Single-Centre Experience with Ultrasound-Assisted Thrombolysis, Rheolytic Thrombectomy, and Low-Dose Fibrinolytic Therapies in the Management of Acute Pulmonary Embolism

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Background and Aims :

Catheter-directed therapies (CDTs), including ultrasound-assisted thrombolysis, rheolytic thrombectomy, and low-dose fibrinolysis, offer targeted treatment for high- and intermediate-high-risk acute pulmonary embolism, aiming to restore perfusion with lower bleeding risk. This study evaluates their safety and effectiveness over a 10-year period.

Methods :

We retrospectively analyzed 913 patients treated for acute PE at a high-volume tertiary center. Patients received either USAT using the EKOS system (n=237) or ART using the AngioJet system (n=62). Median intravenous t-PA dose was 50 (25-50) mg, median infusion duration was 6 (4-10)hours. Bilateral procedures were conducted in 83.5% of USAT and 58.1% of ART cases. The mean t-PA dose was 53.6 ± 29.4 mg overall. In USAT, the average dose was 36.1 ± 13.2 mg with a mean infusion time of 25.3 ± 13.4 minutes. In ART, median t-PA dose was 20 mg (IQR 13–20), with procedural durations averaging 308 seconds.

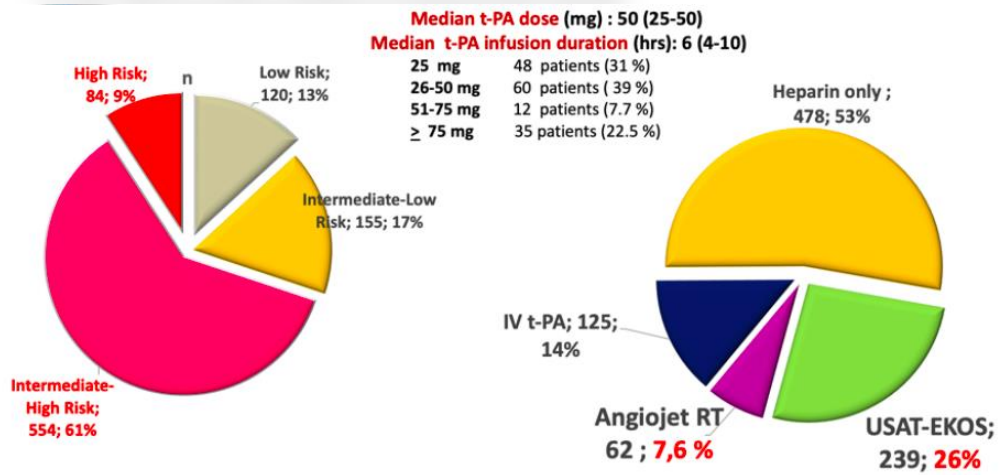
Results :

Both USAT and ART resulted in significant improvements in RV function, pulmonary pressures, and perfusion scores ($p< 0.001$). USAT was particularly effective in patients with higher baseline risk. In both groups, there was no significant correlation between t-PA dose or infusion time and major bleeding or in-hospital mortality. Mechanical ventilation or ECMO was required in only 1.7% of patients. Thirty-day mortality was significantly associated with initial high-risk status. Long-term mortality was more strongly linked to older age at presentation, independent of procedural choice. In patients who received intravenous tPA, significant improvements were observed in RV and RA size and function, thrombus burden, and clinical parameters (all $p < 0.001$). The Qanadli score and RV/LV ratio decreased by 55% and 29%, respectively.

Comorbidities in the USAT and ART Groups

USAT	
Age (years)	61.0±16
Male gender, n (%)	98 (43.6%)
Diabetes mellitus, n (%)	43 (19.1%)
Hipertension, n (%)	108 (48%)
Atrial fibrillation, n (%)	19 (8.4%)
COPD, n (%)	22 (9.8%)
CAD, n (%)	26 (11.6%)
Previous PE, n (%)	20 (8.9%)
DVT, n (%)	150 (66.7%)
Possible secondary causes, n (%)	
Malignancy	23 (10.2%)
Orthopedic fractures	17 (7.6%)
History of stroke	9 (4%)
Postoperative status	95 (42.2%)
Pulmonary infarction, n (%)	58 (23%)
Pleural effusion, n (%)	36 (16.1%)

ART	
Age (years)	62(50-73)
Male gender, n (%)	32 (57.1%)
Diabetes mellitus, n (%)	15 (26.8%)
Hipertension, n (%)	24 (42.9%)
Atrial fibrillation, n (%)	3 (5.4%)
Syncope , n (%)	25(44.6%)
COPD, n (%)	5 (8.9%)
CAD, n (%)	11 (19.6%)
Previous PE, n (%)	7 (12.5%)
DVT n (%)	37 (66.1%)
Possible secondary causes, n (%)	
Malignancy	15 (26.8%)
Ortopedic fracture	7 (12.5%)
History of stroke	6 (10.7%)
Postoperative status	17 (30.4%)
Thrombophilia	2 (3.6%)
Immobility	3 (55.4%)
Pulmonary infarction, n (%)	5 (16.7%)
Pleural effusion, n (%)	6 (20%)



Changes in hemodynamic, echocardiographic, and CT angiographic parameters after USAT-EKOS

	Before USAT	After USAT	Mean change, %95 CI,	P value
PASP-catheter (mm Hg)	55.7±15.2	40.7±12.6	14.9 (13.1, 16.8)	<0.001
PAMP-catheter (mm Hg)	30.5±8.3	22.7±7.5	7.7 (6.7, 8.7)	<0.001
PADP-catheter (mm Hg)	17.1±7.0	12.7±5.6	4.4 (3.6, 5.2)	<0.001
RV/LV ratio	1.2±0.19	0.92±0.11	0.3 (0.26, 0.32)	<0.001
RA/LA ratio	1.35±0.25	1.14±0.21	0.21 (0.18, 0.24)	<0.001
PASP-Echo (mm Hg)	55.5±12.3	36.0±9.4	19.5 (17.7, 21.3)	<0.001
TAPSE (cm)	1.79±0.4	2.3±0.4	0.48 (-0.54, -0.42)	<0.001
ST (cm/sec)	10.7±2.3	14.1±2.3	3.35 (-3.93, -2.78)	<0.001
Qanadli score	24.6±6.0	9.6±5.7	15.0 (14.2, 15.8)	<0.001
Main PA diameter, mm	31.1±4.1	28.0±4.6	3.04 (2.60, 3.48)	<0.001
Left PA diameter, mm	23.2±3.0	21.3±3.3	1.86 (1.47, 2.25)	<0.001
Right PA, diameter, mm	23.7±3.5	21.8±3.5	1.91 (1.55, 2.21)	<0.001

Conclusions:

This 10-year single-centre experience confirms that USAT, ART, and low-dose intravenous fibrinolytics, are effective and safe in managing high-and intermediate-high-risk PE. These modalities offer rapid hemodynamic improvement with low complication rates, supporting their use within a multidisciplinary PERT approach.

Conflict of interest: None to declare