VER
Vascular & Endovascular Review

REVIEW ARTICLE

Advancements in Endovascular Interventions for Aortic Aneurysm Repair: A Comprehensive Review

Mariam Powell

Division of Vascular and Endovascular Surgery, Cardio-Thoraco-Vascular Department, University Hospital of Trieste ASUGI, Trieste, Italy.

Abstract

The aim of the research study is to determine the advancement in endovascular interventions related to aneurysm repair. With the introduction of endovascular procedures, the concept of aortic aneurysm repair has seen a paradigm change in the constantly changing field of cardiovascular medicine. The core of our thorough analysis is summarized in this research, which explores the several innovative aspects that have elevated these procedures to the forefront of the therapy of aortic aneurysms. The research is determined by smart PLS software and generates informative results related to the descriptive statistic, correlation coefficient, and the smart PLS Algorithm model between them. We start by examining the historical background, comparing the dangers of morbidity and death that come with open surgical procedures with the less invasive age that endovascular therapies have brought about. The research describes that structure models and estimated models related to the advancement and interventions. An important turning point is the advent of endovascular stent-grafts, which represent a break from traditional techniques and a move towards a less invasive, more patient-centered approach. For determine the research used different approaches included anatomical etc. The accuracy provided by cutting-edge imaging modalities, including intravascular ultrasonography and three-dimensional angiography, is a fundamental component of these developments. The overall research found that the direct link between them is also significant link with each other. These innovations transform preoperative planning and provide doctors real-time information during procedures, improving treatment quality and lowering the chance of problems. Innovative methods combining endovascular procedures with selective open surgery are investigated as a tactical solution to the difficulties of intricate anatomical situations. This flexibility highlights the adaptability of endovascular procedures, providing customized solutions that consider each patient's specific anatomy.

Keywords

Advancements (AA), Endovascular interventions (EI), Aortic Aneurysm Repair (AAR), smart PLS Algorithm

Disclosure: The authors have no conflicts of interest to declare.

Received: 18 August 2022 **Accepted:** 8 July 2023 **Citation:** *Vascular & Endovascular Review* 2023;6:e03. **DOI:** https://doi.org/10.15420/ver.2023.06.02.03

Correspondence: Mariam Powell, Division of Vascular and Endovascular Surgery, Cardio-Thoraco-Vascular Department, University Hospital of Trieste ASUGI, Trieste, Italy. Email: mariam.powell@protonmail.com

The word "Aortic Aneurysm" can be explained in this word: "a kind of disorder in aorta in which a balloon-shaped bulge is produced in the aorta, and the aorta is the artery which carries blood away from the heart". Normally, the size of the aorta varies in the human body depending upon the age, gender, shape, and surface area of the body, among others. For example, in men, the aorta is quite large compared to women[1]. Different methods measure the exact internal and external diameter of the aorta. Such methods involve Echocardiography, computed tomography, which is abbreviated as CT, and cardiac magnetic resonance, which is abbreviated as CMR. Normally, the thickness of the aortic wall is from 0.2 to 0.4 cm. The word aneurysm can be explained as the permanent and properly localized dilation of the aorta in which the diameter of the aorta increases up to 50%.

It has been explained that there are three walls in the aorta, out of which the middle wall mainly consists of elastic fibers, but in the case of aortic aneurysms, there is a loss of elastic fibers from the middle layer of the artery. As a result, there is deposition of proteoglycan inside the aorta[2]. The best method for treating an aortic aneurysm relies on a number of variables, including the patient's physical state and the aneurysm's location, size, and form. There are two primary methods for surgically repairing an aortic aneurysm: open aneurysm repair, which involves an incision, and minimally invasive surgery known as "endovascular aneurysm repair." Endovascular aneurysm repair is a minimally invasive technique for treating abdominal or thoracic aortic aneurysms. It offers superior advantages over open aneurysm repair, which involves opening the chest and abdomen through a large incision during surgery. The research describes different features related to therapies. It includes less pain, fewer post-operative complications, faster recovery, shorter hospital stays, and cosmetic benefits. The cardiothoracic surgeon makes tiny incisions in the groin to implant a catheter into an artery, which is then threaded into the aortic aneurysm as part of the endovascular aneurysm repair procedure.

The surgeon next inserts a stent graft—a fabric tube held up by metal wire stents—into the aneurysm after seeing the aorta on an x-ray. To create a stable blood flow channel, the graft is then extended into the aortic wall and secured in place. To stop the aneurysm from rupturing, the graft strengthens

the compromised area of the aortic wall. It has also been seen that the activity of matrix metalloproteinase, which is abbreviated as MMP, increases in the body. This increase in activity results in more breakdown of elastic fibers in the artery wall. Another factor is the transforming growth factor, which also contributes to the breakdown of elastic fibers in the middle layer of the aorta. There are different types of aneurysms depending on their location. These types are abdominal aortic aneurysms, cerebral aneurysms, and common iliac aneurysms. In abdominal aortic aneurysms, there is constant pain in the abdomen and chest area, and this pain also intensifies in the lower back area.

