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Abstract

Introduction: Reported mortality rates for endovascular repair (EVR) of ruptured abdominal aortic aneurysm (rAAA) vary from 0% to 50%. Selection bias, inaccurate reporting, and lack of uniform reporting standards are responsible for this significant discrepancy. **Material and Methods:** Existing literature about the classification/reporting systems of rAAA is reviewed. A standard way of reporting rAAA based on the physiological, radiological, and operative findings is proposed. **Conclusion:** The proposed system attempts to provide a universal language of communicating the severity of rupture, address the reporting bias, and allow comparing the outcomes of rAAA.

Keywords

reporting, rupture, abdominal aortic aneurysm

Introduction

Since the first published report by Yusuf et al in 1994,¹ there have been numerous reports on the feasibility and possible benefits of endovascular repair (EVR) in reducing morbidity and mortality compared to open repair (OR) for abdominal aortic aneurysm (rAAA).²⁻⁴ However, similar to OR of rAAA, the published mortality rates for emergency EVR (eEVR) differ widely among various institutions.⁵ The reason for this discrepancy in mortality rates may be due to a variation in practice, selection bias, lack of uniform reporting standards, and inaccurate reporting. Currently, the use of eEVR, even in the most enthusiastic of centers is very selective, and the proportion of patients treated by eEVR ranges from 18% to 76%. Patients offered eEVR are usually hemodynamically stable and anatomically less adverse,⁴ leaving the difficult and awkward cases for OR and this can lead to further reporting bias.

Therefore, existing data on rAAA are difficult to interpret and the terminology used to describe the patients and the severity of rupture are not universally agreed and often inconsistent. In addition, certain terms are used interchangeably, such as ruptured and leaking; with both underscoring the same predicament although some may argue that leaking implies a sense of stability. Similarly, there is conflicting consensus on the definition of a stable patient.^{6,7} Various scoring systems, such as that described by Hardman, have been used in an attempt to demonstrate compatibility between different cohorts of patients and studies.^{8,9} There is also no conformity on reporting computed tomography (CT) scan and operative findings for rAAA, even though there are generally established guidelines for reporting

aneurysm morphology, complications, and procedures during elective EVR.⁷ Therefore, a uniform language for reporting rAAA will be helpful in communicating the severity of rupture and allow accurate comparisons to be made of outcomes.

We, therefore, propose a set of standards for describing the physiological state of patients at the induction for surgery: the CT scan findings and the severity of rupture at open surgery. No attempt will be made to discuss anatomical variations nor complications related to open and endovascular surgery for AAA as reporting standards for these have already been established by others.^{6,7}

Proposed Standards for Reporting rAAA

The physiological status will be reported based on the level of consciousness, blood pressure (BP), and electrocardiograph (ECG), which have been found to be reliable indicators of hemodynamic stability⁹ (Tables 1 and 2). The radiological (Table 3) and intraoperative classification (Table 4) are aimed to differentiate the severity of rupture and to help quantify the hematoma based on its extent found by CT angiography and at surgery. The CT scan and operative classes should complement one another.

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Table 1. Scoring of Preoperative Physiological Criteria

Preoperative Clinical Criteria	Score
Level of consciousness	
Normal	0
Coherent but drowsy	1
Confused	2
Unconscious	3
Systolic BP	
>100mmHg	0
70 to 100mm Hg	1
<70mm Hg	2
ECG	
Normal sinus rhythm <100/min	0
Sinus tachycardia >100/min	1
Arrhythmia or ST changes	2

Abbreviations: BP, blood pressure; ECG, electrocardiogram.

Table 2. Physiological Classification

Sum of the Above Preoperative Scores	Class
0 or 1	1
2 or 3	2
4 or 5	3
6 or 7	4

Reporting of Physiological Condition at Induction for Surgery

This is based on the level of consciousness, BP, and ECG (Table 1). These scores should reflect the severity of the hemodynamic changes. The level of consciousness is graded 0 to 3; 0 being normal with spontaneous communication and movement. The highest score of 3 is given to a patient who is unconscious and moribund. Scores of 1 and 2 are slightly more subjective and may be affected by the use of narcotic analgesics and in patients with severe comorbidities such as dementia. Hopefully, the presence of such influencing factors will be obvious in the patient's history. The BP at presentation will be graded from 0 to 2 according to whether it is above 100 mm Hg, between 70 and 100 mm Hg, or less than 70 mm Hg. The last category to be graded will be changes on the ECG that should be routinely available when patients are attached to a monitor. In this category a heart rate of less than 100 will be given a score of 0, over 100 a score of 1, and if there are obvious ST segment changes or arrhythmias a score of 2. Unfortunately, like the other 2 components, ECG changes may be influenced by unrelated cardiac conditions, medication, and resuscitation techniques.

The hemodynamic stability will then be classified according to the cumulative score of these 3 components as in Table 2. Class 1 will represent a very stable patient with 1 or no abnormal indicator, whereas the unstable patient, with a maximum number of abnormal indicators, will be classed as 4.

