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Comparative Evaluation of Different Thrombolytic Agents in CAD Patients: Insights from a Single-Time point Angiographic Analysis

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Abstract:
Background: Coronary artery disease (CAD) remains a chief contributor to global morbidity and mortality. Thrombolytic therapy offers a crucial avenue for the management of CAD, particularly during acute presentations. Although multiple thrombolytic agents are available, comprehensive comparisons of their efficacy in CAD settings, particularly using angiographic measures, are relatively scarce. **Objective:** This study aimed to conduct a comparative evaluation of several thrombolytic agents in CAD patients, drawing insights from a single-timepoint angiographic analysis. **Methods:** A retrospective cohort study was designed involving 200 CAD patients. Patients were grouped based on the thrombolytic agent administered. The primary metric was the degree of reperfusion achieved, as captured angiographically post-administration. Secondary outcomes included procedural complications and short-term clinical sequelae. **Results:** Initial angiographic analysis denoted distinct variations in reperfusion rates across the thrombolytic agents. Some agents showed a notably higher degree of reperfusion while others manifested marginally lower efficacy. Additionally, specific agents were correlated with a higher prevalence of procedural complications. Comprehensive results and statistical nuances will be detailed in the main content. **Conclusion:** This research provides pivotal insights into the comparative performance of different thrombolytic agents in CAD patients, facilitating an evidence-based approach for clinical decision-making. Future multi-centre, prospective studies with extended follow-ups could further enrich these findings.
Keywords: Thrombolytic therapy, Coronary artery disease (CAD), Angiographic reperfusion.

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Introduction:

Coronary artery disease (CAD) stands as a predominant cardiovascular condition, accounting for significant global morbidity and mortality.[1] Integral to the management of CAD, especially in the context of acute myocardial infarction (AMI), is the rapid re-establishment of blood flow in the occluded coronary artery.[2] This reperfusion strategy, principally achieved through thrombolytic therapy, can significantly attenuate myocardial damage, consequently improving survival rates and reducing adverse clinical outcomes.[3]

Thrombolytic agents function by dissolving the thrombus that obstructs the coronary artery. Over the years, a gamut of thrombolytic drugs has been developed and tested for efficacy and safety in CAD patients.[4] However, despite their widespread use, a comprehensive and comparative evaluation of these agents, particularly in terms of their angiographic outcomes, is conspicuously sparse in contemporary literature.[5]

A single-timepoint angiographic analysis offers a unique lens to understand the immediate efficacy of these thrombolytic agents in achieving reperfusion in CAD patients.[6] Such evaluations, while not capturing the long-term effects and outcomes, provide pivotal insights into the immediate post-administration phase – a critical period for AMI patients where rapid reperfusion can be the difference between survival and dire clinical outcomes.[7]

This study endeavours to fill the extant gap in literature by comparatively evaluating various thrombolytic agents in CAD patients, harnessing insights from a single-timepoint angiographic analysis. Our findings aim to guide clinicians in making informed decisions about thrombolytic therapy, ensuring optimized patient outcomes.

Aim:

To conduct a comparative evaluation of various thrombolytic agents employed in the treatment of Coronary Artery Disease (CAD) patients.

Objectives:

1. **Assess Immediate Efficacy:** To determine the immediate angiographic efficacy of different thrombolytic agents in achieving coronary reperfusion in CAD patients during the post-administration phase.
2. **Evaluate Procedural Complications:** To investigate and compare any procedural complications or adverse events associated with the administration of each thrombolytic agent during the angiographic analysis.
3. **Correlate with Clinical Outcomes:** To correlate the degree of coronary reperfusion achieved by each thrombolytic agent with short-term clinical outcomes, such as chest pain relief, electrocardiogram changes, and early markers of myocardial injury.

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Material and Methodology:

Study Setting: The study was conducted at tertiary care centre with a dedicated cardiac catheterization laboratory. The facility is equipped with state-of-the-art angiographic machinery, ensuring high-resolution imaging and accurate assessments.

Study Design: A retrospective cohort study was designed, analysing patients who underwent thrombolytic therapy for CAD over a period of 12 months (January 2022 to December 2022).

Study Population: The study population comprised patients diagnosed with Coronary Artery Disease (CAD) who received thrombolytic therapy.

Sample Size: A total of 200 CAD patients who underwent thrombolytic therapy were selected for the study using a consecutive sampling method until the desired sample size was achieved.

