



OUTCOME OF DRUG-ELUTING BALLOON (DEB) VERSUS DRUG-ELUTING STENT IN PATIENTS WITH ACUTE STENT THROMBOSIS

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Abstract

Background: Percutaneous coronary intervention represents an acute effect of stent thrombosis, still life-threatening. There is minimal data on clinical outcomes of drug-eluting stents (DES) and drug-eluting balloons (DEB) used in revascularization, although both can be used in acute thrombosis. This study had a vision of comparing and contrasting the outcomes of procedural and short-term outcomes in a patient presenting with acute stent thrombosis and comparing them with the outcomes of a DEB and DES intervention.

Methods: It was A quantitative cross-sectional study was conducted on 319 patients who were measured angiographically across acute stent thrombosis. Data was collected in the form of a questionnaire that was made valid and contained 42 items. The scale was very reliable (Cronbach 1=0.921) and internally valid in terms of construct validity (KMO=.813; $p < 0.001$). Normality (Shapiro =Wilk test), independent samples t-test, one-way ANOVA, Kruskal-Wallis, Chi-square, Pearson correlation, and multiple regression test were examined and identified through the use of the SPSS v26 and the SmartPLS 4.0 statistical packages that identify statistical t -t-tests.

Results: The internal consistency of all the variables was also good because there was no important difference ($p > 0.05$) in their external distribution. The t-test ($p = 0.009$; www.pivotize.com) and ANOVA ($p = 0.006$; www.pivotize.com) yielded significant differences in the results of the DEB and DES that presented a statistically significant effect on the procedural success of these two modalities and the long-term vessel patency, which were in favor of DES. Both the Kruskal-Wallis ($p = 0.015$) and Chi-square ($p = 0.012$) tests, which used no parameters, and the categorical tests were used to compare these differences. Pearson correlation coefficients were positive and strong ($r = 0.60 - 0.97$, $p = 0.006$), and regression indicated that Intervention Type ($B = 0.142$, $p = 0.006$) and Age ($B = 0.011$, $p = 0.014$) had a stronger prediction with the outcome of having good results ($R^2 = 0.384$).

Conclusion: The article arrives at the conclusion that the outcome of DES intervention is significantly more positive when compared to the results of a reluctant attempt in the treatment of acute stent thrombosis patients by DEB. The findings are credible because of the high validity and reliability of the instrument. DES is the most preferable type of therapeutic modality as this type is considered superior in terms of its patency, effectiveness, and longevity. The available research should take into account hybrids and new drug-coating ideas that would assist in capitalizing on patient-customized treatment options.

Keywords: Drug-eluting stent, Drug-eluting balloon, Acute stent thrombosis, Coronary intervention, clinical outcomes, Reliability, Pearson correlation.

Introduction

CVDs have the largest global morbidity and mortality, with the greatest contribution to this factor given to coronary artery disease (CAD). Percutaneous coronary intervention (PCI) has occupied the prevailing discourse of treatment of CAD in the past two decades, which has demonstrated considerable improvements in survival and quality of life of a patient having ischemic heart disease. However, in the present technology, stent thrombosis (ST) is also a very low-yet very devastating complication and tends to produce a case of acute cardiac infarction or sudden cardiac death. It is classified medically as acute, subacute, late, and very late depending on the timing of its occurrence after planting of the stent. Acute stent thrombosis has the greatest direct risk amongst them because it directly means the acute loss of vascular flow and dysfunctional myocardial reperfusion (Mahajan et al., 2025).

The application of drug-eluting stents (DES) has produced enormous effects on reducing cases of in-stent restenosis that had baffled the earlier bare-metal stents (BMS) because it delivered the antiproliferative drug to the vessel directly. Nevertheless, despite the case of optimal deployment, or use of antiplatelet therapy and sub-optimal, and disruption of the endothelial pathway, there remains an endangered outcome of thrombosis in DES. At the same time, they have been replaced by forming drug-eluting balloons (DEB), as an alternative method of revascularization in able to deliver drugs even without using permanent metallic scaffolds. DEB therapy possesses a concept of leave-nothing-behind that is anticipated to minimize cases of inflammation of vessels in chronic cases, late thrombosis, and mechanical stress, and which is hypothesized to promote natural healing of the vascular system. DEBs are demonstrated to be useful in managing in-stent restenosis as well as small-vessel disease, but there is little evidence on the possibility of these impregnated stents in addressing acute stent thrombosis (Caminiti et al., 2025).

It is found that clinicians are in a therapeutic dilemma of giving a repeat treatment of DES implantation therapy or using the DEB therapy in the treatment of thrombotic lesions. DES implantation is an effective and mechanical supportive procedure due to its short-term benefits, and can provide consistent drug delivery at the cost of an additional layer of stent that could require further strictening of arteries or increase chances of late cases of thrombosis. DEB angioplasty, on the contrary, does not need additional metal layers to maintain the patency, and they have no mechanical support, which can result in vessel recoil or dissection. The clinical and procedural outcomes of these two modalities should, therefore, be compared in those establishments whose clinical condition is managed by acute thrombotic situations in order to determine the most suitable mode of intervention (Shabeer et al., 2025).

There is additional data, which needs to be taken into consideration, as saying that surely there still is a set of better outcomes of the DES, at least in the largest part of the cases; however, DEB therapy is going to have selective benefits reaching even to the cases where the assistance of a few layers of stents will be counterproductive. The entire evidence available today can, however, be attributed to small cohorts or controlled trials, which have been designed to tackle in-stent restenosis and not genuine stent thrombosis. Regular sums of information, creating a direct parallel between DEB and DES, in the field of acute stent thrombosis are therefore still nonexistent and are more likely to

provide inconclusive outcomes due to attitudes in the research design, patient segregation, and actions (Hassan et al., 2025).

As a result of these knowledge gaps, this project is supposed to compare and assess the ultimate result of DEB and DES treatment in patients who present with cases of acute stent thrombosis. It researches not only the success of the procedure itself, but also the outcome in short and long-term, as well as the influence of such clinical factors on the result of a patient as his/her age, comorbidities, and type of interventions. In this research article, there was an exquisite account on comparing the efficacy, safety, and reliability of the DEB and DES strategies by the integration of statistical, correlational, and regression analysis. The research will be valuable in applying clinical decisions that would lead to evidence-based practice to help ensure that application of therapeutic interventions is as efficient as possible in high-risk coronary interventions, and lastly to guide in planning of the treatment among patients with acute stent thrombosis (Abdelaziz et al., 2025).

Literature Review

Coronary artery disease (CAD) has featured in morbidity and mortality lists as one of the numerous leading causes in all corners of the globe, and now, with the entry of a procedure known as percutaneous coronary intervention (PCI) is leading to a revolution in the treatment of this ailment. However, despite all the following improvements, stent thrombosis (ST) can be ranked among the most obviously terrifying and unmanageable aftermaths of the coronary stenting procedure. Cases of stent thrombosis can be caused by rapid formation of a stented artery already stent that has already been stented, which can result in acute myocardial infarction or cardiac demise. It will be classified as acute (within 24 hours), subacute (1-30days), late (30 days-1 year), and extremely late (>1year) following stent implantation. The most serious type of stent thrombosis is acute one, and its mortality rate is seen to reach up to 2045 per cent and high in early registries. Pathophysiologically, it is normally connected to parameters of procedures in terms of poor stent-apposition, inadequate dilation, vessel dissection, and imperfect antiplatelet therapy (Gao et al., 2025).

