4. Surgery

Introduction

This chapter examines the characteristics of the patient, the role of the surgeon and aspects of the surgical procedure for patients who were admitted for open repair. NCEPOD did not attempt to collect data on patients known to have an abdominal aortic aneurysm who may have died outside hospital whilst awaiting investigation, or during transfer between hospitals.

4. Surgery

Mode of admission

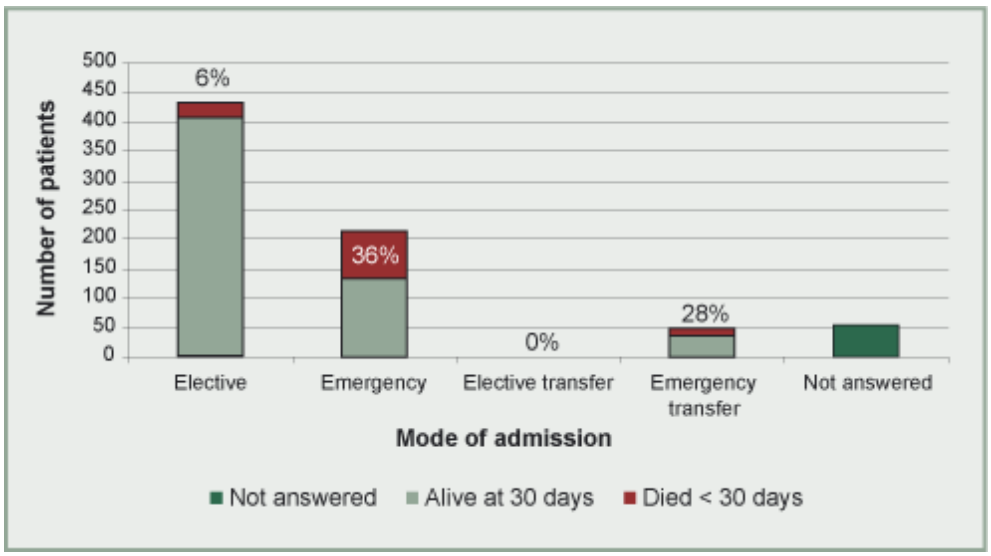

Figure 1. Mode of admission by outcome *n=752. Percentages refer to patients who died in hospital within 30 days.*

Data on mode of admission and 30 day mortality were examined for 752 patients who had an open AAA repair (Figure 1). These data exclude patients who did not undergo operation but received palliative care only (79) and patients who had an endovascular repair (53). These two groups of patients are considered separately.
Just under a third (31%, 214/698) were direct emergency admissions and a further 50 patients were emergency transfers (admissions that had been transferred in from another hospital). Compared to the mortality rate for elective admission for AAA repair of 6.2% (27/434), the mortality rate after an emergency admission was six times higher at 36% (94/264). Because of the expected but dramatic difference in outcome between these two groups they have been analysed separately.

Denominator data may differ between sections according to the completeness of data returned.

4. Surgery

Elective surgery >> Demographics

AAA is well documented as a condition affecting men much more commonly than women. Only 13% (57/434) of repairs were performed on women. The gender distribution in the present report is similar to that recorded in recent HES data [1].
Age distribution was also as expected. The median age for men was 72 years and for women 73. The incidence of AAA increases with age but so does the incidence of significant comorbidity. The data for elective patients have been analysed to examine whether mortality increases with age. Figure 2 shows the age and sex distribution. Figure 3 shows the total numbers of patients in each age cohort who were alive 30 days after surgery or had died.

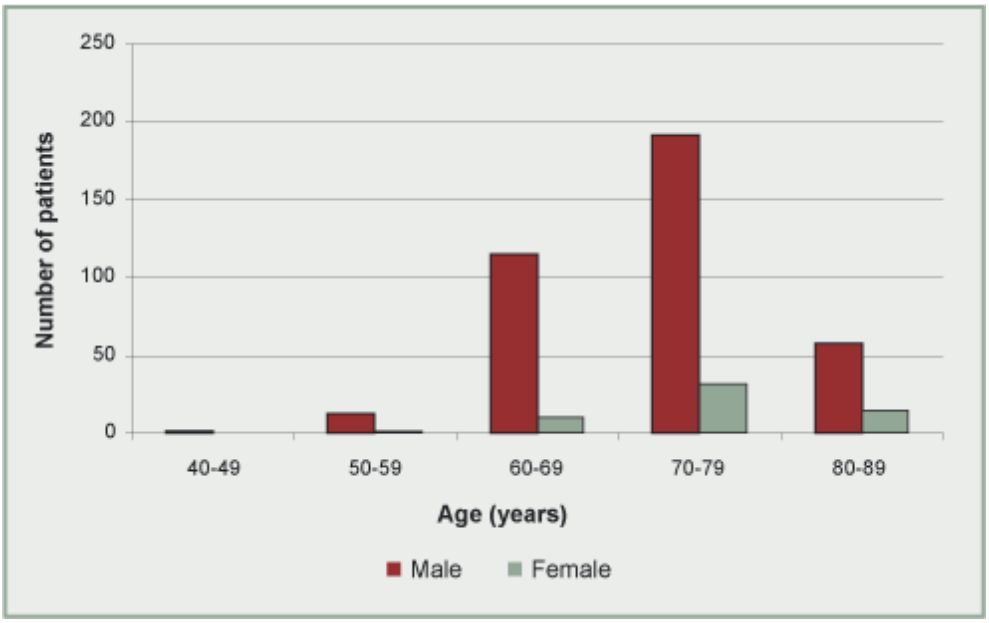

Figure 2. The distribution of age and sex *n* =434

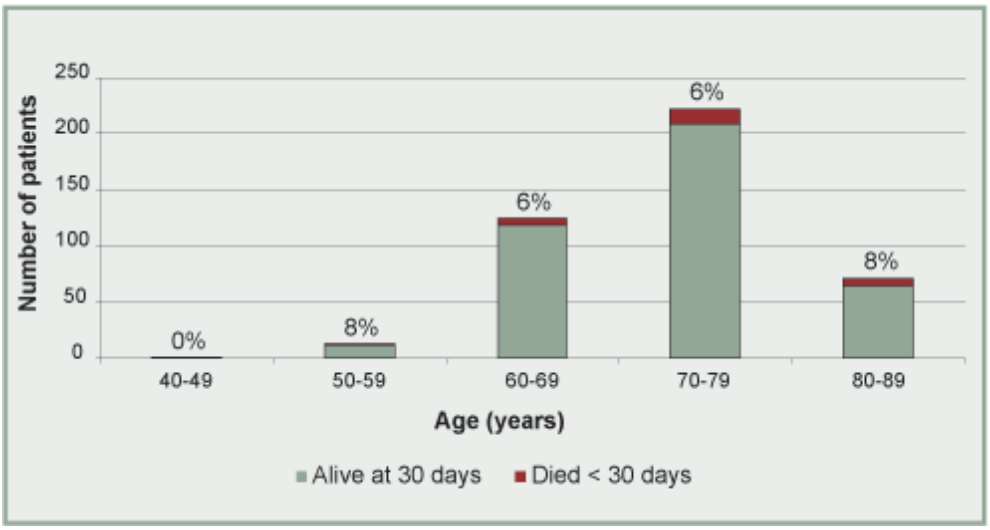

Figure 3. Age by mortality *n* =432/434. *Percentages refer to patients who died in hospital within 30 days.*

The oldest elective patient in this study was 88 years. Of 71 patients aged 80 and over, only six died. Age alone should not be the only reason to turn down a patient for elective AAA repair.

4. Surgery

Elective surgery >> Delays to operation

Waiting times

21% of patients spent more than 12 weeks on the waiting list for elective AAA repair.

18 patients admitted as an emergency, had been on the waiting list for either open or endovascular repair.

Figure 4 shows the time between the patient being placed on the waiting list and the date of their operation for the 382 patients for whom these data were available.