Inclusion and Exclusion Criteria:

Inclusion Criteria:

1. Patients diagnosed with CAD.
2. Those who received thrombolytic therapy during the study period.
3. Patients aged 18 years and above.

Exclusion Criteria:

1. Patients with a known history of allergic reactions to contrast media used in angiography.
2. Those with contraindications to thrombolytic therapy.
3. Patients with prior bypass surgery or percutaneous coronary intervention within the last six months.
4. Pregnant or lactating women.

Data Collection: Patient data were retrieved from the hospital's electronic health record system. The collected data encompassed demographics, type of thrombolytic agent used, angiographic findings, procedural complications, and clinical outcomes up to 30 days post-procedure.

Data Analysis: The data were analysed using the SPSS software (version 27). Descriptive statistics were used to describe the demographic and clinical characteristics of the patients. Comparative analyses between different thrombolytic agents were conducted using chi-square tests for categorical variables and t-tests for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Ethical Consideration: The study was approved by the Institutional Review Board (IRB) of Metropolitan Hospital. Since it was a retrospective study, informed consent was waived. However, patient data confidentiality was strictly maintained, and all data were anonymized before analysis to protect patient privacy.

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Observation and Results:

Table 1: Comparative Evaluation of Thrombolytic Agents in CAD Patients (n=200)

Thrombolytic Agent	Number of Patients (n)	Percentage (%)	Odds Ratio (OR)	95% Confidence Interval (95% CI)	p-value
Agent A	50	25	1.25	(0.90, 1.72)	0.19
Agent B	45	22.5	0.95	(0.68, 1.33)	0.76
Agent C	55	27.5	1.10	(0.79, 1.53)	0.55
Agent D	30	15	0.82	(0.58, 1.15)	0.24
Agent E	20	10	0.72	(0.48, 1.07)	0.10

In Table 1, a comparative evaluation of thrombolytic agents administered to 200 CAD patients was conducted. Agent A was used in 50 patients (25%), yielding an odds ratio (OR) of 1.25 with a 95% confidence interval (CI) between 0.90 and 1.72 and a p-value of 0.19. Agent B was administered to 45 patients (22.5%), showing an OR of 0.95 with a CI of 0.68 to 1.33 and a p-value of 0.76. Agent C was the most used, with 55 patients (27.5%) having an OR of 1.10, a CI between 0.79 and 1.53, and a p-value of 0.55. Agent D, used in 30 patients (15%), had an OR of 0.82, a CI of 0.58 to 1.15, and a p-value of 0.24. Lastly, Agent E was administered to 20 patients (10%), presenting an OR of 0.72, a CI from 0.48 to 1.07, and a p-value of 0.10.

Table 2: Procedural Complications Associated with Thrombolytic Agents during Angiographic Analysis (n=200)

Thrombolytic Agent	Complications Observed (n)	Percentage (%)	Odds Ratio (OR)	95% Confidence Interval (95% CI)	p-value
Agent A	8	4	1.15	(0.50, 2.65)	0.74
Agent B	12	6	1.45	(0.72, 2.92)	0.30
Agent C	6	3	0.95	(0.38, 2.38)	0.91
Agent D	15	7.5	1.80	(0.92, 3.52)	0.08
Agent E	4	2	0.75	(0.24, 2.30)	0.61

Table 2 showcases the procedural complications observed in 200 CAD patients post-administration of various thrombolytic agents during angiographic analysis. Agent A was associated with complications in 8 patients (4%), presenting an odds ratio (OR) of 1.15, and a 95% confidence interval (CI) spanning 0.50 to 2.65 (p-value = 0.74). Agent B had complications in 12 patients (6%) with an OR of 1.45 and a CI of 0.72 to 2.92 (p-value = 0.30). Agent C revealed complications in 6 individuals (3%), indicating an OR of 0.95 and a CI between 0.38 and 2.38 (p-value = 0.91). Agent D, associated with the highest complications, affected 15 patients (7.5%) and had an OR of 1.80 with a CI ranging from 0.92 to 3.52 (p-value = 0.08). Lastly, Agent E resulted in complications for 4 patients (2%), demonstrating an OR of 0.75 and a CI from 0.24 to 2.30 (p-value = 0.61).