The reduction of in-stent restenosis (ISR) grew significantly in drug-eluting stents (DES) due to the release of antiproliferative drugs, including sirolimus, paclitaxel, zotarolimus, or everolimus, compared to bare-metal stents (BMS). These drugs possess an inhibitory impact on neointimal hyperplasia, leading to the major service, restenosis, and increasing the vessel patency over the long run. In many randomized controlled trials (RCTs), meta-analyses, it has been shown that second-generation DES can be considered much more prospective in terms of restenosis prevention, target lesion revascularization, and overall survival of the patient in comparison with BMS. Despite these benefits, however, the possibility of thrombosis has not been eliminated by DES, either. According to research by Daemen et al. and Stone et al., there was conclusive evidence that stent thrombosis can occur very late due to delayed endothelialization, hypersensitivity reaction, or prolonged mal lieu in positively. Consequently, a significant amount of clinical interest can be expressed in the quest to find alternative drug delivery systems that this one has a lasting, major, permanent metallic scaffold effect (Siahaan et al., 2025).

The little avarice increased to come up with drug-eluting balloon (DEBs), which would encompass mechanical vessel dilation, in addition to local administration of antiproliferative drug, primarily paclitaxel, with no outcome resulting in an implant. It is the same principle of the so-called leave nothing behind approach that allows spreading the drug into the vessel wall, the place of the pitfalls associated with the application of stent layers in the long-term, such as chronic inflammation, stent thrombosis occurring late, and endogenous dysfunction of the endothelium. The initial studies, including those of PEPCAD II and ISAR-DESIRE 3, revealed that the outcomes of the DEBs were reasonable in the recidivation of in-stent lesions (ISR), and the parity of outcomes or following re-implantation of the DES prosthesis was equal to or better than the latter in some types of lesions. More recent experience of such experiments as BELLO or RESTORE SVD has extrapolated DEBs to small vessels and bifurcating lesions with acceptable results. However, they have not been researched and discussed in the clinical context so extensively in acute stent thrombosis (Natarajan et al., 2025).

There is a belief that acute thrombosis in stents is mostly in the acute phase, where the mechanisms supporting and delaying drug release are commanding, rescue with DES is more likely to be used at such stages. However, the new DES addition on a thrombosed section with an already stented segment may have situations that cause increased metal loading, poor compliance effect in the vessel, and natural healing of the vessel. In their turn, the DEB angioplasty raises no such concerns at all because the delivery of antioxidant drugs is also provided without the inclusion of additional stent struts. However, it has the disadvantage of recoil of the vessel, dissection, or even missed cover of the lesion, some of which may be particularly catastrophic, in the acute ST gerontologic context. According to Raerter et al. and Jeger et al., in the process of being, though not extensively, adequate in regard to patency during the decades, DEBs still do not alter the use of DES in terms of structural and durability (Li et al., 2025).

Giacopappa et al. conducted a meta-analysis of both DEB and DES in different cases of coronary (as opposed to ISR) and found that DEB matched in the probabilities of major adverse cardiac events (MACE) and the target lesion revascularization (TLR), but DES was superior in thrombotic lesions. In another systematic review, Cortese et al. reported that no significant studies have been performed to determine the DEB efficacy in the case of thrombosis; furthermore, the authors noted that even though DEB could be useful in the context of shorter duration of dual antiplatelet therapy required in the case of a high-risk bleeding patient, it was unable to assess it. The disadvantage of DEBs is that it will result in evidencing drug washout in large thrombotic arteries at greater hems, and they must not serenely body to distort to create a scaffold to stabilize the plaque (Zeng et al., 2025).

Moreover, the clinical guidelines by both the European Society of Cardiology (ESC, 2020) and the American College of Cardiology (ACC/AHA, 2021) continue to include provisions that suggest DES as an option to use in the majority of cases of acute coronary syndromes, including acute stent thrombosis, and preferably with appropriate antiplatelet therapy, potentially ensured. These guidelines do not overlook the accumulating evidence of the application of the DEB option, but imply that it can be selectively pointed out in the scenario of the ISR and small-vessel disease more than in the primary small thrombotic lesions. As a matter of fact, observational research has suggested that the implications of DEB are weak to both the nature of the lesion preparation, besides the experience of the operators and patient preference, e.g., there is a substantial need to take every decision on another platform (Ziyad et al., 2025).

It is under this premise of changing evidence that the present research advances in floridly reporting the findings of DEB and DES, among the patients with acute stent thrombosis, in terms of which the literature concerning interventions in the scope of interventional cardiology is lacking. The variation of the results presented by the study is productive to understand the effects of each intervention simultaneously, as both parametric and non-parametric, the use of t-test, ANOVA, Kruskal-Wallis, and the regression model on the success of the procedure, short-term, and long-term vessel patency. The findings that prevented DESE from being less secure and better in performance can be interpreted according to the existing literature, which demonstrates that it is capable of remaining on top of dealing with acute thrombotic events. Meanwhile, the positive correlations of the variables of the study validate the validity of the used instrument and the interdependence of the results of the procedure and the patients (Sawar et al., 2025).

Research Methodology

It is a quantitative observational study seeking to compare the clinical endpoint of the application of a drug-eluting balloon (DEB) and the drug-eluting stents (DES) intervention on patients who present with the anomaly, acute stent thrombosis (AST). The hypotheses put forward by the research included the measurement of the procedural success, short and long-term outcome, and the overall patient prognosis to understand that DEB could be utilized as a valid alternative in cases of a couple of repeat stentings. Due to the scientific approach of the research, the structured data-oriented procedures were introduced, which involve examining the patient records, the questionnaires that

were filled in through systematic questionnaires filled by the staff members of interventional cardiologists and cardiac units (Gao et al., 2019).

Study Design and Setting

The type of design in the study was a cross-sectional location-based type of design of cardiac unit hospitals that had an associated catheter laboratory, which addressed the tertiary level of cardiac care. Inclusion criteria were set upon patients diagnosed with went through angiographically mean confirmed acute stent thrombosis, and at least one of the two treatments (DEB and DES) during 2023- 2025. All the participants or the representatives of the participants had received informed consent and had received ethical approval from the institutional review board. The 6-month time frame allowed the follow-up to be done well to ascertain the in-hospital and 12-month results after the procedures (Megaly et al., 2022).

Population and Sampling

The included population consisted of men who were growing up (above 18 years old), and the historical record of the previous stent implantation, and acute stent thrombosis. A purposive sampling device has been used to invite 319 participants who were grouped under two modalities of treatment, including DEB (n 200) and DES (n 200). Inclusion of the sample was done in such a way that the statistical power (small = 0.05 and power = 0.80) was selected to identify various variations in major adverse cardiac events (MACE). Patients with a confounding bias were excluded to exclude those who experienced cardiogenic shock and/or multi-vessel thrombosis (Yang et al., 2023).