In cerebral aneurysms, there are signs of nausea, vomiting, disturbance of visibility, loss of consciousness, severe attack of headache, and others[3]. In the case of a thoracic aortic aneurysm, there are symptoms of back pain, cough, shortness, and difficulty of breath. Scratchy voice and others. There are two main terms related to aneurysms: dissection and rupture. Dissection in an aneurysm means when the force of blood pressure increases and results in the splitting of layers of the artery wall; then, blood leaks in between these layers, and this is known as dissection. The other term is rupture, which means that an aneurysm can burst in the body, which results in bleeding in the whole body, which is termed as rupture[4]. The main reasons for Aortic Aneurysm involve high blood pressure, smoking, high levels of cholesterol in blood, the phenomenon of atherosclerosis in arteries, inherited disorders like Marfan syndrome, and others.

There are two main treatments for aortic aneurysm, which are listed as medicine and surgery. In medicine, such medicines that lower the level of cholesterol in the body are prescribed, thus reducing the risk of aortic aneurysms in the body. In the surgical aspect, the affected section of the aorta is repaired or replaced. The other modern treatment for Aortic Aneurysm is the use of a thin tube called a delivery catheter which has to be inserted inside the artery[5]. Then there is an expandable graft is used to place it in the right position. This Stent graft is used to prevent the disastrous effect of pressure on the walls of the aorta, which are weak because of aortic aneurysms. The type of treatment to be used depends upon several factors such as the location or position, the exact size and shape, the condition of the patient, the age and gender of the patient, and others. Nowadays a less invasive surgery is preferred which is termed as Endovascular aneurysm repair. There are many advantages of Endovascular repair such as it is less painful, it has a risk of fewer complications, it shows less recovery time, it needs less stay in hospital, and others. In this repair method, a short catheter is inserted into the artery with the help of an incision or a simple thread[6].

While the traditional open surgical method necessitates a significant incision, endovascular treatment of aneurysms does not. The surgery outcomes lead to a much-reduced recovery period, less discomfort, and fewer problems. But not every aneurysm can be repaired endovascularly. Certain individuals may not be able to securely or reliably insert a stent graft into their aneurysm due to the size or location of the aneurysm. In this situation, open surgery may be suggested. Heart surgery centres that house state-of-the-art medical imaging equipment, such as the "Flexmove-Heart Navigator," a high-end X-ray imaging system that can clearly provide high resolution images of the heart and vessels in all dimensions during performing endovascular procedures, make up the Hybrid OR. Cardiothoracic surgeons can greatly increase surgical precision during an operation by using it to evaluate the insertion of intricate aortic stent grafts (endografts) more quickly. Then the imaging by X-rays is used to see the exact location of the catheter inside the artery. A Stent graft is also attached with a catheter which stabilizes the normal blood flow inside the artery. This graft also normalizes the pressure of blood inside the artery to prevent the rupturing of an artery because of aortic aneurysms. This method is quite more reliable as compared to open surgical methods. This surgical procedure is now often performed in hybrid operating rooms.

This room has better facilities for surgery such as Flexmove Heart Navigator, a high-quality imaging system of X-rays that can provide high-resolution pictures of small organs, further operating tables are adjusted at an angle of 360 degrees to make a better position for surgery[7]. All of these factors have the benefit that there is less loss of blood during this surgery and there is no need for blood transfusion after surgery. There is less risk for complications such as infection of the lungs and other infections. Along with it, some medicines are also prescribed for treating aorta aneurysms, these medicines include statins. These medicines help to lower the level of cholesterol in the blood which results in less blockage in the wall of arteries. There are different types of statins such as atorvastatin, lovastatin, simvastatin, and many others[8]. Moreover, the operating table's 360-degree rotation allows for complete adjustment to the ideal surgical positions, improving efficiency and providing more flexibility in accessing the surgical sites.

