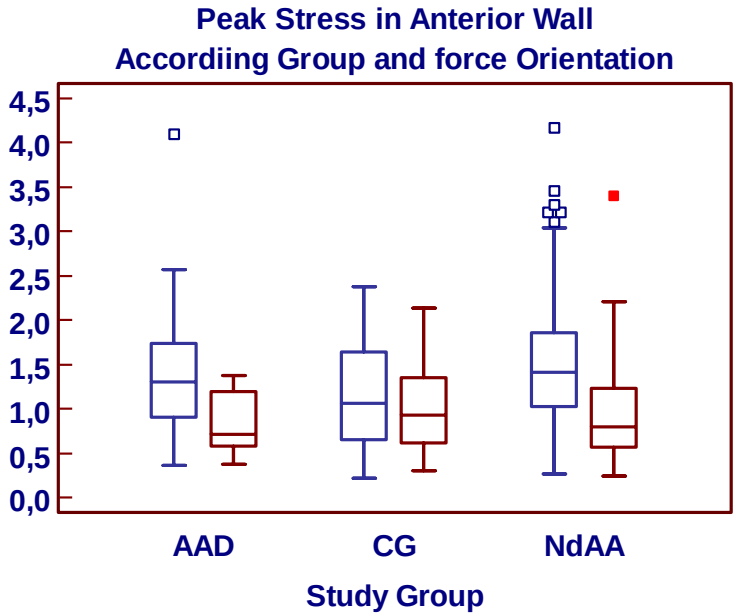


Comparative analysis of overall mechnaical properties showed no significant differences between non dissected and dissected aorta. Control group, on other hands showed more preserved elasticity and strenght.

Results 3

AAD=Acute aortic dissection;
CG=Control group;
NdAA=Non dissecting aortic aneurysm;

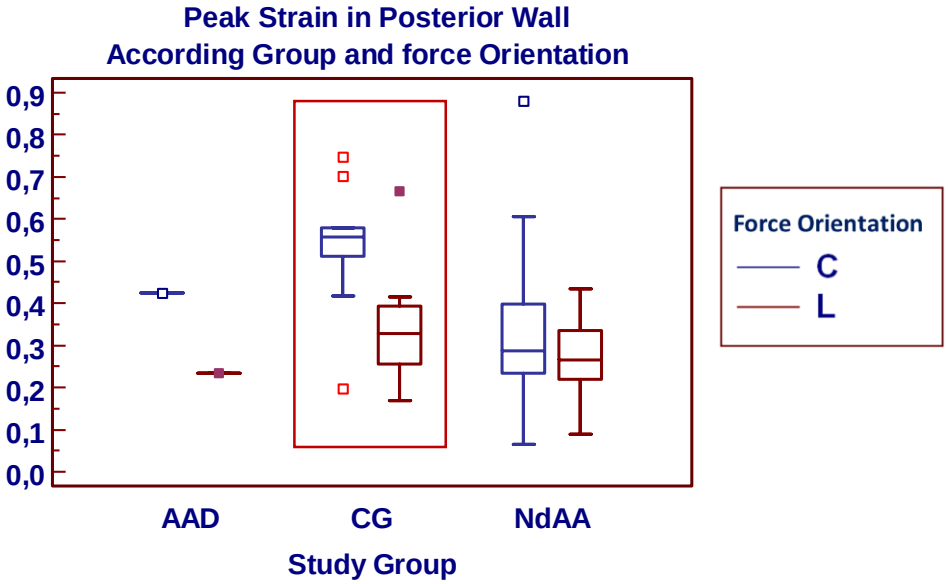


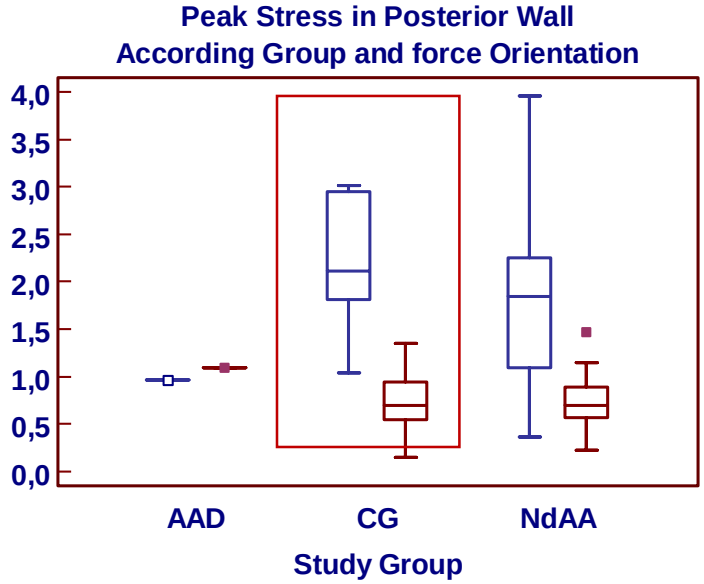


Sub-group analysis was focused in patients with and without dissection + control group and showed overall similar mechanical properties between dissected (bleu square) and non dissected aortic specimen. Only control groups specimens showed increased peek strain especially under circumferential traction (red square) in specimen from Anterior wall

Results 4

AAD=Acute aortic dissection;
CG=Control group;
NdAA=Non dissecting aortic aneurysm;





In specimens from Posterior wall, both Peak Strain and Peak Stress were improved in control group (red square) once more under circumferential traction.

Conclusion

- **As far as our knowledge this is the first study reporting mechanical properties not only of dilated aortic wall but also of non dilated and dissected aortic wall.**

- **A small group of dilated ascending aorta from patients with genetic disorders were also included showing that thickness of aortic wall in this patients is preserved compared to non genetic-based aortic dilatation.**

- **Control group showed the better elasticity and strength confirming that impaired mechanical properties are characteristics of dilated aorta.**

- **The preserved mechanical properties in undamaged wall of dissected patients showed, however, that acute dissection is characterized by a focal fragility more than a diffuse impaired mechanical properties of aortic wall.**

Thank You