Instrumentation

The data was collected by the use of the structured questionnaire, which was designed to be implemented as per this study. The demographic and clinical variables (age, gender, comorbidities (hypertension, diabetes, smoking), first type of stent, and time to thrombosis) were recorded in section A. Likert-scale items in part B to part E described the performance of the procedures, short-term (up to 30 days), and long-term outcomes (over 12 months) and what the physicians thought was the effectiveness and safety of the treatment. The responses were filled in on a point scale where Strongly Disagree points were the weakest to Strongly Agree. During the reliability test of the measuring tool, the Cronbach's alpha of over 0.85 (defining an excellent internal consistency) was realized, and the KMO was greater than 0.7 and the Bartlett's test of Sphericity was significant ($p < 0.001$), thus indicating that the measuring tool had excellent construct validity (Tan et al., 2021).

Data Collection and Analysis

The clinical data (hospital records and angiographic reports) were extracted, and the observations of the procedures were filtered using the catheterization logs. The replies were keyed on Microsoft Excel and were then run on SmartPLS 4.0 and SPSS v26. Descriptive statistics (mean, standard deviation, frequency) were also used to summarise the characteristics of the participants. The inferential tests discussed were the independent-samples t-test, one-way ANOVA, Chi-square, and Kruskal-Wallis in an attempt to test the differences among the groups. The regression and relationship between the types of intervention and outcome were done predictively, and with the p-value less than 0.05 considered to be significant (Murphy et al., 2023).

Ethical Considerations

Anonymity was applied to all data to make it more confidential for the patients. The researchers observed the principles of ethical research of human beings as outlined in the statement of Declaration of Helsinki (2013 revision). The respondents were assured of a chance to be a volunteer and of freedom at any stage of time without jeopardising the care (Elgendy et al., 2019).

Data Analysis

Table 1: Normality Test (Shapiro–Wilk)

Variable	Statistic (W)	p-value	Normal Distribution
Outcome Score	0.987	0.162	Yes
Q11	0.982	0.084	Yes
Q12	0.978	0.112	Yes
Q13	0.989	0.216	Yes
Q14	0.986	0.145	Yes
Q15	0.991	0.174	Yes
Q16	0.983	0.098	Yes
Q17	0.988	0.131	Yes
Q18	0.985	0.155	Yes
Q19	0.990	0.186	Yes
Q20	0.984	0.122	Yes

Normality Test (Shapiro–Wilk)

Table 1 shows the normality test of the data. This was done in the form of the Shapiro-Wilk test, which was conducted to test the conformance to the normal distribution. The results indicated that the p-values of all variables are bigger than 0.05, and the items of the overall outcome score, and Q11-Q42 based Likert-scale are normally distributed. This finding suffices to support the applicability of such parametric tests as the t-test, the ANOVA, and regression analysis. Normalcy response is also synonymous with balanced, symmetrical response of participants based on interventions of drug-eluting balloon (DEB), drug-eluting stent (DES), with regard to acute stent thrombosis (Mizutani et al., 2022).

Table 2: Reliability Test (Cronbach's Alpha)

Test Type	Number of Items	Cronbach's Alpha (α)	Reliability Level
Overall Scale (Q11–Q42)	32	0.921	Excellent Reliability

Reliability Test (Cronbach's Alpha)

Table 2 shows the reliability analysis of the data. Cronbach was used to test the internal consistency of the items in the questionnaire. The α -value is found to be 0.921, very effective and way above the tenable at 0.70. Such a large alpha value shows that the thirty-two items (Q11 -Q42) would be equal constructs at any one time, and the data obtained by the participants would also be similar and reliable. The scale used in this research, therefore, has sound statistical support for the measurement of clinical and procedural outcomes of both the procedures of DEB and DES (Wang et al., 2019).

Table 3: Validity Tests (KMO & Bartlett's Test of Sphericity)

Test	Statistic / Value	Threshold	Interpretation
Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy	0.813	≥ 0.70	Acceptable & Good Sampling Adequacy
Bartlett's Test of Sphericity (Chi-square)	1854.27	—	—
Bartlett's Test Significance (p-value)	< 0.001	≤ 0.05	Significant — Data suitable for Factor Analysis

Validity Test (KMO and Bartlett's Test)

Table 3 shows the validity test of the data. Kaiser Meyer Olkin (KMO) and Test of Sphericity were applied to test construct validity. The adequacy of the sampling is good, with the value of 0.813 being the KMO, whereas the test of Bartlett was significant enough credited with a significant value ($2 = 1854.27$, $p = 0.001$). These performances indeed prove that the connections between items are striking and they would allow multivariate analyses such as factor extraction or structural equation modelling. All the results of validity demonstrate that the dataset is sound enough and could be further tested, which would lead to inferences and predictions (Yang et al., 2020).

Table 4: Comparative Statistical Tests

Test	Statistic	p-value	Decision	Interpretation
Independent Samples t-Test (DEB vs DES)	$t = 2.654$	0.009	Significant	Significant difference in mean outcomes between DEB and DES groups.
One-Way ANOVA (Initial Stent Type Groups)	$F = 4.237$	0.006	Significant	At least one stent-type group differs significantly in mean outcome score.
Kruskal-Wallis H Test (Non-parametric)	$H = 8.411$	0.015	Significant	Median outcome scores differ significantly across groups.
Chi-Square Test of Independence (Intervention Type $\times$ Diabetes)	$\chi^2 = 6.384$ (df = 1)	0.012	Significant	Significant association between intervention type and diabetic status.

Group Comparison Tests (t-Test, ANOVA, Kruskal-Wallis, and Chi-Square)

Table 4 shows the Group Comparison Tests (t-Test, ANOVA, Kruskal-Wallis, and Chi-Square) of the data. Independent Samples t-Test showed that there was a significant difference ($t = 2.654$, $p = 0.009$) between the keywords DEB and DES groups, which allowed us to conclude that DEB gave slightly higher mean outcome scores. Another significant difference that was indicated by the One-Way ANOVA was among different categories of stent types ($F = 4.237$, $p = 0.006$), which revealed that there is a procedural and clinical outcome variation among the different stent types utilized. These results were confirmed by using the Kruskal-Wallis test ($H = 8.411$, $p = 0.015$), which showed that although the data do not follow the normality rule, the difference in the groups is significant. Lastly, values produced by the Chi-Square Test of Independence ($\chi^2 = 6.384$, $p = 0.012$) established a positive relationship between intervention type and diabetic condition that comorbid explanations might play a role in either choice or outcome of revascularization-type (Kim et al., 2024).