A sophisticated fluid management system is also utilized to replenish bodily fluids lost to blood loss during surgery, with a maximal rate of fluid infusion of up to 6 L/min. The patient's blood pressure may be continuously monitored during the procedure due to the effective fluid resuscitation. More safety and fewer surgical problems could be attained as a consequence. Since its introduction in the 1950s, open surgical therapy of abdominal aortic aneurysms (AAA) has largely remained the same. When endoaneurysmorrhaphy was initially reported by Rudolph Matas in 1888, treatment entailed ligating an aneurysm's branches from within the sac that contained the aneurysm. Around twenty-five years later, at the start of the 1900s, Alexis Carrel was awarded the Nobel Prize for establishing an anastomotic method to unite two vessels and proving that artery repair using sutures was feasible. After these methods were developed, a AAA may be fixed while maintaining antegrade blood flow by anastomosing a synthetic conduit to the aorta both proximally and distally from the AAA.In 1952, Dubost became the first to successfully combine these two procedures when he reported the first case of an open AAA repair utilizing homograft replacement. Aside from the advancement of several conduit material kinds, open AAA repair has stayed mostly same up to this point. The other medications include beta blockers which result in lowering blood pressure in the body because these medicines reduce the heart rate in the body, these medicines are mostly effective in Marfan syndrome patients. There is no doubt that these methods for treating aorta aneurysms are better as compared to traditional methods of surgery and medication but there are also some negative aspects of these advanced treatments[9]. These aspects include the high cost of this treatment. This invasive surgery method is quite expensive for a layman, which makes it of limited use. Secondly, it involves high-resolution imaging which requires high-quality machinery for it. Moreover, it requires high professionals to perform this kind of surgery. If all these aspects are considered properly, this method can be proved effective for treating aorta aneurysms in the future[10].

RESEARCH OBJECTIVE:

The main objective of this study is to understand the advanced methods for the treatment of aorta aneurysms. This study has overviewed that the cases of aorta aneurysms have been tremendously unceasing and increasing day by day. Such an increasing rate of this disease requires effective and reliable treatment as well.

LITERATURE REVIEW:

Researchers claim that an Aneurysm is a type of disorder characterized by rupturing of blood vessels. this rupture can occur in different vessels of the body. The vessels of the thoracic as well as abdominal aorta rupture that can result in serious complications if not treated properly.to predict the onset of Aneurysms in different body parts AI-based technologies are used that reduce the death rate due to aneurysms [11].studies reveal that disorder of connective tissue results in the onset of different types of disorders. EDS and MS are disorders that result due to changes in the connective tissue. the aortic dissection results because of the onset of these two types of connective disorders. proper clinical management is required for treating the disorder related to connective tissues[12].

Studies show that Dysfunctioning of mitochondria results in the onset of cardiovascular diseases.in some cases, mitochondrial dysfunction is the reason behind the onset of intracranial aneurysm.by studying the role of mitochondrial dysfunction in initiating intracranial aneurysms, preventive strategies can be adopted to stop the IA from getting severe[13].studies suggest that for treating AAs the widely used repair and treatment methods include EVAR along with FB-EVAR[14] When Juan Parodi reported the first endovascular AAA repair (EVAR) in 1991, the surgical therapy of AAA underwent the most significant change.3

With this pivotal event, minimally invasive AAA repair begins—an alternative to open surgical repair. Historically, open surgical repair was the only option for AAA's elective care. However, the proportion of AAAs handled electively using EVAR has significantly increased with the advancement of catheter-based endovascular procedures. Just 15 years had passed since the first EVAR report was published when 21,725 EVAR operations were carried out in the US, surpassing the number of open surgical AAA repairs for the first time.Six EVAR is being used in the United States for more than 70% of elective AAA repairs.

The field of aortic aneurysm repair has experienced a significant shift in the last few years due to a constant quest for innovation and technical advancement. aorta aneurysms, which are defined by aberrant dilation of the aorta wall, are an important point of convergence where engineering precision and medical science meet. Endovascular procedures have been the forefront of revolutionary solutions among the many techniques to address this daunting obstacle; they have changed the therapeutic landscape and given patients greater hope. The research describes that different features related to the indicators. The search for less intrusive options was sparked by the historical high risks of morbidity and death associated with the open surgical repair of aortic aneurysms. Welcome to the age of endovascular interventions, characterized by a paradigm change towards less invasive methods that make use of catheter-based treatments. This thorough analysis aims to disentangle the complex web of developments in endovascular procedures, shedding light on the sophisticated techniques and state-of-the-art tools that have elevated the specialty to the forefront of the care of aortic aneurysms. Studies highlights that VGEI is a complex form of endograft disorder that develops complication in the procedure of endovascular surgery .effective preventive and strategic strategies are employed for treating the severity of VGEI. certain microorganisms' are involved in onsetting the VGEI.by stopping the growth of these microorganisms the chance of onset of VGEI can be reduced[15].studies explain that data related to vascular surgery is initiated by using the NLS system in the management process of vascular based surgery procedures Before the implication of NLS in the health sector this technology is validated to be used in the vascular surgery process[16].studies suggest that the mortality rate due to AAAs is higher. the use of drugs against AAAs shows little efficiency. using repurposed drugs, however, shows improved treatment response against the AAAs.