Table 3. Classification Based on CT Scan Findings

CT Findings	Class
Intact aneurysm	1
Stranding of periaortic tissue	2
Definite evidence of leak but contained hematoma on one side of aorta, with no extension beyond the length of infrarenal aorta	3
Definite leak with hematoma extending into pelvis or suprarenal space or to both sides of the aorta	4
Free intraperitoneal blood	5

Abbreviation: CT, computed tomography.

Table 4. Operative Classification

Intraoperative Findings	Class
Intact aneurysm	1
Blood stained peritoneum	2
Contained hematoma on one side of the aorta or with no extension beyond the length of infrarenal aorta	3
Contained hematoma extending into pelvis or suprarenal space or to both sides of aorta	4
Free intraperitoneal blood	5

Reporting the CT Angiogram Findings

This is based on the size and severity of the leak (Table 3). An intact aneurysm with no obvious identifiable abnormality in the surrounding tissue will be classified as 1 (Figure 1). Patients who have subtle changes such as "stranding" of the fatty tissues around the aneurysm that may represent a very small leak will be classed as 2 (Figure 2). Classes 3 (Figure 3) and 4 (Figures 4 and 5) represent obvious hematomas of increasing volume but are well contained within the posterior peritoneum. Class 5 is reserved for patients with evidence of intraperitoneal blood (Figure 6).

Reporting of Operative Findings

This should emulate the CT angiography classes and represent the severity of the leak and volume of blood present in the abdominal cavity. Class 1 is an intact aneurysm with no macroscopic evidence of extra-aneurysmal blood. Class 2 is when there is "staining" or "bruising" of the posterior peritoneum but no actual hematoma identifiable. Classes 3 and 4 are self-explanatory, whereas class 5 is presence of free blood as soon as the peritoneal cavity is entered (Table 4).

Discussion

Currently, one of the most controversial topics in vascular surgery is whether eEVR is better than OR for rAAA. Mortality rates of 0% to 70% are reported with OR and 0% to 53% by EVR.^{5,10-12} A prospective multicenter nonrandomized study evaluating the efficacy of the 2 techniques failed to



Figure 1. Axial sections of CT aortogram demonstrating an intact AAA with no periaortic stranding or hematoma—Class 1. AAA indicates abdominal aortic aneurysm; CT, computer tomography.



Figure 3. Axial sections of CT aortogram demonstrating ruptured AAA with unilateral hematoma—Class 3. AAA indicates abdominal aortic aneurysm; CT, computer tomography.



Figure 2. Axial sections of CT aortogram demonstrating AAA with periaortic stranding—Class 2. AAA indicates abdominal aortic aneurysm; CT, computer tomography.

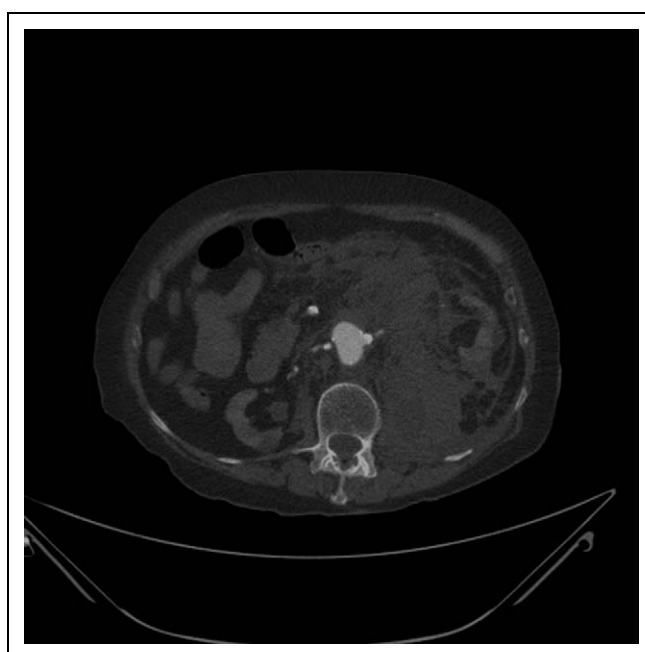


Figure 4. Axial sections of CT aortogram demonstrating ruptured AAA with unilateral suprarenal hematoma—Class 4. AAA indicates abdominal aortic aneurysm; CT, computer tomography.

demonstrate any difference in the mortality rates between eEVR and OR.¹³ Unfortunately, interpretation of currently available data and comparisons between studies are difficult because it is often impossible to judge if the patients described in these studies are compatible. In addition, the diagnosis of

suspected abdominal aortic rupture by CT angiography can be inconsistent with a tendency to overdiagnose rupture.¹¹

The lack of any standards for reporting this condition has not helped to address the issue. The existing jargon to describe the clinical, operative, and radiological findings is vague with