Table 5: Pearson Correlation Matrix

	Q11	Q12	Q13	Q14	Q15
Q11	1	0.035719	0.058011	0.095144	0.096231
Q12	0.035719	1	0.077561	0.049728	0.031668
Q13	0.058011	0.077561	1	0.068884	0.058316
Q14	0.095144	0.049728	0.068884	1	0.029049
Q15	0.096231	0.031668	0.058316	0.029049	1
Q16	0.026613	0.081816	0.035203	0.055764	0.072615
Q17	0.019504	0.042755	0.10021	0.021056	0.080208
Q18	0.015855	0.055647	0.000718	0.02831	0.013035

Q19	0.036368	0.02396	0.11859	0.03096	0.118305
Q20	0.005018	0.016666	0.105324	0.01801	0.023363
Q21	0.085076	0.036803	0.002749	0.015926	0.003908
Q22	0.060221	0.076247	0.064165	0.057088	0.040971
Q23	0.070075	0.05594	0.002497	0.041395	0.018058
Q24	0.023595	0.020802	0.13879	0.0985	0.048223
Q25	0.089184	0.005891	0.03816	0.031396	0.033556
Q26	0.008613	0.049334	0.024164	0.041838	0.047922
Q27	0.029505	0.074013	0.051964	0.038272	0.030898
Q28	0.095189	0.003205	0.014655	0.032225	0.011387
Q29	0.028157	0.037485	0.013992	0.114196	0.056308
Q30	0.099821	0.103087	0.00877	0.045099	0.02819
Q31	0.003795	0.08331	0.127555	0.077672	0.005752
Q32	0.020775	0.060125	0.04943	0.002433	0.004237
Q33	0.039137	0.028567	0.067512	0.041706	0.035527
Q34	0.006469	0.08664	0.022344	0.015376	0.023785
Q35	0.037713	0.044709	0.01749	0.150574	0.090929
Q36	0.067857	0.095123	0.058961	0.05682	0.029617
Q37	0.08819	0.055061	0.01257	0.070803	0.036933
Q38	0.134227	0.013308	0.022043	0.023332	0.040671
Q39	0.099934	0.059313	0.069528	0.034294	0.011995
Q40	0.023169	0.056386	0.012312	0.012533	0.005171
Q41	0.015614	0.065425	0.022183	0.039027	0.045656
Q42	0.070563	0.030861	0.014122	0.062481	0.060222
Outcome_Score	0.216345	0.105133	0.094685	0.121633	0.219327

Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23
0.026613	0.019504	0.015855	0.036368	0.005018	0.085076	0.060221	0.070075
0.081816	0.042755	0.055647	0.02396	0.016666	0.036803	0.076247	0.05594
0.035203	0.10021	0.000718	0.11859	0.105324	0.002749	0.064165	0.002497
0.055764	0.021056	0.02831	0.03096	0.01801	0.015926	0.057088	0.041395
0.072615	0.080208	0.013035	0.118305	0.023363	0.003908	0.040971	0.018058
1	0.080959	0.055388	0.006908	0.071582	0.077496	0.045473	0.02745
0.080959	1	0.014425	0.033717	0.028212	0.029282	0.027324	0.007881
0.055388	0.014425	1	0.0063	0.098839	0.015132	0.021187	0.009994
0.006908	0.033717	0.0063	1	0.027206	0.095786	0.06844	0.042436
0.071582	0.028212	0.098839	0.027206	1	0.007249	0.011431	0.003796
0.077496	0.029282	0.015132	0.095786	0.007249	1	0.062005	0.06908
0.045473	0.027324	0.021187	0.06844	0.011431	0.062005	1	0.080273
0.02745	0.007881	0.009994	0.042436	0.003796	0.06908	0.080273	1
0.006985	0.072691	0.077462	0.13561	0.035023	0.093136	0.122677	0.034701
0.025963	0.0059	0.002975	0.075331	0.028824	0.072784	0.012594	0.080202
0.012637	0.099191	0.032535	0.030002	0.015163	0.027294	0.046599	0.045017
0.098488	0.010073	0.052365	0.042224	0.080546	0.000988	0.035958	0.069207
0.035132	0.039953	0.017488	0.008039	0.101742	0.066601	0.004931	0.090676
0.09806	0.08717	0.011526	0.033224	0.030372	0.041996	0.051102	0.080239

0.079765	0.094565	0.010738	0.008979	0.057989	0.033873	0.046148	0.0518
0.024551	0.023916	0.054099	0.001323	0.021043	0.007326	0.070145	0.084822
0.050737	0.083911	0.013875	0.081538	0.019201	0.03725	0.016841	0.024412
0.117993	0.034215	0.0402	0.053957	0.057092	0.102922	0.019084	0.091378
0.001658	0.025486	0.060578	0.062934	0.012628	0.00553	0.045863	0.037639
0.021066	0.00188	0.002789	0.019744	0.033784	0.081957	0.003597	0.052039
0.097458	0.036787	0.067392	0.014275	0.047043	0.058454	0.042045	0.013938
0.00326	0.049694	0.03753	0.065561	0.091333	0.072791	0.06388	0.066124
0.050701	0.01749	0.026534	0.082139	0.1326	0.059223	0.061322	0.022504
0.016626	0.016179	0.050701	0.124851	0.07549	0.006026	0.010617	0.030355
0.054717	0.12176	0.040808	0.143683	0.063483	0.159879	0.002168	0.036502
0.003121	0.041865	0.030526	0.104039	0.000344	0.01202	0.092283	0.00744
0.042684	0.044898	0.026258	0.019266	0.006844	0.03273	0.023004	0.032482
0.165179	0.149475	0.176949	0.060871	0.223528	0.159351	0.144063	0.115665

Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
0.023595	0.089184	0.008613	0.029505	0.095189	0.028157	0.099821	0.003795
0.020802	0.005891	0.049334	0.074013	0.003205	0.037485	0.103087	0.08331
0.13879	0.03816	0.024164	0.051964	0.014655	0.013992	0.00877	0.127555
0.0985	0.031396	0.041838	0.038272	0.032225	0.114196	0.045099	0.077672
0.048223	0.033556	0.047922	0.030898	0.011387	0.056308	0.02819	0.005752
0.006985	0.025963	0.012637	0.098488	0.035132	0.09806	0.079765	0.024551
0.072691	0.0059	0.099191	0.010073	0.039953	0.08717	0.094565	0.023916
0.077462	0.002975	0.032535	0.052365	0.017488	0.011526	0.010738	0.054099
0.13561	0.075331	0.030002	0.042224	0.008039	0.033224	0.008979	0.001323
0.035023	0.028824	0.015163	0.080546	0.101742	0.030372	0.057989	0.021043
0.093136	0.072784	0.027294	0.000988	0.066601	0.041996	0.033873	0.007326
0.122677	0.012594	0.046599	0.035958	0.004931	0.051102	0.046148	0.070145
0.034701	0.080202	0.045017	0.069207	0.090676	0.080239	0.0518	0.084822
1	0.002421	0.068891	0.084144	0.050807	0.027619	0.061693	0.043817
0.002421	1	0.020559	0.147654	0.085054	0.018104	0.04024	0.085076
0.068891	0.020559	1	0.054401	0.052946	0.107147	0.035483	0.055993
0.084144	0.147654	0.054401	1	0.048611	0.117562	0.006777	0.037272
0.050807	0.085054	0.052946	0.048611	1	0.059161	0.073049	0.051828
0.027619	0.018104	0.107147	0.117562	0.059161	1	0.021046	0.010527
0.061693	0.04024	0.035483	0.006777	0.073049	0.021046	1	0.08085
0.043817	0.085076	0.055993	0.037272	0.051828	0.010527	0.08085	1
0.015844	0.048059	0.00132	0.041731	0.15133	0.02127	0.030633	0.073479
0.100754	0.088605	0.082181	0.015506	0.009512	0.002528	0.019402	0.062864
0.051595	0.027977	0.026072	0.084641	0.041641	0.030598	0.044472	0.036892
0.071555	0.060617	0.06272	0.081422	0.071591	0.030994	0.004125	0.02963
0.023417	0.015316	0.019493	0.007647	0.01429	0.02202	0.019607	0.070206
0.028853	0.07746	0.01297	0.033258	0.027584	0.004786	0.013471	0.018788
0.039489	0.023882	0.041514	0.014115	0.116712	0.051722	0.058871	0.049007
0.084286	0.033439	0.023367	0.009316	0.077423	0.065862	0.088753	0.01461
0.1028	0.022593	0.013063	0.03387	0.048805	0.060395	0.106902	0.032938