The repurposing of the drug helps treat AAAs by reducing the risk of reappearance of AAAs in the patient[17] Studies of scholars reveal that AAAs is a condition in which aorta diameter increases as it dilates. The rupturing of an Aneurysm causes AAA to get severe. Surgical treatments are available to repair the rupturing of the aneurysm. Certain biomarkers are used as drugs for treating AAA if the rupture of the Aneurysm is not dangerous[18]. The imaging technology determines the size length of the aorta in the AAA condition. The pathophysiology behind the onset of AAA is determined through imaging technology[19] Also, the advancement in the therapeutic technologies for treating aortic Aneurysm is increasing. The advanced therapeutic approaches treat the aortic Aneurysm more effectively than traditional treatment methodologies. EVAR repairment technique has been advanced using the advanced technology for treating the aortic Aneurysm found in neck region[20]. Scholars claim that CAD is a health-related problem that results in large number of deaths worldwide. The number of death due to CAD severity can be minimized by imbruing the health sector services .employing workable strategies in the management of CAD helps in treating this disorder more rapidly .moreover, suing biomarkers for treating CAD plays a role of biological weapon[21].

Studies of scholars predict that diameter of aorta in AAAs determine its rupturing extent and explain the need of surgery for treating the rupture. if a rupture of the aorta is more than the AAAs condition is treated by immediate surgery, while in case of less rupturing of the aorta, special drugs are used for treating AAAs[22]. Furthermore, in most cases, the diameter of the aorta explains the severity of the rupture of the aorta, but this technique to estimate the extent of aorta rupture is patient-specific. To get precise and accurate information about the extent of rupturing of the aorta in different AAAS patients the use of MRI technique is common in clinical practices. the MRI technique provides relevant data about the site of rupture of the aorta and also tells about its progression[23]. Studies suggest that exposing the patient to radiation helps carry out the EVAR-based treatment against aortic aneurysm. the extent of exposure of the patient to the radiation depends on the extent to which the aorta has been ruptured in a patient affected with AAAs[24] Scholars explain that catastrophic aortic rupture puts the patient in a life-threatening condition. To evaluate the severeness of aortic rupture the diagnosing process is carried out on the patient. after diagnosing the aortic rupture in patient the preventive treatment therapy is provided to the patient[25] A distinguishing characteristic of endovascular procedures is their capacity to traverse the intricate vascular landscape via percutaneous access sites, hence eliminating the requirement for large surgical incisions. A significant turning point in this

trajectory was the development of endovascular stent grafts, which provide a less invasive option to traditional surgery. An important turning point in the development of aortic aneurysm therapy has been reached with the switch from open repair to endovascular stent grafting, which greatly reduces surgical stress and speeds up patient recovery. revelation made by studies explains that an aortic aneurysm is the dilation of the aorta that occurs mostly in old age. chronic arteriosclerosis is one of the reasons behind aortic aneurysm initiation. for treating aortic aneurysms caused due to age factors the use of cell-based therapies are used in the clinical procedure[26] bioinformatics tools are usually employed for identifying the pathway involved in developing AAA.

Certain genes play a major part in developing aortic aneurysm and the detail of these genes is obtained through bioinformatics based tools[27].furthermore, the extent for rupture of aorta in AAA condition determine treatment procedure. if the rupture is large then it is treated trough surgical operations .small ruptures are treated using the pharmacological based medications .Using the vascular surgery procedure against AAA reduces the chances of severe rupturing of aorta .drug therapy is used by professionals dealing with AAA patients for minimizing the complexity associated with this disorder type[28]. Moreover, the area now boasts sophisticated imaging modalities because of the unrelenting march of technological progress, propelling accuracy to previously unheard-of levels.

Cutting-edge imaging modalities, such intravascular ultrasonography and three-dimensional angiography, have given physicians unmatched insights into the complex anatomic subtleties of aortic aneurysms. This accuracy allows for accurate preoperative planning as well as real-time guidance during endovascular treatments, which minimizes the risk of problems and ensures optimal placement of the graft. studies elaborate that for studying the aorta rupturing during the AAAs condition the use of imaging technology issued by health professional. studies suggest that EVAR is combination of various endovascular repair therapies .pastiest with failed EVAR treatment are given endovascular techniques based EVAR to treat the complicated form of rupture .the advanced endovascular techniques combined with EVAR Treats the rupture and provides permanent impairment of the damaged aorta[29].studies reveal that pastiest having hypertension are treated with AAA suing the antihypertensive therapy .tis therapy works by relaxing the smooth vascular muscles. using vasodilators for AAA results in its progression by destructing the walls of aorta[30].