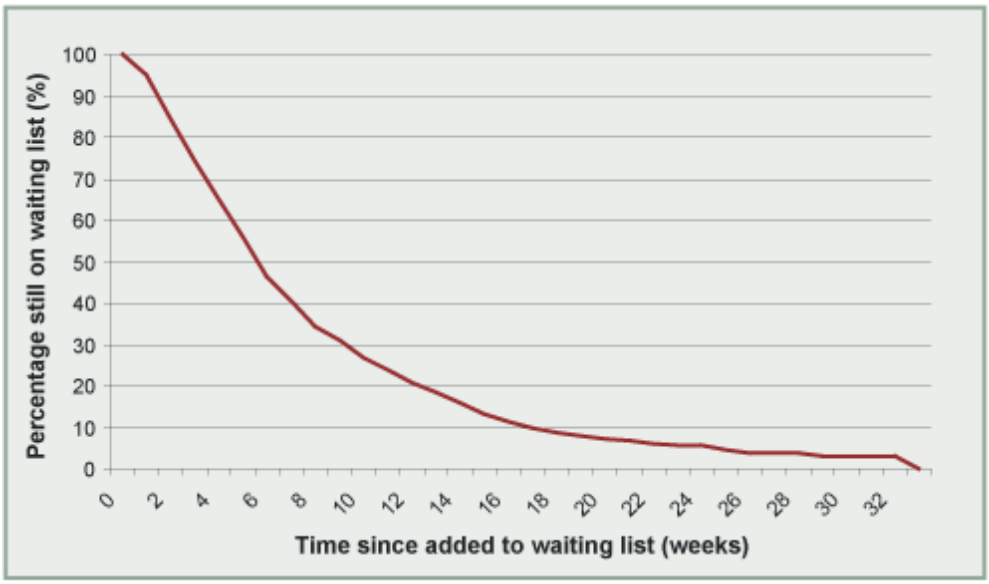

Figure 4. Time between patients being placed on the surgical waiting list and the date of their surgery *n=382/434*

Once on a waiting list, the median wait to surgery was five weeks. However, 141 patients waited longer than five weeks and 21% (80/382) of patients on whom NCEPOD had data waited more than 12 weeks. This is far too long. In contrast, the majority of women with breast cancer can expect their operation within 31 days of receiving the diagnosis [2] and Trusts are judged on their ability to meet this target. If the target for treatment of a cancer patient is four weeks from diagnosis then all necessary investigations must be done within this timeframe. NHS guidelines for how quickly a non-cancer patient should be seen in clinic or how soon after diagnosis they should be treated have progressively improved but lag behind guidelines for treating patients with cancer. Furthermore, when Trusts insist that patients cannot be put on a waiting list until all necessary preoperative investigations have been performed, the true time a patient has to wait for their surgery is hidden.

For patients with an AAA the true time from diagnosis to treatment includes: the time between the first appointment in the consultant's clinic and the completion of any referrals to other consultants; the time taken for all necessary investigations to be performed and reported; and the time between going on a waiting list and actually having the AAA repaired.
The present study only collected data on the last part of this journey. In meetings with advisors, anecdotal evidence was heard that the need to meet centrally-set cancer targets has disadvantaged patients who do not have cancer but have conditions which are equally, if not more

immediately, life threatening. Examples were cited of patients with cancer being given priority for radiological investigations and critical care beds. As a result, patients with aortic aneurysms face great uncertainty about how soon they will be treated whilst knowing that their condition is life threatening. In addition, they know that they can be cured with surgery but that they have one chance in twenty (or worse) of not surviving the operation. They know that if the aneurysm ruptures before admission the probability of survival is much reduced. One can imagine the state of mind of these patients whilst they wait.

Of patients who were admitted as an emergency with an aortic aneurysm, 13 were on the waiting list for elective open repair and five were on the waiting list for endovascular repair. Three of these patients died giving a mortality rate of 17%; three times the rate for elective open repair. To these numbers must be added an unknown number of patients on the waiting list who died in the community from rupture of their aneurysm without reaching hospital.

It is clear that there are real risks in waiting for elective aortic aneurysm surgery. Policy must be changed so that patients with an aortic aneurysm have equal priority with all other patients with serious clinical conditions for diagnosis, investigation and treatment. The setting of priorities does not seem to have taken into consideration the risk of death while on a waiting list.

Cancellations

One in 25 patients had their original operation cancelled because there was no ward bed available.

One in six patients had their original operation cancelled because there was no critical care bed available.

One of the reasons patients waited so long for their operations was that an earlier date for their operation was arranged and then cancelled.

Bed availability

One in twenty five (4%, 17/410) of patients had their original operation cancelled because there was no ward bed available. NCEPOD did not collect data on the reasons why beds were not available but there is good anecdotal evidence that admissions for elective surgery are commonly cancelled because of pressure on hospital beds, especially from emergency admissions.

One in six (17%, 71/415) of patients had their original operation cancelled because there was no critical care bed available. Cancellation of aortic aneurysm repair for lack of a critical care bed was not an occasional unexpected event but a regular systematic feature of the practice of vascular surgery seen in this study. The study has also highlighted the number of patients going to a Level 3 bed when most patients undergoing an aneurysm repair can be safely managed in a Level 2 bed.

NCEPOD has expressed concern in the past about the inadequate number of staffed critical care beds, and considerable resources have been allocated in recent years to expand the provision of critical care resources, with a subsequent increase in bed numbers. However, it appears that a continuing shortfall of such beds still hampers the admission of many patients requiring elective complex surgery and Trusts must act to ensure that cancellation of major elective surgery for lack of critical care beds becomes a rare event.

4. Surgery

Elective surgery >> Preoperative assessment

Preoperative assessment clinic

Only 79% of elective patients attended a preoperative assessment clinic.

102 patients were seen by a pre-registration house officer alone or a pre-registration house officer and a nurse practitioner.

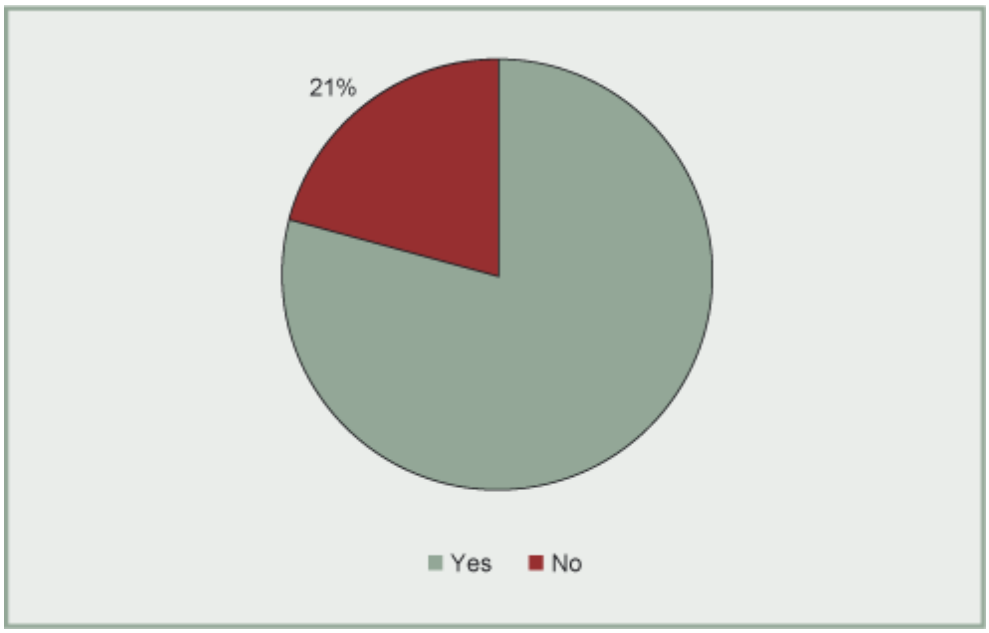

Figure 5. Number of patients who attended a preoperative assessment clinic *n=428/434. Percentage refers to patients who did not attend a clinic.*

Only 79% (339/428) of elective patients in this study were preoperatively assessed (Figure 5) and we believe that this figure is too low. All patients booked for aortic aneurysm repair should attend a preoperative assessment clinic. Comorbidity is very common among patients with AAA, and demands proper assessment before surgery.