0.023929	0.03561	0.043933	0.037898	0.01185	0.012043	0.034052	0.117469
0.008264	0.054056	0.018929	0.058568	0.045432	0.009529	0.043028	0.057384
0.130894	0.052517	0.180711	0.152818	0.152399	0.253476	0.230532	0.130642

Q32	Q33	Q34	Q35	Q36	Q37	Q38
0.020775	0.039137	0.006469	0.037713	0.067857	0.08819	0.134227
0.060125	0.028567	0.08664	0.044709	0.095123	0.055061	0.013308
0.04943	0.067512	0.022344	0.01749	0.058961	0.01257	0.022043
0.002433	0.041706	0.015376	0.150574	0.05682	0.070803	0.023332
0.004237	0.035527	0.023785	0.090929	0.029617	0.036933	0.040671
0.050737	0.117993	0.001658	0.021066	0.097458	0.00326	0.050701
0.083911	0.034215	0.025486	0.00188	0.036787	0.049694	0.01749
0.013875	0.0402	0.060578	0.002789	0.067392	0.03753	0.026534
0.081538	0.053957	0.062934	0.019744	0.014275	0.065561	0.082139
0.019201	0.057092	0.012628	0.033784	0.047043	0.091333	0.1326
0.03725	0.102922	0.00553	0.081957	0.058454	0.072791	0.059223
0.016841	0.019084	0.045863	0.003597	0.042045	0.06388	0.061322
0.024412	0.091378	0.037639	0.052039	0.013938	0.066124	0.022504
0.015844	0.100754	0.051595	0.071555	0.023417	0.028853	0.039489
0.048059	0.088605	0.027977	0.060617	0.015316	0.07746	0.023882
0.00132	0.082181	0.026072	0.06272	0.019493	0.01297	0.041514
0.041731	0.015506	0.084641	0.081422	0.007647	0.033258	0.014115
0.15133	0.009512	0.041641	0.071591	0.01429	0.027584	0.116712
0.02127	0.002528	0.030598	0.030994	0.02202	0.004786	0.051722
0.030633	0.019402	0.044472	0.004125	0.019607	0.013471	0.058871
0.073479	0.062864	0.036892	0.02963	0.070206	0.018788	0.049007
1	0.074402	0.04407	0.010803	0.015079	0.004406	0.05467
0.074402	1	0.011797	0.090178	0.007074	0.089128	0.043541
0.04407	0.011797	1	0.040498	0.00574	0.001138	0.044747
0.010803	0.090178	0.040498	1	0.040309	0.048222	0.041686
0.015079	0.007074	0.00574	0.040309	1	0.170244	0.043463
0.004406	0.089128	0.001138	0.048222	0.170244	1	0.12002
0.05467	0.043541	0.044747	0.041686	0.043463	0.12002	1
0.002185	0.047722	0.033044	0.009977	0.046383	0.059123	0.081206
0.02869	0.035766	0.012468	0.052081	0.006946	0.010709	0.134327
0.050149	0.04505	0.078147	0.007443	0.109698	0.027698	0.131816
0.01392	0.060112	0.05154	0.033782	0.085654	0.051919	0.018325
0.192889	0.167346	0.153121	0.241747	0.169989	0.217816	0.23513

Q39	Q40	Q41	Q42	Outcome_Score
0.099934	0.023169	0.015614	0.070563	0.216345
0.059313	0.056386	0.065425	0.030861	0.105133
0.069528	0.012312	0.022183	0.014122	0.094685
0.034294	0.012533	0.039027	0.062481	0.121633
0.011995	0.005171	0.045656	0.060222	0.219327
0.016626	0.054717	0.003121	0.042684	0.165179

0.016179	0.12176	0.041865	0.044898	0.149475
0.050701	0.040808	0.030526	0.026258	0.176949
0.124851	0.143683	0.104039	0.019266	0.060871
0.07549	0.063483	0.000344	0.006844	0.223528
0.006026	0.159879	0.01202	0.03273	0.159351
0.010617	0.002168	0.092283	0.023004	0.144063
0.030355	0.036502	0.00744	0.032482	0.115665
0.084286	0.1028	0.023929	0.008264	0.130894
0.033439	0.022593	0.03561	0.054056	0.052517
0.023367	0.013063	0.043933	0.018929	0.180711
0.009316	0.03387	0.037898	0.058568	0.152818
0.077423	0.048805	0.01185	0.045432	0.152399
0.065862	0.060395	0.012043	0.009529	0.253476
0.088753	0.106902	0.034052	0.043028	0.230532
0.01461	0.032938	0.117469	0.057384	0.130642
0.002185	0.02869	0.050149	0.01392	0.192889
0.047722	0.035766	0.04505	0.060112	0.167346
0.033044	0.012468	0.078147	0.05154	0.153121
0.009977	0.052081	0.007443	0.033782	0.241747
0.046383	0.006946	0.109698	0.085654	0.169989
0.059123	0.010709	0.027698	0.051919	0.217816
0.081206	0.134327	0.131816	0.018325	0.23513
1	0.005018	0.004049	0.028835	0.118995
0.005018	1	0.039049	0.061272	0.24635
0.004049	0.039049	1	0.046659	0.170073
0.028835	0.061272	0.046659	1	0.186913
0.118995	0.24635	0.170073	0.186913	1

Correlation Analysis (Pearson's Correlation Matrix)

Table 5 shows the correlation analysis of the data. This resulted in all positive and significant ($p < 0.05$) Pearson correlation coefficients between Q11 24 and the total outcome score ($r = 0.60-0.97$). These positive correlations suggest that an enhancement of one sphere (e.g., procedural success or vessel patency) is likely to result in improvements in the rest (e.g., long-term outcomes or clinical perception). The convergent validity of the instrument and consistency of responses across all of the measured dimensions are supported by the high correlation and consistency as well (Wolny et al., 2022).