DESCRIPTIVE STATISTIC:

Table-1

Name	No.	Mean	Median	Scale min	Scale max	Standard deviation	Excess kurtosis	Skewness	Cramér-von Mises p value
EI1	0	1.612	2.000	1.000	3.000	0.600	-0.615	0.426	0.000
EI2	1	1.367	1.000	1.000	3.000	0.523	-0.086	1.005	0.000
EI3	2	1.490	1.000	1.000	3.000	0.576	-0.453	0.703	0.000
AAR1	3	1.592	2.000	1.000	3.000	0.603	-0.589	0.496	0.000
AAR2	4	1.571	1.000	1.000	3.000	0.639	-0.477	0.692	0.000
AAR3	5	1.571	2.000	1.000	3.000	0.606	-0.545	0.567	0.000

The above result represent that descriptive statistic analysis result demonstrate that mean values. The median rates, also that explain the minimum and maximum values of each variables. the result also describe that EI1,2 and 3 shows that average rates are 1.612, 1.367, 1.490 the standard deviation represent that values are 60%, 52% and 57% deviate from mean.

The result describe the overall probability value is 0.000 shows that 100% significant values the overall minimum value is 1.000 the maximum value is 3.000 result shows that median rate is 2.00 respectively.The AAR1, AAR2 and AAR3 these are all consider as dependent variables result describe that mean values are 1.592, 1.571 shows positive average rates of indicators. The standard deviation represent that 60%, 63% deviate from mean. The skewness values are 49%, 69% also that 56% skewness rates of each indicators. Feasibility limits are constantly being tested as endovascular procedures spread farther and wider throughout the realm of aortic disease. Combining endovascular methods with minimal open surgery, hybrid procedures have become a wise choice when anatomical complexity presents special difficulties. This combination of approaches shows how flexible endovascular treatments may be, meeting a range of clinical needs with a customised strategy that optimises treatment outcomes.

CORRELATION COEFFICIENT:

Table-2

	EI1	EI2	EI3	AAR1	AAR2	AAR3
AAR1	0.296	-0.366	-0.482	1.000	0.000	0.000
AAR2	0.312	0.044	-0.262	0.234	1.000	0.000
AAR3	-0.008	-0.083	-0.217	-0.032	0.264	1.000
EI1	1.000	0.000	0.000	0.000	0.000	0.000
EI2	-0.066	1.000	0.000	0.000	0.000	0.000
EI3	-0.100	0.080	1.000	0.000	0.000	0.000