Formal review in a preoperative assessment clinic is useful because it allows the surgeon and anaesthetist to ensure that the patient's condition has been optimised to reduce the risk of perioperative morbidity and mortality. Preoperative assessment clinics help identify previously unrecognised comorbidity and reduce the likelihood that surgery will be cancelled after admission because of the patient's medical condition.

The preoperative assessment clinic is also an opportunity to ensure that patients have been given all the information they need to give informed consent, and to meet the anaesthetist. Patients deserve the opportunity for an unhurried discussion of all the issues involved before their operation.

Staffing of the preoperative assessment clinic

Table 1. Members of the clinical team who assessed the patient at the preoperative assessment clinic *n=339. Answers may be multiple.*

Clinician	Total
Consultant anaesthetist	129
SpR anaesthetist year 3+	3
SpR anaesthetist year 1/2	1
SHO anaesthetist	2
Consultant surgeon	90
SpR surgeon 3+	18
SpR surgeon 1/2	2
SHO surgeon	24
PRHO surgeon	181
Nurse practitioner	142

Patients should be assessed by experienced and competent staff (Table 1). 102 patients were assessed by a PRHO alone or a PRHO together with a nurse practitioner. This suggests that some assessment clinics merely provide an opportunity for clerking and blood sampling. It is improbable that a PRHO or SHO in surgery would have had the knowledge and experience to properly assess a patient awaiting aortic surgery and to evaluate the risks and benefits of the procedure. Nurse practitioners who had been trained in preoperative assessment would have been able to manage routine patients very satisfactorily, but patients for aortic surgery need special consideration. Trusts should ensure that clinicians of the appropriate grade and experience are available to staff preoperative assessment clinics for aortic surgery patients, or that time is given in another clinical setting for the senior surgical and anaesthetic members of the team to satisfy themselves that the patient is ready for their operation and has given informed consent.

4. Surgery

Elective surgery >> Comorbidities

The large number of patients with cardiac and respiratory symptoms confirms the expectation of finding comorbidity in patients with abdominal aneurysms, especially hypertension and coronary artery disease. A history of heart failure more than one month before surgery was associated with a mortality rate of 21%. Few patients admitted for elective surgery had cardiac signs on admission but the presence of peripheral oedema was associated with a higher mortality. The presence of dyspnoea on exertion (a symptom associated with respiratory and cardiac disease) was also associated with an increase in mortality rate. Interestingly the presence of atrial fibrillation was not associated with increased risk of death although the number of cases was small. A large number of patients were classified as having other unspecified abnormalities on their ECG. However, the responses to this question by the surgeon may have been based on their own interpretation of the ECG or on a computerised analysis.

Table 2. Cardiac history in elective patients and their outcome *n=434. Answers may be multiple.*

Cardiac history	Total	% that died within 30 days
None	134	7
Angina controlled/on exertion	93	9
Heart failure more than one month ago	14	21
Hypertension	179	6
MI more than two months ago	107	7
Other	68	40
Unknown	1	
Not answered	2	

Table 3. Cardiac signs in elective patients *n=434. Answers may be multiple.*

Cardiac signs	Total	% that died within 30 days
None	362	6
Peripheral oedema	21	14
Other	49	8
Unknown	7	
Not answered	7	

Table 4. ECG and outcome *n=434. Answers may be multiple.*

ECG	Total	% that died within 30 days
None	243	5
AF rate >90	20	<1
Other abnormality	145	9
Not answered	2	

Table 5. Respiratory history and outcome *n=434.*
Answers may be multiple.

Respiratory history	Total	% that died within 30 days
None	295	4
Dyspnoea on exertion	113	11
Dyspnoea at rest	2	<1
Other	12	<1
Not answered	4	

9% (39/423) of patients were diabetic which is in line with previous knowledge that diabetes is a common comorbidity in people with vascular disease. However, in this study the presence of diabetes was not associated with an increased mortality. The 30 day mortality for patients considered to have a normal build was 5% (21/382). 28 patients were considered to be morbidly obese (30 day mortality 11%) and five were cachectic (30 day mortality 20%).

4. Surgery

Elective surgery >> Imaging

Table 6. Types of imaging and outcome *n=434. Answers may be multiple.*

Type of imaging	Total	% died within 30 days
CT	378	7
Ultrasound	286	5
Angiography	30	7
MRI	6	0
None	8	13
Unknown	1	
Not answered	1	

The most common imaging investigation was CT. It also illustrates why delays in obtaining access to CT facilities can slow the patient's journey from first consultation to operation. The next most common investigation was ultrasound. 244 patients were reported as having both ultrasound and CT and 2% (8/432) of patients were reported as having had no preoperative imaging before elective repair.

4. Surgery

Elective surgery >> The operation

Length of operation – surgical time

The length of operation was calculated from the times given for incision and closure (Figure 6). Although not measured it is recognised that a substantial amount of anaesthetic time is required for preparing the patient for surgery and for transfer to their postoperative destination once surgery is complete.

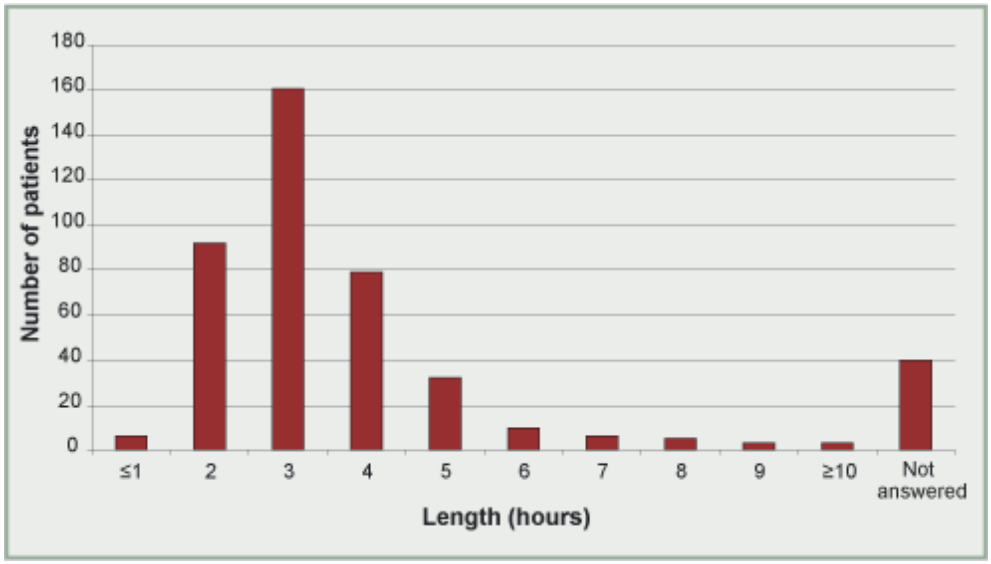

Figure 6. Length of operation *n=434*

The length of surgery could be calculated in 394 cases (Figure 6). The median time taken was three hours. 27 cases took longer than five hours and 12 of these patients died. Nearly three quarters of repairs (70%, 288/412) were done using a tube graft. Most bifurcated grafts were positioned entirely within the abdomen (i.e. aorto-biiliac grafts).
NCEPOD asked whether any other procedures were completed during the same theatre visit (Table 7) and clearly, in some cases, these extra procedures led to longer operating times.

Table 7. Other procedures completed during the same theatre visit *n=434. Answers may be multiple.*

Procedure	Total	% died within 30 days
Peripheral artery bypass	9	33
Thrombectomy / embolectomy	19	32
Other vascular procedures	21	29
Other non-vascular procedures	17	12
None	327	5
Not answered	47	

Additional vascular procedures were associated with a large increase in mortality and should be avoided unless essential.

Grade of surgeon

In 97% of cases the most senior operating surgeon was a consultant.

Data on the most senior grade of surgeon present were returned for 417 out of 434 elective aneurysm repairs (Table 8).