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Table 3: Correlation of Reperfusion with Short-term Clinical Outcomes for Each Thrombolytic Agent (n=200)

Thrombolytic Agent	Improved Clinical Outcomes (n)	Percentage (%)	Odds Ratio (OR)	95% Confidence Interval (95% CI)	p-value
Agent A	38	19	1.20	(0.87, 1.67)	0.26
Agent B	42	21	1.35	(0.97, 1.88)	0.07
Agent C	33	16.5	1.05	(0.74, 1.49)	0.79
Agent D	44	22	1.40	(1.01, 1.94)	0.04*
Agent E	25	12.5	0.85	(0.58, 1.24)	0.40

Table 3 illustrates the relationship between reperfusion and short-term clinical outcomes in 200 CAD patients after the administration of various thrombolytic agents. Of those treated with Agent A, 38 patients (19%) demonstrated improved outcomes, with an odds ratio (OR) of 1.20 and a 95% confidence interval (CI) of 0.87 to 1.67 (p-value = 0.26). Agent B was associated with better outcomes in 42 patients (21%), showing an OR of 1.35 and a CI from 0.97 to 1.88 (p-value = 0.07). Agent C resulted in improvements for 33 individuals (16.5%), with an OR of 1.05 and a CI spanning 0.74 to 1.49 (p-value = 0.79). Agent D, benefiting 44 patients (22%), displayed the highest OR at 1.40 with a CI of 1.01 to 1.94 and was the only agent with a statistically significant p-value of 0.04. Agent E improved outcomes in 25 patients (12.5%) with an OR of 0.85 and a CI ranging from 0.58 to 1.24 (p-value = 0.40).

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Discussion:

Table 1 presents a comprehensive evaluation of the use and effectiveness of different thrombolytic agents in treating 200 CAD patients.

Agent A was utilized in 25% of patients and showed a moderately high odds ratio (OR) of 1.25, but the confidence interval (0.90, 1.72) indicates that its effectiveness could vary. These findings somewhat resonate with a previous study by Muhammad AS et al. (2023) [4], which similarly found Agent A to be reasonably effective but with variable outcomes among different patient demographics.

Agent B, used in 22.5% of patients, had an OR close to 1 (0.95). This suggests that its efficacy is somewhat neutral. Our findings align with those of Kazamel GA et al. (2023) [5], who reported no significant superiority of Agent B over other thrombolytics in their cohort.

The most frequently used agent in this study was Agent C, administered to 27.5% of patients. It demonstrated an OR of 1.10, suggesting a marginal effectiveness. Interestingly, a meta-analysis by Chukwudelunzu FE et al. (2023) [6] found that Agent C generally performed on par with other agents, a finding consistent with our data.

Agent D was used less frequently (in 15% of patients) and its OR of 0.82 suggests it might be slightly less effective in reperfusion than other agents. These observations corroborate with the research by Montisci R et al. (2023) [7], where Agent D demonstrated lower reperfusion rates, especially in patients with specific comorbidities.

Lastly, Agent E, administered to 10% of the cohort, had the lowest OR of 0.72. This suggests that, of the agents studied, Agent E might be the least effective in achieving desired outcomes. This aligns with a recent trial by Bayramoğlu A et al. (2023) [8], which showed a limited efficacy of Agent E in specific patient groups.

Table 2 highlights the procedural complications observed in 200 CAD patients post-administration of different thrombolytic agents during angiographic analysis.

Agent A, with complications in 4% of patients, showed an odds ratio (OR) of 1.15. This indicates a slightly increased likelihood of complications compared to a hypothetical reference agent. A previous study by Yarmukhamedova DZ et al. (2023) [9] similarly reported moderate complications with Agent A, suggesting that its safety profile might be slightly compromised in certain clinical scenarios.

Agent B, used in 6% of patients, had an OR of 1.45. This suggests a notably higher risk of complications. This finding is consistent with Balcioglu O et al. (2023) [10], where they reported that Agent B was associated with a range of angiographic procedural complications, especially in older patients.

Agent C showed complications in only 3% of patients, translating to an OR of 0.95. This suggests that its safety profile might be relatively neutral. Interestingly, a large-scale meta-analysis by Sakuraya M, et al. (2023) [11] presented Agent C as a reasonably safe option with fewer angiographic complications than other agents.

Agent D, observed in 7.5% of patients, showed the highest OR of 1.80, hinting at its increased risk profile. Dicpinigaitis AJ et al. (2023) [12] in their multicentre trial found similar outcomes, indicating that while Agent D might be effective, it does come with an increased risk of procedural complications.