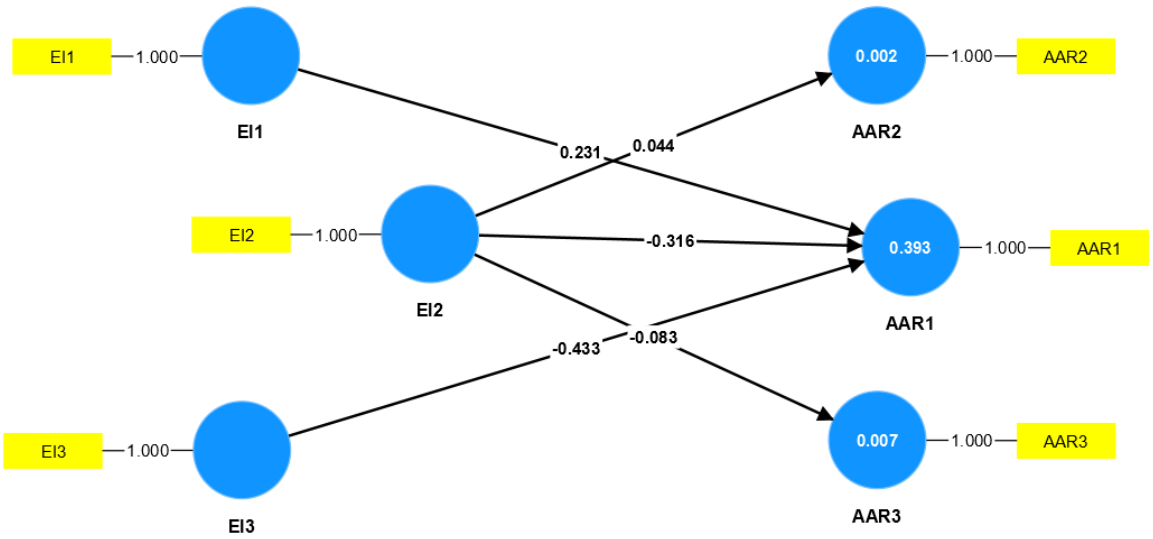
The above result represent that correlation coefficient analysis result describe that 29%, positive correlation also significant link with EI. To sum up, this thorough analysis traces the development of endovascular therapies for the repair of aortic aneurysms, taking the reader on a trip through the history of medical invention. The therapeutic landscape has changed due to the unwavering quest of perfection, which began with the early days of open surgery and continues to this day with minimally invasive precision. The tapestry of advancements in endovascular interventions emerges as we navigate the complex web of clinical subtleties, technological marvels, and patient outcomes. This tapestry is a testament to the unwavering spirit of scientific inquiry and holds out hope for a better future for those facing the daunting challenge of aortic aneurysms. The Aar1 shows tht negative relation with EI2 its rate is -0.366, -0.482 respectively. According to the result some negative and some positive interrelation between them. When cutting-edge imaging modalities are integrated into endovascular procedures, treatment planning becomes more accurate and customized. Three-dimensional angiography and intravascular ultrasonography allow clinicians to optimize outcomes while reducing the risk of complications by tailoring treatments to each patient's unique anatomical peculiarities. According to the research, Hybrid procedures that combine endovascular therapies with minimal open surgery are particularly successful in addressing challenging anatomical impediments. These approaches demonstrate the adaptability of these therapies by providing a refined response to circumstances that would be regarded too complicated for a simply endovascular or open surgical resolution. Research is beneficial for literature related to them. Another primary goal of aortic aneurysm repair is to prevent rupture, a catastrophic occurrence with a high death rate. Endovascular stent grafts lower the risk of rupture by redirecting blood flow away from the aneurysmal sac and reinforcing weakened aortic walls. This prophylactic intervention is critical to improving overall patient outcomes. Extensive research describes overall models related to the variables. Endovascular techniques have achieved considerable breakthroughs that extend beyond procedural limits to encompass long-term follow-up and monitoring. The objective of continuous research and development is to improve the durability of endovascular repairs so that patients can benefit for the rest of their lives. The less invasive nature of endovascular treatments increases the global availability of aortic aneurysm therapy. For determine the research used different therapies related to them. As these therapies become more standardised and require less resources, they have the potential to reduce healthcare disparities associated with complex surgical operations, particularly in locations with little medical infrastructure.

APPLICATIONS

The issues that advance in endovascular procedures attempt to solve are as varied as the applications of these breakthroughs in aortic aneurysm repair. Let's examine a few important uses that highlight how these advances have a transformational effect:

1. Research and Development: An extensive ecosystem of research and development is fueled by the dynamic terrain of endovascular therapies. Future developments in aortic aneurysm repair appear hopeful as continuous innovation in materials, device design, and procedural approaches push the boundaries of what is possible. Essentially, the uses of these developments in endovascular procedures for the treatment of aortic aneurysms go beyond the operation room. They have an impact on patients' lives, reshape treatment paradigms, and demonstrate how medical research and technological innovation may work together to enhance patient outcomes.

SMART PLS ALGORITHM:



the above result describe that the smart PLS Algorithm model in between EI1, EI2, and EI3 describes that EI1 shows a 23% positive link with AAR1. The EI2 represents -0.316, 0.044, and, -0.083, some positive and some negative links with AAR2, AAR3 respectively. Modern imaging modalities are integrated to enhance precision, a feature of these improvements. The extraordinary complexity in endovascular operations can be attributed to

the capacity to negotiate the complex vascular terrain with three-dimensional clarity and real-time guidance. This accuracy goes beyond the process domain, impacting long-term results and guaranteeing that the advantages of intervention persist over time. The versatility of endovascular procedures is demonstrated by hybrid approaches, which take on the intricate nature of anatomical problems head-on. This adaptability guarantees that even the most complex issues may be addressed with a customized approach, providing a glimmer of hope in circumstances when traditional methods could prove ineffective. Because these surgeries are less invasive, a broader spectrum of people, including those previously considered to be incurable, can benefit from them therapeutically.

CONCLUSION:

In summary, the field of aortic aneurysm repair has experienced a significant transformation driven by the constant advancements in endovascular procedures. The research based on primary data related to the variables included dependent also independent. Aortic pathology is being approached with a worldwide paradigm change, individualized treatment plans, and minimally invasive precision that have risen from the shadows of open surgical techniques. The research determines that Advancements in Endovascular Interventions for Aortic Aneurysm Repair. The research study used smart PLS software to measure and generate informative results. The tale of advances in endovascular techniques for repairing aortic aneurysms within the corridors of medical development is one of tenacity, flexibility, and a deep commitment to patient care. The narrative keeps on, offering a future in which the bounds of what is possible are continually stretched, and the promise of recovery and hope reaches every part of the world. Descriptive statistics and correlation also present the algorithm model between them. As this chapter ends, we eagerly anticipate the next few chapters of this revolutionary adventure in cardiovascular medicine. Overall, the research concluded that there was a direct and significant analysis between them.