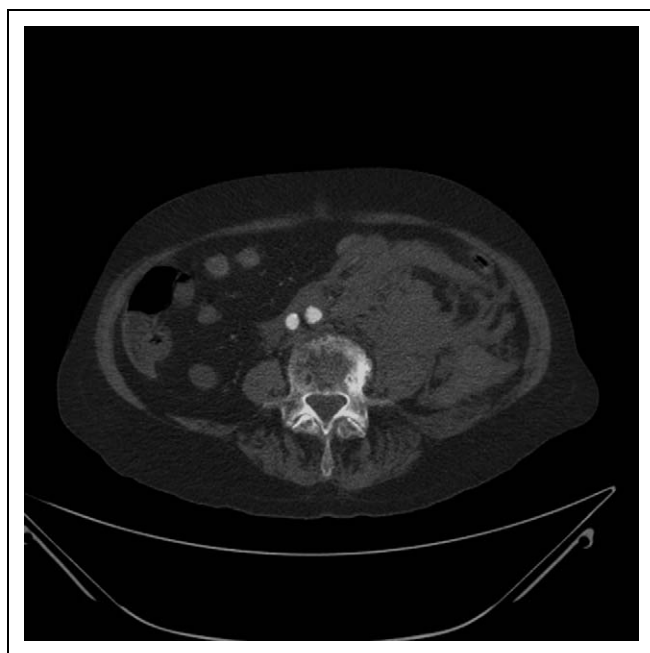


Figure 5. Axial sections of CT aortogram demonstrating ruptured AAA with retroperitoneal hematoma extending into pelvis—Class 4. AAA indicates abdominal aortic aneurysm; CT, computer tomography.



Figure 6. Axial sections of CT aortogram demonstrating ruptured AAA with free intraperitoneal blood—Class 5. AAA indicates abdominal aortic aneurysm; CT, computer tomography.

acute expansion, impending rupture, contained rupture, leak, and rupture; all reported as emergency or acute AAA. Although various scoring systems have been proposed to prognosticate outcomes in rAAA and a reporting standard for elective EVR exists, there has been no attempt to standardize the terminology in which rAAA is reported.

Callam et al proposed The Edinburgh Ruptured Aneurysm Classification based on the mortality patterns: (1) died in the community without diagnosis, (2) died after reaching primary or secondary referral centers or in transit, and (3) died prior to operation, during, or after the operation. Those who survive an operation are classified as survivors. This is probably a useful method of reporting the postoperative morbidity rates and long-term complications among the survivors of rAAA repairs but does not differentiate the hemodynamic status and severity of the aneurysm rupture.¹⁴

The classification we have proposed has several advantages over other methods. The clinical class indicates the severity of hemodynamic instability but using parameters that are routinely and rapidly noted when a patient presents with a rAAA. Although Hardman et al showed that outcome may be predicted using the 5 criteria: age, creatinine level, hemoglobin, ECG changes and level of consciousness⁹; many patients have missing creatinine and hemoglobin measurements because these are not always performed at the time of presentation. The classification suggested here also attempts to standardize CT and operative reporting so that studies on rAAA can be compared easily. The classes are based on the severity of

rupture with the CT angiographic findings corresponding with operative findings.

Unfortunately, there are shortfalls to the classification. These parameters are graded at a specific time in which a snapshot of a dynamic situation is taken. This assumes the patient's condition does not change from the time of evaluation and recording the data. At present, no imaging tool or monitoring equipment exists, which can accurately monitor the degree of hemorrhage of the aneurysm. The Subcommittee on Reporting Standards for Arterial Aneurysms of Society for Vascular Surgery and North American Chapter, International Society for Cardiovascular Surgery suggested using a classification of the central hemodynamic status for aneurysms based on standard clinical criteria including BP, urine output, and response to resuscitation as stable, unstable, cardiac arrest, and death. They also suggested noting the patients' initial condition on presentation and at the time of operation, time interval between the onset of symptoms and treatment.⁶ However, this too does not address the issue of the lack of uniformity in describing the severity of rupture of the aneurysm. A more recent paper from the Ad Hoc Committee for Standardized Reporting Practices in Vascular Surgery of The Society for Vascular Surgery/American Association for Vascular Surgery suggested that the hemodynamic status including BP and response to initial resuscitation (stable, unstable, cardiac arrest) should be reported, while distinguishing a free rupture, fistulization into an adjacent organ, and a contained rupture.⁷ However, they failed to offer any suggestion on how CT scan and operative reporting may be standardized.

Table 5. Proposed Grading of rAAA Based on the Sum of Physiological and Radiological or Operative Classification

Grade	Score
Mild	2 to 3
Moderate	4 to 6
Severe	7 to 9

Abbreviation: rAAA, ruptured abdominal aortic aneurysm.

Conclusion

A standard way of communicating data in studies involving rAAA is very much needed to ensure a universal language that is uniform and allows outcomes to be compared accurately. We have therefore, proposed one that is easy to apply and will take into consideration the different degrees of aneurysm rupture based on assessment tools that are normally used to evaluate patients with rAAA. In addition, it is possible that these individual parameters may be scored and used to prognosticate outcome; however, this will require further validation. The clinical score may be added to the radiological or intra-operative scores and patients can then be categorized into mild, moderate, and severe (Table 5).

Declaration of Conflicting Interests

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