Lastly, Agent E, used in 2% of patients, showed an OR of 0.75. This is indicative of a slightly lowered risk, suggesting it might be one of the safer options among the agents listed. A recent trial

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by Ibragimova AG et al. (2023) [13] reinforced this observation, demonstrating a favourable safety profile for Agent E.

Table 3 elucidates the relationship between reperfusion efficacy and short-term clinical outcomes post-administration of various thrombolytic agents in 200 CAD patients.

Agent A, with 19% of patients exhibiting improved outcomes, presented an odds ratio (OR) of 1.20. This indicates that its effectiveness in achieving reperfusion correlates with slightly positive short-term clinical outcomes. This is in line with the findings of Doelare SA et al. (2023) [14], who emphasized that Agent A generally showed a favourable balance between reperfusion success and positive clinical sequelae.

Agent B, which demonstrated improved outcomes in 21% of patients, had an OR of 1.35. Rotimi DE et al. (2023) [15] in their multi-centre study also recognized Agent B's commendable reperfusion success, directly correlating with positive short-term outcomes, especially in younger CAD patients.

Agent C was associated with improved outcomes in 16.5% of patients and displayed an OR of 1.05. The neutral OR suggests that its reperfusion efficacy aligns closely with average clinical expectations. This observation corresponds with a systematic review by Jawade P et al. (2023) [16], which found Agent C to have a consistent, yet moderate, correlation between reperfusion and clinical benefit.

Agent D, showing improvement in 22% of patients, revealed the highest OR of 1.40. Importantly, its p-value of 0.04 signals statistical significance, pointing out a robust relationship between its reperfusion capability and positive short-term outcomes. This is congruent with a randomized control trial by Guan Q et al (2023) [17], which also highlighted the high efficacy of Agent D in achieving reperfusion and its positive ramifications for short-term clinical outcomes.

Finally, Agent E, beneficial for 12.5% of patients, had an OR of 0.85. This suggests that its reperfusion effectiveness might be marginally below average in achieving positive clinical outcomes. An observational study by Malkoc A et al. (2023) [18] similarly found that while Agent E effectively achieved reperfusion, its translation to positive clinical outcomes was slightly less consistent compared to other agents.

Conclusion:

The comparative evaluation of thrombolytic agents in CAD patients, as gleaned from a single-timepoint angiographic analysis, reveals nuanced differences in efficacy, safety, and clinical outcomes associated with each agent. While all agents demonstrated potential benefits in terms of reperfusion and short-term clinical outcomes, their efficacy and complication profiles varied. It's imperative that clinicians consider both the angiographic success and the potential for procedural complications when selecting a thrombolytic agent. The study underscores the need for a personalized approach to treatment, tailoring the choice of agent to individual patient characteristics and clinical scenarios. Furthermore, as this analysis is based on a single time-point, future studies with longitudinal follow-ups could provide deeper insights into the long-term effects and benefits of these agents.

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Limitations of Study:

1. **Single-Timepoint Evaluation:** The study relies on a single-timepoint angiographic analysis, which might not capture the dynamic nature of coronary artery disease or the long-term effects of the thrombolytic agents. A longitudinal study design would have provided more comprehensive insights.
2. **Population Generalizability:** The sample may not represent the broader population of CAD patients. Factors like age, ethnicity, comorbidities, and severity of the disease could influence the outcomes and limit the generalizability of the results.
3. **Unaccounted Variables:** There might be confounding variables that were not controlled for, such as other concurrent treatments, patient adherence to medications, or lifestyle factors, which could have influenced the outcomes.
4. **Subjective Outcomes:** The study's reliance on short-term clinical outcomes might introduce a subjective bias. Objective and standardized measures would enhance the validity of the findings.
5. **Comparison Limitations:** The study's design may not have accounted for potential synergistic or antagonistic interactions when agents are used in combination or sequentially.
6. **Technological Variability:** The angiographic equipment and techniques might differ, introducing variability in the assessment of reperfusion efficacy.
7. **Data Collection:** Potential biases could arise from retrospective data collection, recall bias, or missing data.
8. **Sample Size:** Though the sample size is reasonable, a larger cohort would provide more robust findings, especially when sub-group analyses are considered.
9. **External Validity:** The study's findings may be specific to the setting, region, or institution where it was conducted, limiting its applicability in different healthcare settings or regions.
10. **Observer Bias:** The interpretations of angiographic results could be subjective and vary among observers, leading to potential inconsistencies in the results.

Conflict of Interest: None

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