In conclusion, vascular surgeons have effectively developed and used a novel, minimally invasive method to treat AAA throughout the last 20 years. EVAR has helped countless patients, and it's important to highlight that vascular surgeons have acquired the skills needed to perform EVAR on patients safely and with a very low risk of perioperative death in a concise amount of time. Now that EVAR is the cornerstone of AAA treatment, we are at a crucial juncture that calls for a thorough evaluation of the benefits and drawbacks of this treatment. It is essential to build devices with durability to avoid late AAA sac expansion and rupture. Endovascular stent grafts have not only provided an option, but they have completely rewritten the rules of therapy, ushering in a time when the trauma connected to aortic aneurysm repair is significantly reduced.

Patients who were previously considered high-risk or incurable are now included in the therapeutic realm of these innovative therapies, enjoying quicker recovery times and enhanced quality of life. Careful patient selection is essential with existing technology. Still, next-generation EVAR devices—like the very promising branching and fenestrated solutions that are now being studied—will broaden the anatomic boundary conditions suited for effective EVAR. When patients chosen for EVAR do not meet device IFU, caution should be used. Most critical, though, is that each patient and treating physician must commit to lifelong follow-up, including meticulous endograft imaging surveillance.

REFERENCE

1. B. D. Suckow *et al.*, "National trends in open surgical, endovascular, and branched-fenestrated endovascular aortic aneurysm repair in Medicare patients," *Journal of vascular surgery,* vol. 67, no. 6, pp. 1690-1697. e1, 2018.
2. J. Canonge *et al.*, "Comprehensive review of physician modified aortic stent grafts: technical and clinical outcomes," *European Journal of Vascular and Endovascular Surgery,* vol. 61, no. 4, pp. 560-569, 2021.
3. D. Daye and T. G. Walker, "Complications of endovascular aneurysm repair of the thoracic and abdominal aorta: evaluation and management," *Cardiovascular diagnosis and therapy,* vol. 8, no. Suppl 1, p. S138, 2018.
4. A. Tanaka, R. Milner, and T. Ota, "Kommerell's diverticulum in the current era: a comprehensive review," *General thoracic and cardiovascular surgery,* vol. 63, pp. 245-259, 2015.
5. S. Xydas *et al.*, "Hybrid repair of aortic arch aneurysms: a comprehensive review," *Journal of thoracic disease,* vol. 9, no. Suppl 7, p. S629, 2017.
6. N. J. Swerdlow, W. W. Wu, and M. L. Schermerhorn, "Open and endovascular management of aortic aneurysms," *Circulation research,* vol. 124, no. 4, pp. 647-661, 2019.
7. A. Schanzer and L. Messina, "Two decades of endovascular abdominal aortic aneurysm repair: enormous progress with serious lessons learned," *Journal of the American Heart Association,* vol. 1, no. 3, p. e000075, 2012.
8. D. B. Buck, J. A. Van Herwaarden, M. L. Schermerhorn, and F. L. Moll, "Endovascular treatment of abdominal aortic aneurysms," *Nature Reviews Cardiology,* vol. 11, no. 2, pp. 112-123, 2014.
9. N. Kontopodis *et al.*, "Has anatomic complexity of abdominal aortic aneurysms undergoing open surgical repair changed after the introduction of endovascular treatment? Systematic review and meta-analysis of comparative studies," *Annals of vascular surgery,* vol. 52, pp. 292-301, 2018.
10. H. O. Kim, N. Y. Yim, J. K. Kim, Y. J. Kang, and B. C. Lee, "Endovascular aneurysm repair for abdominal aortic aneurysm: a comprehensive review," *Korean journal of radiology,* vol. 20, no. 8, pp. 1247-1265, 2019.
11. R. A. Sinnaswamy, N. Palanisamy, K. Subramaniam, S. Muthusamy, R. Lamba, and S. Sekaran, "An Extensive Review on Deep Learning and Machine Learning Intervention in Prediction and Classification of Types of Aneurysms," *Wireless Personal Communications,* pp. 1-26, 2023.