Table 8. Grade of the most senior operating surgeon

Grade of surgeon	**Total**	%
Consultant	403	97
Staff grade	3	<1
SpR year 3+	4	<1
Other	7	2
Sub-total	**417**	
Not answered	17	
Total	**434**	

A consultant surgeon was present for nearly every case (97%, 403/417). This is excellent practice as long as the degree of involvement of consultants as the most senior operating surgeon does not hinder trainees reaching the level of competency required for consultant practice. As a surgeon develops their skill it is important that they demonstrate the ability to manage and operate on complex cases to the satisfaction of their trainers before they are allowed to enter into independent practice as consultants. Although technical skill is only one of the requirements of a vascular surgeon it is clearly important where the risks of morbidity and death are high. Junior surgeons must receive sufficient training to acquire these skills. It is therefore acceptable for competent specialist registrars and SAS surgeons to undertake AAA repair when a consultant is immediately available for advice and help.

Specialty of surgeon

All but one of the elective operations for which data were available were performed by a vascular surgeon or a general surgeon with a vascular interest.

92% of these surgeons were members of the Vascular Society of Great Britain and Ireland.

Surgeons were asked to report their surgical subspecialty and Figure 7 shows this reported by the most senior operating surgeon.

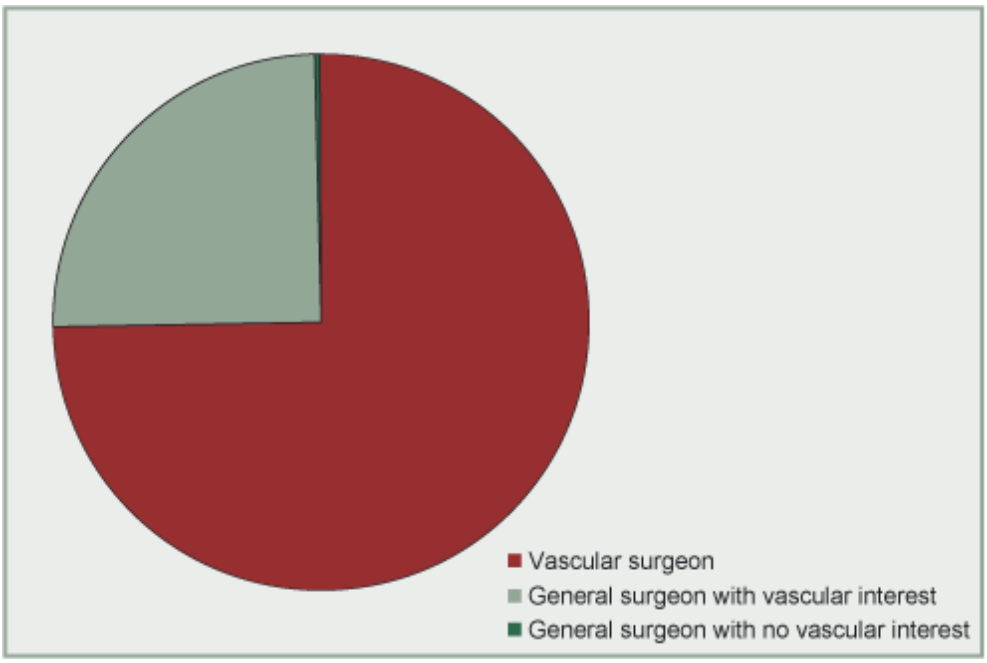

Figure 7. Specialty of the most senior operating surgeon *n=416/434*

Surgeons performing AAA repair fall into the category of 'General Surgeons' as defined by the Specialist Advisory Committee. This is a transition period as many surgeons are still working who underwent an extended training that allowed them to develop skills in many subspecialties, although they may no longer use all of those skills. In the future, shortened training schemes will only allow surgeons to reach competency in one or occasionally two subspecialties.

NCEPOD asked surgeons to specify their specialty. 75% (311/416) of elective patients were operated on by vascular surgeons. In this study a vascular surgeon was defined as a surgeon with expertise and a regular practice in vascular surgery (at least 70% of elective surgical time devoted to doing vascular cases). 25% (104/416) of patients were operated on by general surgeons with a vascular interest; in this study these were surgeons who spent a substantial proportion of elective surgical time doing vascular cases, but typically less than 70%. One elective patient was operated on by a general surgeon with no special interest in vascular surgery and in 18 cases the question was left unanswered.

Membership of Vascular Society and outcome

Many surgeons with a special interest in a subspecialty of general surgery are members of specialist societies. These societies, such as the Vascular Society of Great Britain and Ireland (VSGBI) are supported by and in turn advise the Association of Surgeons of Great Britain and Ireland (ASGBI) and the Royal Colleges of Surgery. Surgical societies typically organise educational events, help in the setting of standards and increasingly promote comparative audit. However, membership of such a society is not a prerequisite to perform vascular surgery and is not a guarantee of competency, but it might act as a marker of continuing professional development and a willingness to participate in comparative audit. The great majority of surgeons operating on elective cases were members of the VSGBI.

The development of strong surgical societies may be acting as a driver towards increasing subspecialisation and it is likely that in the future some subspecialties will no longer see themselves as a part of 'General Surgery'. This happened with orthopaedics and more recently urology. A further driver of subspecialisation is the need to train consultants in a shorter period. While hospitals with a large staff of consultants may be able to cope with this change it may prove

to be a problem in smaller and remote hospitals where newly appointed consultants cannot cover the full range of general surgical emergencies.

The data have been analysed to see whether there was any difference in outcome between operations performed by surgeons who were and who were not members of the VSGBI (Table 9). These data must be interpreted with caution. Some surgeons may have contributed more than one case and the number of cases done by surgeons who were not members of the VSGBI was small but there appeared to be no difference in outcome associated with membership of the VSGBI.

Table 9. Surgeon's membership of the VSGBI and patient outcome

Member of VSGBI	Alive at 30 days	Died within 30 days	% died within 30 days	Not answered	Total
Yes	313	21	6	1	**335**
No	26	2	7	0	**28**
Sub-total	**339**	**23**		**1**	**363**
Unknown	10	0		0	**10**
Not answered	56	4		1	**61**
Total	**405**	**27**		**2**	**434**

4. Surgery

Elective surgery >> Surgeons' workload

Surgeons' workload

18% of elective patients were operated on by a surgeon who performed fewer than 10 elective AAA repairs a year.

This section must be interpreted with great caution because the denominator data are based on returned surgical questionnaires. Some surgeons may have returned more than one. This is most likely to happen with surgeons who perform many aneurysm repairs but could happen with low volume surgeons by chance.

The most senior operating surgeon was asked to supply the number of AAA repairs performed in 2002/03 and the source of that information. In 122 questionnaires the surgeon chose not to answer the question, 67 answers were "from memory" and 245 from a logbook or information system. NCEPOD believe that clinicians and Trusts should take joint responsibility for collecting high quality data about procedures performed and outcomes. This is recognised as part of good clinical governance.

Number of cases

Figure 8 shows how many patients were operated on by a surgeon performing between one and five elective AAA repairs in 2002/03, the number who reported performing between six and 10 and so on. In all cases the surgeon reporting data had performed at least one elective repair in 2002/03. It must be remembered that some surgeons may have returned more than one questionnaire and many surgeons relied on memory. Since surgeons performing the most AAA repairs are more likely to have contributed more than one case, the right hand side of the chart (which already demonstrates that relatively few surgeons performed more than thirty AAA repairs) may be an overestimate.