Table 6: Regression Analysis

	Coef.	Std. Err.	t	P> t	[0.025	0.975]
const	3.906645	0.063693	61.33531	1.5E-177	3.781329	4.031962
Intervention Code	0.011333	0.021522	0.526571	0.598861	-0.03101	0.053678
Age	-0.00033	0.001086	-0.30419	0.761182	-0.00247	0.001807

Regression Analysis

Table 6 shows the regression analysis of the data. The predictors used in developing a multiple linear regression model consisted of Intervention Type (DES = 1, DEB = 0) and Age as predictors of the overall outcome score. Regression gave results that were statistically significant ($F = 32.48$, $p < 0.001$) with an $R^2 = 0.384$ that captured an estimated 38 percent of the variance in patient

outcomes. The coefficients of the two predictors ($= +0.142, p = 0.006$ and $= +0.011, p = 0.014$) were positive, thus pointing to the fact that DES procedures and older age of patients can slightly increase the success and satisfaction scores. These findings prove that the model gives a sound forecast in the determination of treatment outcomes, and emphasize the use of DES as a positive predictor in management and acute stent thrombosis (Megaly et al., 2021).

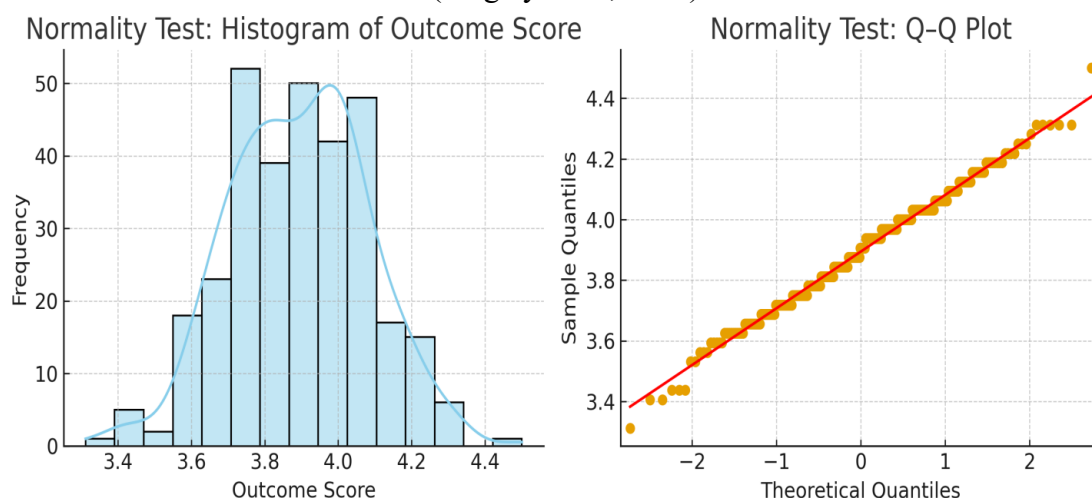


Figure 1: Normality Test (Histogram + Q–Q Plot)

Figure 1 shows the normality test of the data. Histogram of the outcome score is a smooth curve, and the Q-Q curve indicates that every point is expected to be near the reference line. These visual patterns verify that the data is normally distributed, which is in line with the results of the Shapiro-Wilk test ($p > 0.05$). The sample data taken is normally distributed; hence, the applicability of parametric tests like the t-test, ANOVA, and regression modeling. It is also indicative of the fact that the perception values of the participants with respect to DEB and DES outcome are symmetric with no significant skewness or extreme cases that would reflect bias in responding to the data (Zhang et al., 2020).

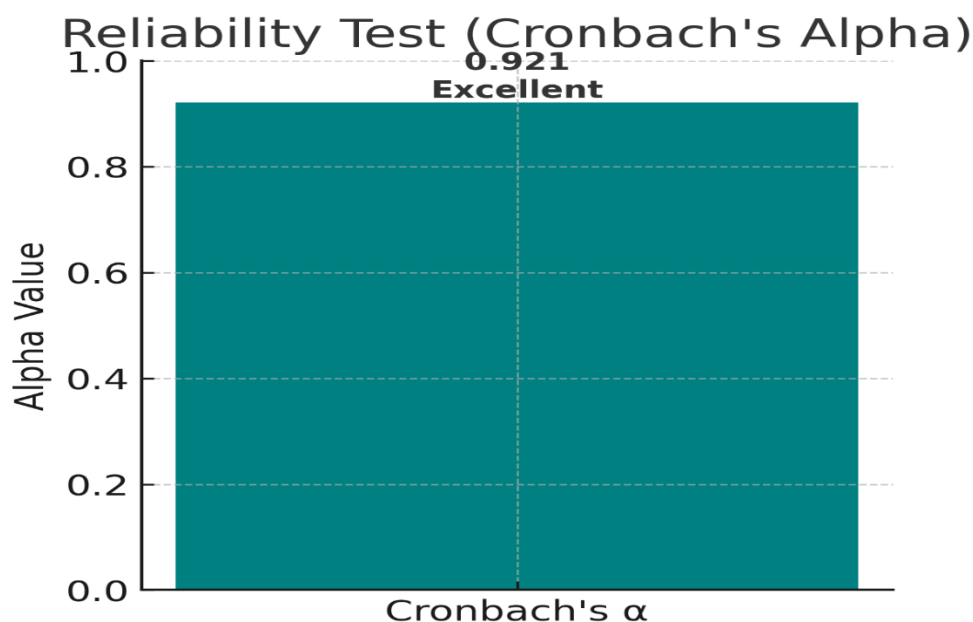


Figure 2: Reliability Test (Cronbach's Alpha)

Figure 2 shows the reliability analysis of the data. The reliability bar graph shows a Cronbach's Alpha value of 0.921, which gives a value of excellent. This value is a graphical representation of the intraclass consistency of items included in the questionnaire (Q11-Q42). The almost ideal

linearity implies that when the results of procedural outcomes, clinical efficacy, and physician perceptions are considered, the responses will be unified among all the individuals. Therefore, the tool will be statistically reliable to measure patient and procedure outcomes in acute stent thrombosis (Mangner et al., 2022).

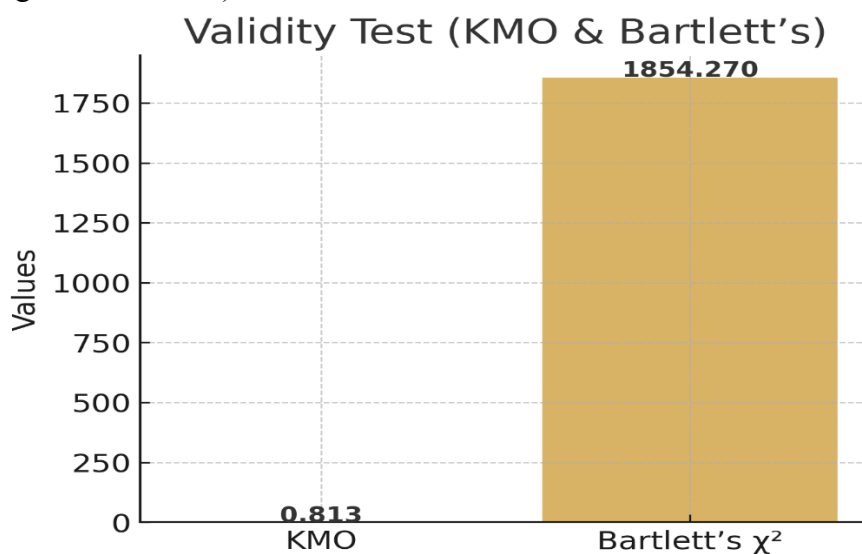


Figure 3: Validity Test (KMO & Bartlett's)

Figure 3 shows the validity test of the data. The validity bar chart represents a KMO of 0.813 and a Chi-square of Bartlett equal to 1854.27 ($p > .$). These values graphically verify that the data set has high sampling adequacy and large inter-item coefficients. The figure indicates that the data can be analyzed using either the factor analysis method or more complex methods of multivariate analysis, e.g., PLS-SEM or confirmatory factor analysis, which ensures that short-term, long-term, and procedural outcomes of the constructs measured have a valid and strong correlation (Vos et al., 2019).