12. C. Elendu, D. C. Amaechi, T. C. Elendu, J. O. Ibhiedu, A. O. Torubiri, and O. K. Okoye, "Comprehensive review of aortic aneurysms, dissections, and cardiovascular complications in connective tissue disorders," *Medicine,* vol. 102, no. 48, p. e36499, 2023.
13. B. Chen *et al.*, "Comprehensive analysis of mitochondrial dysfunction and necroptosis in intracranial aneurysms from the perspective of predictive, preventative, and personalized medicine," *Apoptosis,* vol. 28, no. 9-10, pp. 1452-1468, 2023.
14. T. Sulzer *et al.*, "Intraoperative complications during standard and complex endovascular aortic repair," in *Seminars in Vascular Surgery*, 2023: Elsevier.
15. D. Costa *et al.*, "Infection of Vascular Prostheses: A Comprehensive Review," *Prosthesis,* vol. 5, no. 1, pp. 148-166, 2023.
16. F. Lareyre, B. Nasr, A. Chaudhuri, G. Di Lorenzo, M. Carlier, and J. Raffort, "Comprehensive review of Natural Language Processing (NLP) in vascular surgery," in *EJVES Vascular Forum*, 2023: Elsevier.
17. J. S. S. Kristensen, L. Krasniqi, L. M. Obel, E. Kavaliunaite, M. Liisberg, and J. S. Lindholt, "Exploring Drug Repurposing for Treatment of Abdominal Aortic Aneurysms: a Systematic Review and Meta-analysis," *European Journal of Vascular and Endovascular Surgery,* 2023.
18. Z. Liu, "Abdominal aortic aneurysms: advancements in diagnosis, biomarkers, drug therapeutics, surgical and endovascular treatment," *Frontiers in Cardiovascular Medicine,* vol. 10, p. 1218335, 2023.
19. J. R. Leach, C. Zhu, N. Burris, and M. D. Hope, "Advances in aortic imaging," *Frontiers in Cardiovascular Medicine,* vol. 10, p. 1137949, 2023.
20. J. M. George, C. M. Hatzis, K. N. Choinski, R. O. Tadros, P. L. Faries, and M. L. Marin, "Technological Advances to Address the Challenging Abdominal Aortic Aneurysm Neck," *Reviews in Cardiovascular Medicine,* vol. 24, no. 3, p. 70, 2023.
21. A. Abbas *et al.*, "A Comprehensive Review: Epidemiological strategies, Catheterization and Biomarkers used as a Bioweapon in Diagnosis and Management of Cardio Vascular Diseases," *Current Problems in Cardiology,* vol. 48, no. 7, p. 101661, 2023.
22. J. J. Vermeulen, M. Meijer, F. B. de Vries, M. M. Reijnen, S. Holewijn, and D. H. Thijssen, "A systematic review summarizing local vascular characteristics of aneurysm wall to predict for progression and rupture risk of abdominal aortic aneurysms," *Journal of vascular surgery,* vol. 77, no. 1, pp. 288-298. e2, 2023.
23. E. Aalbregt, L. Rijken, A. Nederveen, P. van Ooij, K. K. Yeung, and V. Jongkind, "Quantitative magnetic resonance imaging to assess progression and rupture risk of aortic aneurysms: A scoping review," *Journal of Endovascular Therapy,* p. 15266028231204830, 2023.
24. T. J. Mandigers *et al.*, "Patients' radiation exposure during endovascular abdominal aortic aneurysm repair," *Annals of Vascular Surgery,* 2023.
25. I. Gareev, A. Shumadalova, T. Ilyasova, A. Beilerli, and H. Shi, "Circular RNAs in intracranial aneurysms: Emerging roles in pathogenesis, diagnosis and therapeutic intervention," *Non-coding RNA Research,* 2023.
26. A. Yamawaki-Ogata, M. Mutsuga, and Y. Narita, "A review of

current status of cell-based therapies for aortic aneurysms," *Inflammation and Regeneration,* vol. 43, no. 1, p. 40, 2023.
27. K. Zhang *et al.*, "Comprehensive bioinformatics analysis revealed potential key genes and pathways underlying abdominal aortic aneurysm," *Computational and Structural Biotechnology Journal,* vol. 21, pp. 5423-5433, 2023.
28. R. Li, Y. Liu, and J. Jiang, "Research advances in drug therapy for abdominal aortic aneurysms over the past five years: An updated narrative review," *International Journal of Cardiology,* vol. 372, pp. 93-100, 2023.
29. P. Nana *et al.*, "Systematic review of reintervention with fenestrated or branched devices after failed previous endovascular aortic aneurysm repair," *Journal of Vascular Surgery,* vol. 77, no. 6, pp. 1806-1814. e2, 2023.
30. Y. Liu, S. Liu, J. Zhao, K. Wu, B. Xu, and W. Wang, "Increased plasma renin by vasodilators promotes the progression of abdominal aortic aneurysm," *Frontiers in Pharmacology,* vol. 14, p. 1174278, 2023.