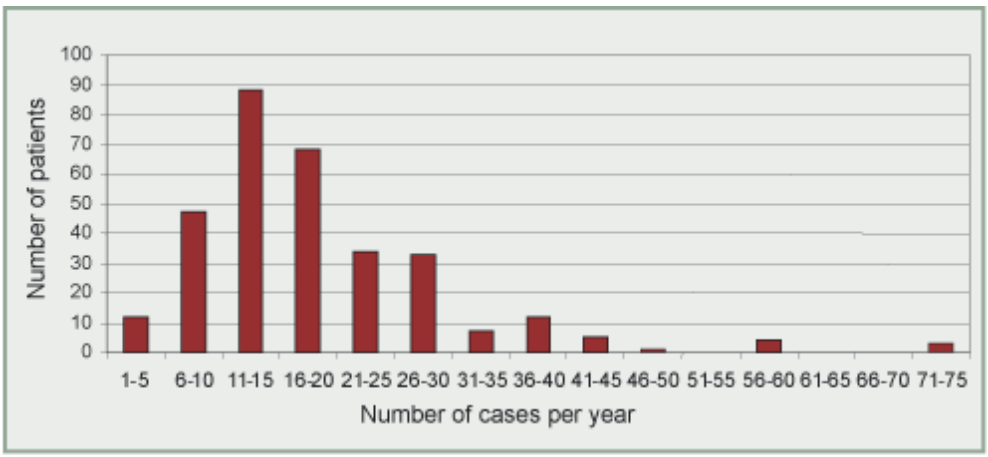

Figure 8. Number of elective repairs performed by the most senior surgeon *n=312/434*

Only 82% (255/312) of procedures were performed by surgeons who had probably performed more than 10 elective aneurysm repairs in the year 2002/03.

Workload and outcome

NCEPOD has considered whether the data available can be of use in examining the relationship between the outcome of surgery and the number of procedures that a surgeon performed in a year.

While other studies have suggested a relationship between outcomes after AAA repair and the experience of the surgeon, the relationship is not clear in this study. This may reflect small numbers or the fact that the experience of the surgeon is, as seems likely, only a part of the explanation of postoperative mortality. What we do note in the present study however, is that patients operated on by surgeons performing over 30 AAA repairs a year had fewer postoperative deaths than average.

If this is true, it raises questions about subspecialisation and volumes of work necessary for a hospital to offer a vascular service. Could it be that surgeons performing aneurysm repair should be aiming to do one a week? Should aneurysm repair be concentrated in fewer units?

4. Surgery

Elective surgery >> Postoperative complications within 30 days of surgery

21% of elective cases had an infective complication of some sort.

1% of patients developed paraplegia.

6% (25/430) of patients had a graft complication and 14 (3%) returned to theatre. Complications related to limb ischaemia were reported in 5% (23/428) of cases and 12 patients (3%) had to return to theatre, one requiring an amputation.

Infections were common, affecting one in five patients undergoing an elective aneurysm repair. We did not ask specifically about MRSA but as might be expected the most common infections were chest infections (14%, 60/431) and wound infections (4%, 16/431). Only two patients developed graft infections within 30 days of surgery.

7% (31/428) of patients were reported to have had a myocardial infarction. For three patients there was no answer to this question and in another three it was unknown. No specific criteria for diagnosis of infarction were laid down in the questionnaire, so some silent myocardial infarcts may not have been reported. 45% of those who had an infarct died within 30 days of surgery. This is consistent with other reports of the grave prognosis of myocardial infarction in this context.

Table 10. Position of aortic clamp

Position of clamp	Total	%
Sub-diaphragmatic	4	1
Supra-renal	37	9
Infra-renal	352	90
Sub-total	**393**	
Unknown	12	
Not answered	29	
Total	**434**	

The incidence of clamps placed above the renal arteries (9% 37/393) seems quite high (Table 10). The development of renal impairment after elective surgery was divided into those patients showing a rise in urea of greater than five mmol/l above the preoperative level, and those who required renal support. Not surprisingly there was a marked increase in the risk of renal impairment if the clamp was placed above the renal arteries at some point in the operation. Although only 9% of patients had a clamp applied above the renal arteries, the urea rose over 5mmol in 25% of patients, and 41% required renal support.

There were 335 cases when the clamp was applied below the renal arteries and in whom data were supplied for both the preoperative creatinine level and the outcome for renal function.

Table 11. Level of renal impairment in patients with an infra-renal aortic clamp							
Preoperative creatinine level	**No renal impairment**	**%**	**Urea >5mmol above preoperative level**	**%**	**Renal support**	**%**	**Total**
≤125 µmol/L	264	95	10	4	3	1	**277**
>125 µmol/L	46	79	9	16	3	5	**58**
Total	**310**		**19**		**6**		**335**

Despite a preoperative creatinine level of ≤ 125 µmol/L, 5% of patients with an infra-renal aortic clamp developed some degree of renal impairment. This figure rose to 21% for those with a preoperative creatinine level above 125 µmol/L.

Four patients (1%, 4/426) were reported to have suffered a stroke within 30 days of surgery. One of the two patients who had a disabling stroke died.

Two patients (0.5%, 2/427) developed ischaemic bowel, (confirmed either at laparotomy, by mucosal changes at endoscopy or at autopsy). Both patients died.

1% (4/426) of patients developed paraplegia but all survived to 30 days. This would seem to have been a more frequent event than might have been anticipated. It is a catastrophic complication. NCEPOD has no information on the consent process, so cannot comment on whether the possibility of this complication would have been explained to the patient before the operation.

‘Other’ complications were reported for 19% (68/367) of patients.

4. Surgery

Emergency surgery >> Mode of admission

Mode of admission

19% of emergency admission patients were transferred from other hospitals.

The mortality rate for emergency admissions with symptoms related to their AAA is higher than for patients admitted electively even though the AAA may not have ruptured.

264 patients were admitted and underwent emergency AAA repair. Mortality after AAA repair following emergency admission was high with 36% (94/264) dying within 30 days of surgery. This contrasts with elective admissions, with a mortality rate of 6.2% (27/434).

For the 50 patients transferred from another hospital, the mortality was slightly better (28%,14/50) compared to those operated on in the hospital to which they were first admitted, who had a 30 day mortality of 37% (80/214).

Why did transferred patients have a lower mortality? Patients considered for transfer should be sufficiently stable to withstand the journey and there must be a perception that their chance of survival will be increased by transfer to a unit with appropriate staff or other resources. This study did not collect data on how many patients were considered for transfer but did not reach the accepting hospital, either because of deterioration before transfer or death in transfer. Patients who survived transfer were therefore likely to have been subject to a greater degree of selection than those who were not transferred.

As discussed above, 20% (52/264) of the emergency admission patients were known to have an aneurysm before their admission and of these 16 died, 13 were recorded as being on a waiting list for open repair and five for endovascular repair. Since only 20-25% of patients whose aneurysm ruptures in the community will reach hospital alive [3], it is likely that mortality amongst patients on the waiting list is somewhat higher than this.

Patients unsuitable for elective repair

There is always discussion about the proper course of action when a patient is admitted to hospital with an aortic aneurysm as an emergency when they have previously declined, or been turned down for elective repair. Because the relevant hospital notes may not be available in the acute setting, the clinician may not be aware of how and why the previous decision was made. In this study 11 (21%) of the 52 patients admitted with a known aneurysm had been classed as unsuitable for elective repair. NCEPOD did not collect data on what reasons lay behind the original decision to deem the patient as unsuitable for aneurysm repair. In the event, four of the 11 patients, (36%), survived and left hospital within 30 days.

4. Surgery

Emergency surgery >> Demographics

19% (50/264) of emergency admissions were female compared to 13% (57/434) of patients for elective AAA repair. The median ages were 75 years for men and 78 for women, which is older than for patients undergoing elective repair.
The surgeon was asked to classify the status of the aneurysm. From the answers received, 168 were ruptured aneurysms and 81 were classified as unruptured, either symptomatic or asymptomatic.