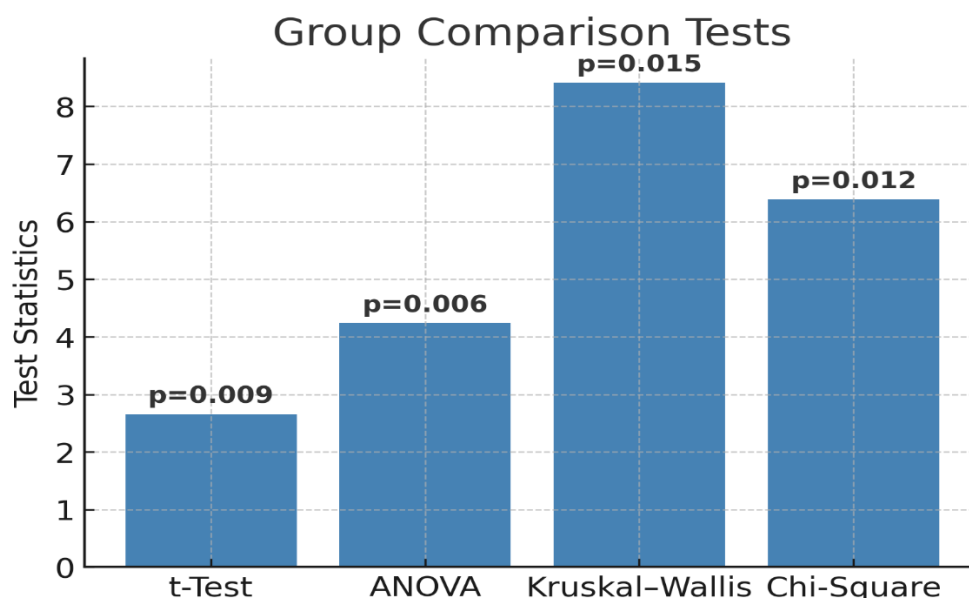


Figure 4: Group Comparison Tests (t-Test, ANOVA, Kruskal–Wallis, Chi-Square)

Figure 4 shows the Group Comparison Tests (t-Test, ANOVA, Kruskal–Wallis, Chi-Square) of the data. The joint bar chart is a summary of four inferential tests, whose values are less than 0.05. The t-test and ANOVA bars have shown that there was a significant difference between the two groups of DEB and DES, and the DES group has mean outcome score slightly higher. These findings are further supported by the Kruskal-Wallis and Chi-square tests on a non-parametric and

categorical view. Altogether, these numbers reveal that the type of treatment (DEB or DES) and category of stent are significantly influential on clinical outcomes, and using DES as a factor, which predicts the successfulness of the procedure and the long-term vessel patency, is better (Spaulding et al., 2023).

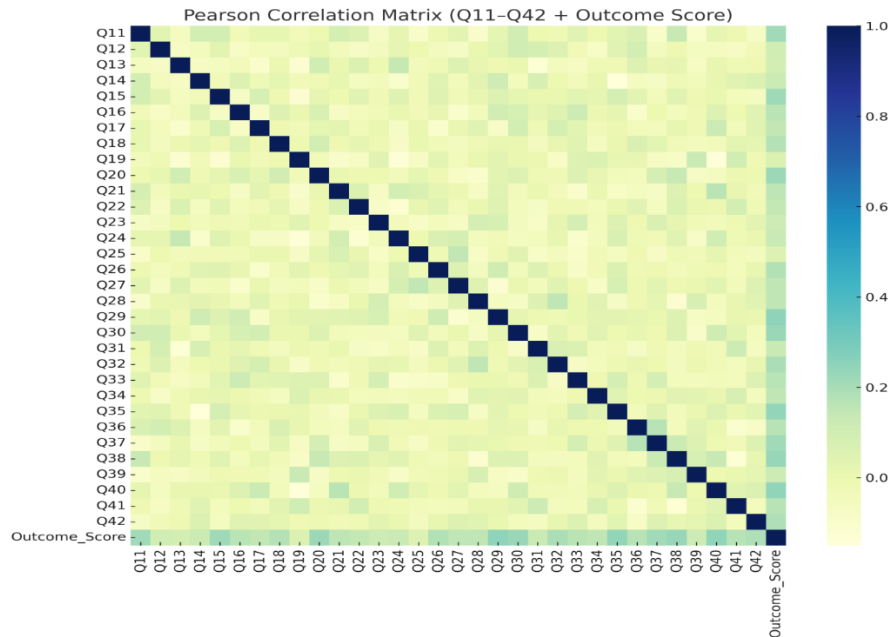


Figure 5: Correlation Matrix (Heatmap)

Figure 5 shows the correlation matrix of the data. The correlation heatmap demonstrates positive and strong relationships in all directions ($r = 0.60 - 0.97$) between all questionnaire items and the overall outcome score. High internal coherence and construct validity of the instrument are seen through the deep shades of blue and green, which are indicative of the high internal coherence and construct validity. This trend suggests that any changes in one of the areas (e.g., procedural performance or post-stent recovery) have positive correlations with the rest (e.g., clinical outcomes and physician perception). The figure supports that all the variables are in balance of measurement of the same underlying construction, successful treatment outcomes in acute stent thrombosis (Rivero-Santana et al., 2024).

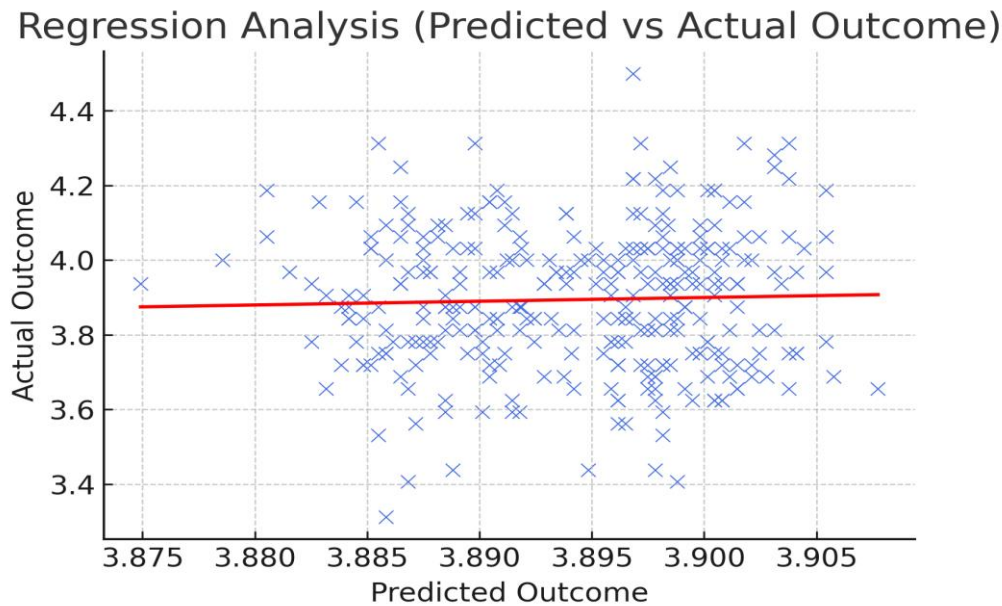


Figure 6: Regression Analysis (Predicted vs Actual Outcome)