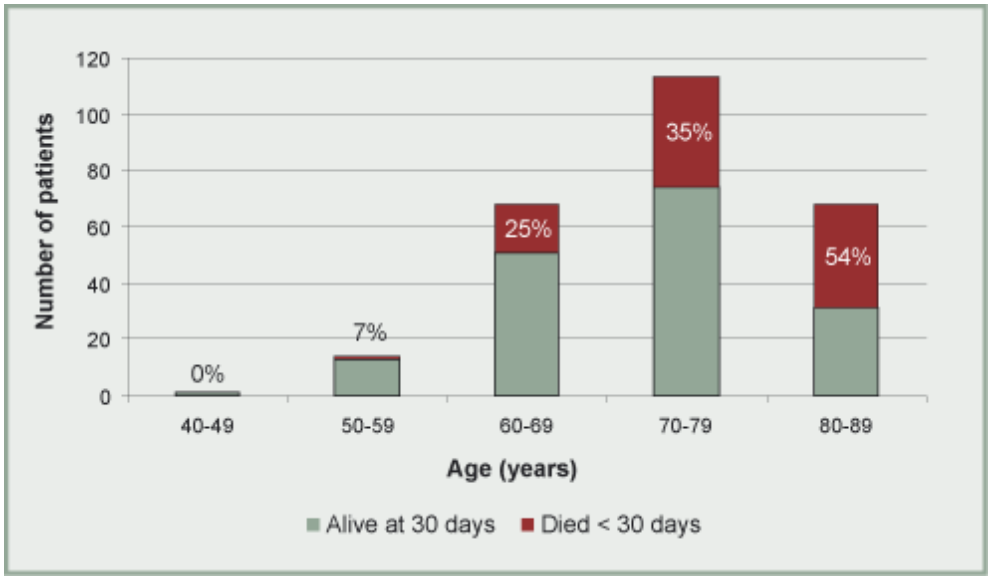

Figure 9. Age by mortality *n=264. Percentages refer to patients who died in hospital within 30 days.*

4. Surgery

Emergency surgery >> Comorbidities

Cardiac and respiratory comorbidity were common. The numbers are small, but an increased risk of mortality is seen with angina and heart failure. The presence of atrial fibrillation was associated with an increased mortality and this is in contrast to elective patients where atrial fibrillation was not associated with increased mortality, although the numbers are small. The presence of dyspnoea on exertion was associated with an increased mortality rate and it is recognised that in some patients the dyspnoea may have been due to cardiac pathology.

Table 12. Cardiac history and outcome *(answers may be multiple)*

Cardiac history	Died within 30 days	% who died within 30 days	Alive at 30 days	Total *n=264*
None	25	27	69	**94**
Angina controlled	25	42	34	**59**
Angina uncontrolled	3	75	1	**4**
Heart failure within one month	5	83	1	**6**
Heart failure more than one month	7	58	5	**12**
Hypertension	35	46	61	**96**
MI/cardiac arrest this admission	2	33	4	**6**
MI 0-2 months before surgery	0	0	1	**1**
MI >2 months before surgery	17	45	21	**38**
Orthopnoea	4	57	3	**7**
Other	12	46	14	**26**
Not answered	1		0	**1**

Table 13. Cardiac signs and outcome *(answers may be multiple)*

Cardiac signs	Died within 30 days	% who died within 30 days	Alive at 30 days	Total n=264
None	55	29	133	**188**
Peripheral oedema	9	50	9	**18**
Pulmonary oedema	2	67	1	**3**
Raised JVP / high CVP	3	75	1	**4**
Other	17	63	10	**27**
Unknown	10		15	**25**
Not answered	1		1	**2**

Table 14. ECG and outcome				
ECG	**Died within 30 days**	**% who died within 30 days**	**Alive at 30 days**	**Total**
Normal	28	24	88	**116**
AF rate >90	8	50	8	**16**
Other abnormality	32	45	39	**71**
Sub-total	**68**		**135**	**203**
Unknown	25		32	**57**
Not answered	1		3	**4**
Total	**94**		**170**	**264**

Table 15. Respiratory history and outcome				
Respiratory history	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
None	47	29	114	**161**
Dyspnoea on exertion	26	43	35	**61**
Dyspnoea at rest	1	25	3	**4**
Other	3	33	6	**9**
Sub-total	**77**		**158**	**235**
Unknown	16		10	**26**
Not answered	1		2	**3**
Total	**94**		**170**	**264**

Mortality was higher among morbidly obese patients (47%, 9/19) than patients of normal build (32%, 68/214) and all three cachectic patients died.

Only 6% (14/251) of emergency admissions were diabetic, lower than elective admissions (9%) but unlike the data from elective patients, diabetes was associated with an increased mortality (50%). However, the numbers are small and there was no information about diabetic status in 13 patients, making it impossible to draw any conclusion about the impact of diabetes on survival in this study.

There was an increased mortality rate among patients who were not fully conscious when assessed before operation. However, being comatose with a Glasgow Coma Score (GCS) of less than nine was not on its own a certain predictor of an adverse outcome. Two out of the seven patients with a GCS less than nine survived their operation and were discharged (Table 16).

Table 16. Glasgow Coma Score and outcome				
Glasgow Coma Score	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
Fully conscious (15)	54	27	143	**197**
Intermediate (9-14)	32	60	21	**53**
Unconscious (3-8)	5	71	2	**7**
Sub-total	**91**		**166**	**257**
Unknown	3		3	**6**
Not answered	0		1	**1**
Total	**94**		**170**	**264**

4. Surgery

Emergency surgery >> Imaging

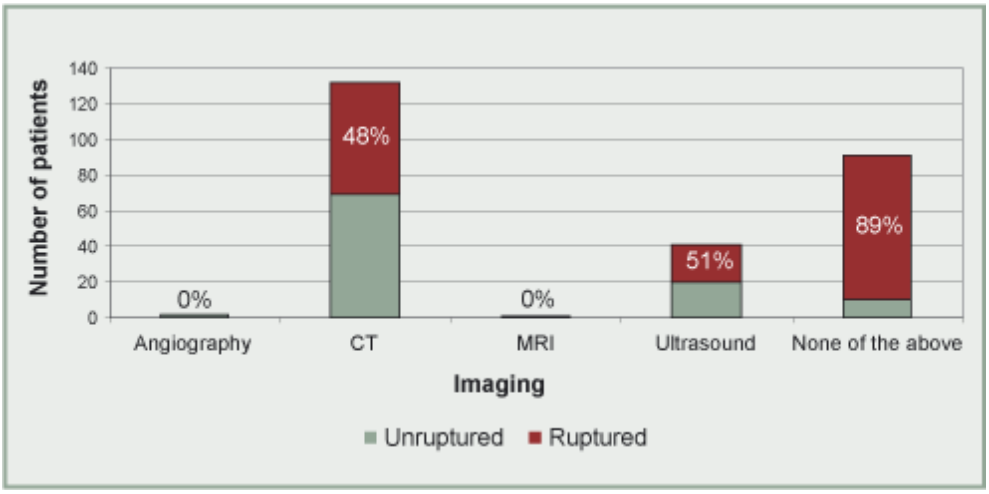

Figure 10. Imaging *n=263/264. Answers may be multiple. Percentages refer to patients with ruptured aneurysms.*

Figure 10 shows the imaging modalities used, divided into whether the aneurysm was ruptured or unruptured. Clearly, there are many patients who are stable enough for imaging even when the AAA has ruptured. Only three patients (unruptured) had any imaging additional to CT or ultrasound. As expected, the great majority of patients in whom no imaging was performed had ruptured aneurysms; presumably the diagnosis was not in doubt and the patient's condition required immediate operation without delay.

4. Surgery

Emergency Surgery >> The operation

Time of day

Figure 11 shows the time of day when the operation started and the outcome.

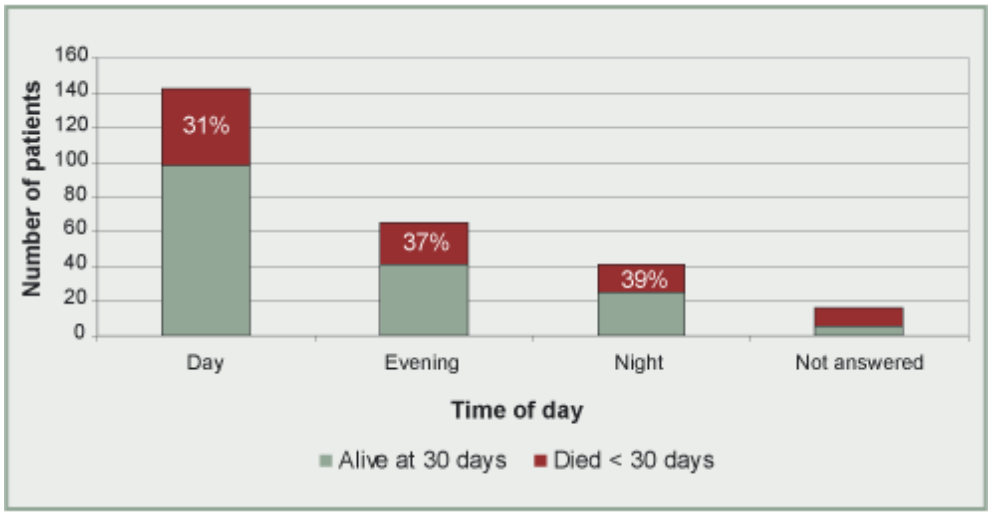

Figure 11. Time of day when operation started by outcome *n=264. Percentages refer to patients who died within 30 days.*

Emergency AAA is a procedure that must be done as soon as reasonably possible especially when patients are cardiovascularly unstable. The procedure may have to be undertaken at night which may cause a deleterious delay if senior staff have to come into the hospital. The differences were not great but there is an impression that the outcome was better when emergency AAA repair was carried out in the daytime. There may be a number of reasons for this but it is possible that patients admitted as an emergency at night with an unruptured aneurysm (with a lower risk of mortality than a ruptured AAA) may have been operated on the next morning, a possibility explored further in the next section.

Time to operation

Figure 12 shows the interval between the time when the decision to operate was taken and the time of incision.

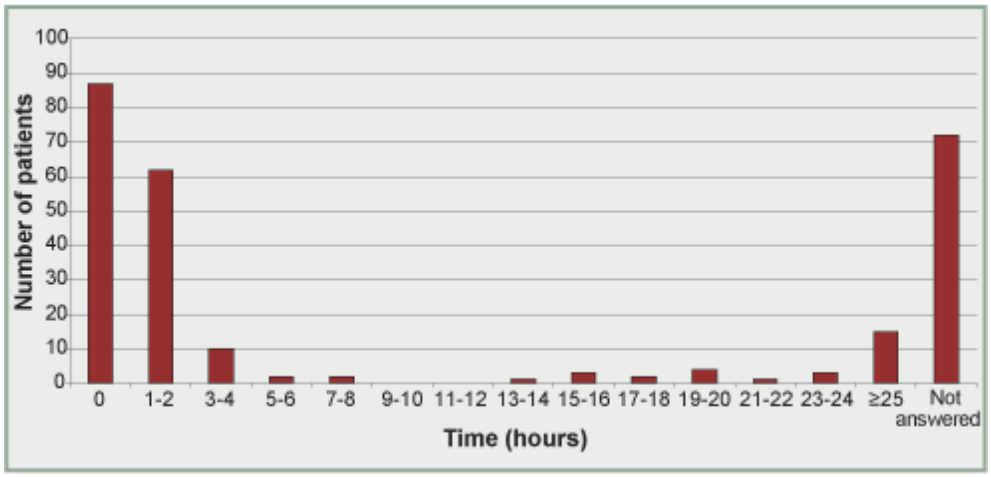

Figure 12. Time to operation from time decision was made to operate *n=264*

Some cases were delayed for many hours, indeed there appears to be a second cohort after a 12 hour interval. This may represent patients admitted in the evening or night with unruptured aneurysms whose operation was planned for the next day.
Data from 192 cases were available to calculate the interval to operation. In 78% (149/192) of cases the incision time was less than two hours after the decision to operate. The interval was over 25 hours in 15 cases.

Delays that prevented surgery at the time it was clinically indicated were reported in 8% (19/244) of cases. The cause of the delay was only supplied in three cases; in two cases the delay was due to lack of theatre resources and in one it was due to lack of critical care resources.

Length of operation - surgical time

The length of operation was calculated from the times given for incision and for closure. Figure 13 gives the range of surgical time, and the number of patients who died or were alive at 30 days. Overall, emergency cases were likely to take a shorter time than elective operations. Operations that were very short or very long often had an adverse outcome.

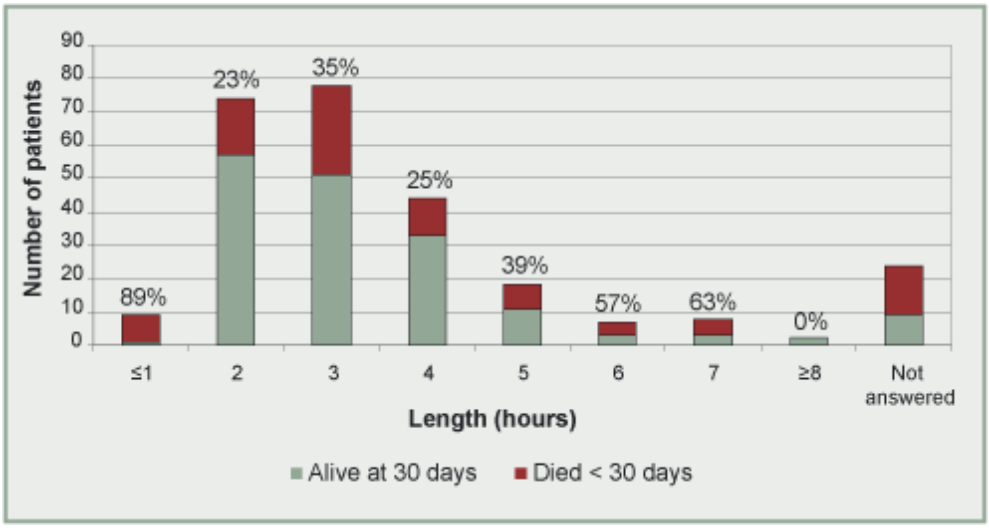

Figure 13. Length of operation *n=264. Percentages refer to patients who died in hospital within 30 days.*

Nearly three quarters of repairs (73%, 182/249) were done using a tube graft. This is a similar

proportion to that for elective repairs. 23 patients also underwent a thrombectomy/embolectomy and four a peripheral artery bypass.

Grade of surgeon

15 emergency operations were performed without a consultant surgeon present.

Data on the grade of the most senior operating surgeon present were returned for 254 out of the 264 emergency aneurysm repairs (Table 17).

Table 17. Grade of the most senior operating surgeon

Grade of surgeon	Total	%
Consultant	239	94
SpR year 3+	8	3
Other	7	3
Sub-total	**254**	
Not answered	10	
Total	**264**	

The data collected in this study did not include any information about how many emergency cases were started by a junior waiting for a consultant to arrive.

Fifteen AAA repairs were performed without a consultant present. Given the high mortality of this operation in the emergency setting it is surprising that even this small number were performed unsupervised. While the elective setting is an ideal opportunity for training, it is only the highly competent junior who could be left to do an emergency repair and it would seem reasonable to have a consultant nearby for advice and help. However, it is possible that a specialist registrar training in vascular surgery may be more competent than a consultant on-call who does no elective vascular surgery. To ensure availability of adequately trained surgeons to treat patients admitted as emergencies with AAA, Trusts may need to develop networks to provide this service and the number of Trusts admitting surgical emergencies may need to be reviewed. Models for delivering emergency vascular services have been proposed by the VSGBI [4].

Specialty of surgeon

16 emergency operations were performed by a surgeon without an elective vascular workload.

Surgeons were asked to report their surgical subspecialty. We received information for all but 12 cases (Table 18).

Table 18. Specialty of the most senior operating surgeon		
Specialty of surgeon	**Total**	**%**
Vascular surgeon	179	71
General surgeon with vascular interest	57	23
General surgeon with no vascular interest	8	3
Specialist surgeon	8	3
Sub-total	**252**	
Unknown	2	
Not answered	10	
Total	**264**	

94% (236/252) of patients were treated by surgeons with expertise in vascular surgery. Many of the operations must have been done in hospitals without a separate vascular on call rota, so the commitment by these surgeons is commendable.
However, 6% (16/252) of AAA repairs were performed by surgeons who had no special interest in vascular surgery or specifically had a special interest in another branch of surgery, for example, colorectal surgery. The mortality rate for vascular surgeons and surgeons with a vascular interest was 32% (76/236) and for general surgeons and surgeons with another specialist interest it was 50% (8/16).