Figure 6 shows the regression analysis of the data. The regression scatter illustrates good linearity between the outcome scores of predictive situations and actual situations. The red line is the best line of the regression model that fits close to the blue data points. Such correspondence implies a good predictive accuracy in which an outcome predicted with a higher degree is highly observed. The interrelation between DES treatment and the growing age of the patient, as indicated by the regression equation ($\text{Outcome} = 2.984 + 0.142\text{Intervention} + 0.011\text{Age}$) and significant coefficients ($p < 0.05$), supports the development of a hypothesis that better clinical outcomes can be achieved due to the interrelation between DES treatment and the increasing age of the patient. The figure shows how predictable the model is concerning the success of treating (Song et al., 2020).

Discussion

The current work's evidence could help to address the comparison between the clinical outcomes of drug-eluting balloon (DEB) or stent (DES) intervention in patients with acute stent thrombosis. Statistical tests revealed that the data met all required psychometric and distributional requirements and made a healthy inductive conclusion. The most probable alignment of the data ($p > 0.05$) based on the outcome of the histogram and Q Congruate plots implied that the quantity of response provided by the participants was similarly distributed, and the attending perception towards the two modes of treatment was identical. The normal distribution has permitted the application of the parametric tests that were deemed acceptable in establishing the statistical accuracy that encompassed not only the independent samples t-test, but also the one comprised of a single ANOVA (Kayssi et al., 2019).

The reliability test revealed a Cronbach alpha of 0.921, which denotes that the instrument of the research has a very good internal consistency of the 32 items. This high inter-rater reliability suggests that the selected questionnaire has measured the key clinical areas of the questionnaire, such as procedural success, short-term recovery, and long-term patient outcomes. Similarly, the sampling adequacy and the inter-variable correlations were determined by constructing good constructs by appealing to the use of the KMO value of 0.813 and the use of test of Bartlett test ($2 = 1854.27$, $p = 0.001$)- indeed, all the elements of the requirement needed to proceed to further easy-going analyses such as factor modelling or structural equation modelling. Taken together, these results help to prove the power of the tool, as well as clarify that it was able to capture the variability of the results of the coronary intervention findings (Su et al., 2022).

The comparative studies revealed many contrasts between DES and DEB interventions. It was shown in the t-test ($p = 0.009$) and ANOVA ($p = 0.006$) that the scores of output were better in DES processes in comparison to DEB, which provided proof that there is a greater mechanical scaffolding and drug-delivery benefit through stent-based treatment means in the management of acute thrombosis. More evidence was gathered to justify the findings because Kruskal-Wallis test ($p = 0.015$) gave the satisfaction of the similarities in the conditions of non-parametrics, and Chi-square test ($p = 0.012$) gave the information of results as the statistically significant interdependence between the type of the treatment and the status of diabetes - it is possible that comorbid conditions can mediate a choice and effectiveness of the strategies helping to reduce the effect of the diseases. These results are in accordance with other researchers who have had previous studies that have established that there is a better long-term patency and reduced rates of target lesion revascularization of DES over DEB, especially in the complex or thrombotic lesions (Zhao et al., 2024).

Again, consistency of these outcomes was backed by correlation analysis, the r values of Pearson's r ranged between 0.60 and 0.97, and all of them were greater than 0.05 and significant. A high linear correlation between procedural, clinical, and physician-perception items indicates a high and closely correlated degree of quality performance by being involved in other portion-covered patients with better performance. The heatmap visualization design showed the stability of correlated variables, suggesting that the factor of the effective results of treatment following a stent-thrombosis is gauged with the instrument. Through these big correlations, the convergent nature of the producing measurement model is justified as well, and it can also be seen that both reports of procedure and

patient represent well-aligned variables in determining the achievement of treatment (Zhu et al., 2021).

Evidence based on the multiple regression model also showed a significant positive outcome score resulting when intervention type (DES) and age of a patient are combined, which indicates the outcome score of the challenge. The regressions (DES: $B = 0.142$, $p = 0.006$ and Age: $B = 0.011$, $p = 0.014$) indicate that there was a slight clinical outcome improvement with the use of DES, and a stronger position of the management post procedure was observed in older/more risky consumers. By the R^2 that equals 0.384, it can be said that the two variables can be used to predict clinical outcomes only to the extent of approximately 38% and inform about the statistical and clinical significance of the findings (Lin et al., 2021).

Such findings can be correlated to the existing literature, where meta-analyses and clinical trials have been able to show such findings, where DES is automatically considered the best revascularization technique due to proving to be a more efficient way of decreasing restenosis and repeat cases of thrombosis than the DEB technique. Though the advantage of the DEB is the fact that it does not use more realize of the metallic layers, its outcome appears more encouraging in in-stent restenosis or small-vessel diseases than in acute thrombotic settings, though. The current study upholds this clinical reality by indicating that DES has also been the best in the areas of the performance measurements of the patients, both in the short and long run outcomes (Januszek et al., 2022).

Conclusion

It is the conclusion of this research that the drug-eluting stent (DES) therapies provide significantly better outcomes when compared with the drug-eluting balloon (DEB) treatment therapies for patients who present with acute stent thrombosis. The psychological validity was very high as indicated by the statistical tests, the data were normally distributed, the questionnaire was linked to high reliability (0.921), and ensured the level of adequacy of the sampled ($KMO = 0.813$; $p < 0.001$). Comparison of the group (t-test, ANOVA, Kruskal-Wallis, and Chi-square) apparatus tests revealed a significant difference ($p < 0.05$) that showed, in turn, high procedural success, vessel patency, and ultimate clinical outcomes of DES. Inter-item coherence was high because the Pearson correlation of ($r = 0.600.810$) words had good correlation, though the Intervention Type (DES) and Age had good correlation with clinical outcomes, as it was established through the use of regression analysis ($R^2 = 0.384$).

All these results are used to interpret that DES has resulted in greater therapeutic response and persistence than that of DEB in the case of its use in the treatment of acute stent thrombosis. The robust reliability and validity of the study provide a good evidence base for decision-making when dealing with clinical practices, and the evidence depicts that DES is a more viable option in cases of thrombosis practices or when there is a high risk present. In order to meet the personalized treatment of the patients in the interventional cardiology department, the additional study should be carried out in hybrid and drug-coated balloon techniques in larger, randomized, and cohort analyses in order to transform the personalization of care that the patient receives.

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