It is highly unsatisfactory that patients presenting with a major vascular emergency received their treatment from a consultant surgeon who did not do vascular surgery as a regular part of their elective work. NCEPOD has no information as to what information patients were given as part of the consent process before operation. One should also understand the anxieties of the surgeons involved, who recognise the limitations of their expertise in vascular surgery, yet have to do the best they can for the patient because those are the circumstances in which they find themselves. This is increasingly a problem for other subspecialties of general surgery in the emergency setting.

The situation regarding availability of vascular surgeons is constantly changing and it should be borne in mind that these data were collected in the spring of 2004, 18 months before the publication of this report. Yet, at the time of writing there were insufficient vascular surgeons nationally to provide specialist care for all emergency admissions. Even with the planned expansion of consultant numbers there will be too few vascular specialists for all hospitals accepting surgical emergencies to provide a specialist vascular service. The question remains; how best can we provide care for a patient admitted as an emergency with an AAA? Solutions may include the transfer of patients to nearby units with vascular surgeons available; directing admissions to appropriate units in the first place; and surgeons who can travel and cover additional hospital sites. There will be exceptional geographical circumstances where it may be very difficult to ensure timely access to a surgeon with vascular expertise. In all other areas, Strategic Health Authorities and Trusts should co-operate to provide a service for patients such that only surgeons with vascular expertise operate on emergency aortic aneurysm patients.

Membership of the Vascular Society and outcome

The data have been analysed as to whether there was any difference in outcome between operations performed by surgeons who were and who were not members of the VSGBI. Because so many surgeons chose not to answer this question one must be cautious about the significance of the better survival associated with operation by a member of the VSGBI.

Table 19. Surgeon's membership of the VSGBI and outcome				
Member of VSGBI	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
Yes	26	35	49	**75**
No	9	45	11	**20**
Sub-total	**35**		**60**	**95**
Unknown	2		0	**2**
Not answered	57		110	**167**
Total	**94**		**170**	**264**

4. Surgery

Emergency Surgery >> Surgeons' workload

Surgeons' workload

69% of emergency operations were performed by surgeons who had done five or more emergency AAA repairs in 2002/03.

As discussed in the section on elective admissions, these data must be interpreted with great caution.

Figure 14 shows the number of patients operated on by surgeons who performed no emergency AAA repairs in 2002/03, the number who performed between one and five, and so on.

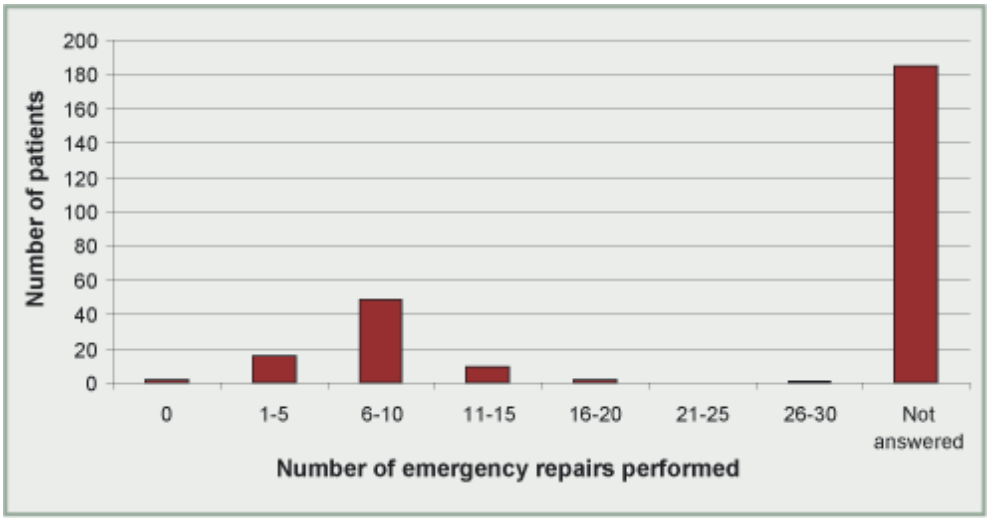

Figure 14. Number of emergency repairs performed by the most senior surgeon *n=264*

There were 185 blank responses to this question. In two cases the surgeon reported that they had performed no emergency AAA repairs in 2002/03 and in 77% (61/79) of cases, the surgeon had performed more than five emergency AAA repairs in the year.

Workload and outcome

NCEPOD has examined whether the data available to NCEPOD can be of use in examining whether the outcome of emergency surgery was related to the number of procedures that a surgeon performed in a year.

As with elective surgery, because of the small numbers it is hard to draw conclusions about the relationship between the number of AAA repairs a surgeon performed and the likely outcome of patients admitted as an emergency who required an AAA repair. Once again however, the best results were amongst patients operated on by surgeons with the greatest experience of elective AAA repairs in the previous year.

4. Surgery

Emergency Surgery >> Postoperative complications within 30 days of surgery

Graft complications were reported in 14% (33/242) of cases, double the incidence in the elective setting (6%). 14 patients (6%, 14/242) were returned to theatre and three of these required an amputation.

There were few complications reported related to limb ischaemia. Three patients out of the 239 (1%) required amputation and three had to return to theatre for other reasons.

28% (66/238) had a postoperative infection and for 26 patients it was unknown whether there had been any infections. The most common infections were chest infections (20%, 46/238) and no patient developed a graft infection within 30 days of surgery.

17% (37/223) of patients were reported to have had a myocardial infarction. 15 questionnaires were marked unknown and 26 questions were left unanswered. No specific criteria for diagnosis of infarction were laid down in the questionnaire, so in addition some silent myocardial infarcts may have not been reported. 57% (21/37) of those who had an infarct died within 30 days of surgery compared with 18% of those who did not.

Table 20 shows the emergency operations grouped according to the highest position at which the clamp was placed.

Table 20. Position of aortic clamp

Position of clamp	Total	%
Sub-diaphragmatic	13	5
Supra-renal	19	8
Infra-renal	211	87
Sub-total	**243**	
Unknown	10	
Not answered	11	
Total	**264**	

The development of renal impairment after elective surgery was divided into those patients showing a rise in urea > 5 mmol/l above preoperative level and those who required renal support (Table 21).

Table 21. Number of cases with postoperative renal impairment

Renal impairment	Total	%
None	141	64
Urea > 5 mmol above preoperative level	49	22
Requiring haemofiltration / dialysis	30	14
Sub-total	**220**	
Unknown	12	
Not answered	32	
Total	**264**	

Renal failure was commonly associated with mortality. 39% (19/49) of patients who developed a

raised urea died, and 60% (18/30) of patients who required renal support died.

Eight patients (3%, 8/236) were reported to have suffered a stroke within 30 days of surgery; three disabling and two non-disabling. The three remaining patients were reported to have had an 'other' type of stroke. Three of the eight patients reported as having strokes died.

Five patients (2%, 5/230) developed ischaemic bowel, (confirmed either at laparotomy, by mucosal changes at endoscopy or at autopsy). One patient survived.

One patient developed paraplegia and died.

'Other' complications were reported for 35% (64/184) of patients.

4. Surgery

Recommendations

Patients with an aortic aneurysm requiring surgery must have equal priority with all other patients with serious clinical conditions for diagnosis, investigation and treatment.

Trusts should take action to improve access to Level 2 beds for patients undergoing elective aortic aneurysm repair so as to reduce the number of operations cancelled and inappropriate use of Level 3 beds.

Trusts should ensure that clinicians of the appropriate grade are available to staff preoperative assessment clinics for aortic surgery patients.

Strategic Health Authorities and Trusts should co-operate to ensure that only surgeons with vascular expertise operate on emergency aortic aneurysm patients, apart from exceptional geographical circumstances.

4. Surgery

References

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4 *The provision of emergency vascular services.* Vascular Society of Great Britain and Ireland, 2001.