Decreased Mortality of Abdominal Aortic Aneurysms in a Peripheral County

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Objectives: To analyse the effect on the mortality associated with abdominal aortic aneurysms, due to the establishment of a decentralised vascular surgical unit in the county of Viborg.
Methods: Death after aneurysm repair and from rupture without repair were analysed retrospectively for the 3 year period before (1986–88), and after (1989–91), the unit was established.
Results: Between 1986 and 1988, one patient (5%) died after 19 elective and three emergency non-ruptured aneurysm repairs. Only three ruptures were repaired with two deaths. In the county, 41 deaths due to ruptured aneurysm were recorded. Between 1989 and 1991 two patients (4%) died after 26 elective and 27 emergency non-ruptured aneurysm repairs. Nineteen ruptures were repaired with six deaths (32%). In the county, 28 deaths due to rupture were recorded during this period.
Conclusions: The establishment of a decentralised vascular surgical unit has increased the proportion of ruptured aneurysms reaching surgery with a resultant decrease in mortality from this condition.

Key Words: Abdominal aortic aneurysm; Rupture; Surgical repair; Mortality; Decentralisation.

Introduction

The prevalence of abdominal aortic aneurysms (AAA) is increasing[1–5] and despite an increasing number of elective operations, the incidence of ruptured AAA is also increasing.[1] Despite improved diagnosis, surgical and anaesthetic techniques, the postoperative mortality after ruptured AAA remains between 40–50%.[6–11] The overall mortality of ruptured AAA is un-changed at 75–90%.[3,4,6,7,12]

Any analysis of the importance of a short transfer time to hospital is made difficult by diagnostic delay and selection because haemodynamically stable patients have the best prognosis, and tolerate longer transport times.[13] As a consequence a peripheral unit will probably receive a larger number of haemodynamically unstable patients with a poorer prognosis than centralized units.[13] Despite this some authors have found increased postoperative mortality with increasing duration of transfer.[6,13]

One possible solution would be to perform emergency operations in peripheral units but reports have shown higher mortality when such operations are carried out by non-vascular surgeons[14] or when the

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volume of operations is low.[15] We therefore analysed the safety and effect of operations for AAA carried out by vascular surgeons in a decentralized vascular surgical unit, integrated in a general surgical department. There are two full-time vascular surgeons and ultrasonography, angiography and an intensive care unit were also available at the hospital.

Material and Methods

The County of Viborg has approximately 230 000 inhabitants of whom 73 000 are above 50 years. Data from patients operated for AAA in the county of Viborg from 1986–1988 before establishment of the unit and from 1989–91 afterwards were reviewed. Demographic data, indications, complications and mortality were recovered. No inhabitants of the county were operated on in any other centres after the establishment of AAA. Data concerning people in the county who died from ruptured AAA or were diagnosed having a ruptured AAA at the five hospitals in the County from 1986 to 1991 were collected from local, neighbouring and The National Health Department register. The term emergency operation performed on patients without rupture means an acute

operation indicated by symptoms but no leak found at operation.

Results

Between 1986 and 1988 19 elective operations (76%), three acute operations without rupture (12%) and three operations with rupture (12%) were performed. There was one death after elective and acute non-ruptured repair (mortality 5%) and two deaths after ruptured repair (mortality 66%). The total incidence of operations was 36/million/year and elective 28/million/year. In the period 1989–91 elective resection was carried out on 26 patients (36%), acute operations without rupture on 27 patients (37.5%) and ruptured AAA was repaired in 19 cases (26.5%). There were two deaths after elective and non-ruptured repair (4%) and 6 deaths after ruptured repair (32%). The total incidence of operations was 104/mill/year, and elective 38/mill/year (Table 1).

Between 1989 and 1991 postoperative complications were seen in 37.5% of cases. 15.3% of all patients required re-operation and 22% had other complications, mostly cardiopulmonary (Table 2). Eight patients died within 30 days after operation, six deaths

Table 1. Demographic date. Abdominal Aortic Aneurysm Operation. County of Viborg, Denmark, 1989–1991

	Total	Elective	Acute (no rupture)	Acute (rupture)
Number	72	26	27	19
Mean age (years)	69.8	68.2	67.9	74.9
Range (years)	49–82	49–78	53–78	59–82
Sex ratio (M/F %)	75/25	73/27	83/17	72/27
Incidence (million/year)	104.4	37.7	38.3	26.9

Table 2. Complications after AAA-surgery in the county of Viborg 1989–1991

		Number	%	95% CI*
	Bleeding	4	5.5%	1.5–13.6%
	Ileus	4	5.5%	1.5–13.6%
Operation-demanding	Wound infection	1	1.4%	0.0–7.5%
	Wound rupture	2	2.7%	0.3–9.7%
	Occlusion	0	0.0%	0.0–5.0%
	Amputation	0	0.0%	0.0–5.0%
Non-operation-demanding	Cardial	5	6.9%	2.3–15.5%
	Renal failure	5	6.9%	2.3–15.5%
	Haemodialysis	0	0.0%	0.0–7.5%
	Respirator >48 h.	6	8.3%	8.3–17.3%

Fatal complications are not included.
* 95% confidence limits.

after operation for ruptured AAA. Three of these were because of bleeding, two because of multiorgan failure, and one because of uraemia. Two died of cardiac failure, one after elective and one after acute operation without rupture.

In 1983 to 1987, 600 patients were operated on because of ruptured AAA in the whole of Denmark and 296 survived, giving a postoperative mortality of 50.5%.[11] A total of 934 patients died of ruptured AAA in Denmark during the same period (overall mortality 76%).

The Health Authorities of Viborg County identified all persons with ruptured AAA diagnosed at the hospitals of the County. From our study and data from neighbouring counties we know who underwent operation. Unoperated patients with ruptured AAA must have died at the primary receiving hospital or during transportation to the vascular surgical unit.

Between 1986 and 1988 41 patients died of ruptured AAA in the County, 26 (63%) outside hospital and 13 (32%) at the primary receiving hospital. Three reached operation (7.3%) and two of these died giving an overall mortality of 98%. 187/million above 50 years/year died in the county of AAA compared with a national incidence of 136/million above 50 years/year. In the period immediately after the introduction of vascular surgery in the county (1989–91), 39 patients were diagnosed as having a ruptured AAA and 26 died of ruptured AAA (67%) i.e. 127/million 50 + /year. Eleven persons died outside hospital (28%), eight at the primary hospital (20.5%), one at the vascular unit preoperatively, and six after operation. After the establishment of the vascular unit, 50% of patients with a ruptured AAA reached operation, a sevenfold increase compared with the previous period (Chi square = 10.3, $p < 0.01$). There was also a significant decrease of 32% in deaths caused by ruptured AAA in the county (Chi-square = 27.7, $p < 0.001$).

Discussion

Is it safe for AAA-surgery to be carried out at a peripheral hospital by vascular surgeons integrated in a general surgical department? Two conditions must be fulfilled for the answer to be yes: The level of activity must be equal to the national activity and the frequency of serious complications including mortality should be similar to that in specialised vascular units.

It is striking that only 36% of operations in the peripheral unit were elective compared with 50% nationally.[10] The reason could be explained by the

unusually large number of acute operations. It should be noticed that 1989–91 results are compared with national results from 1987.[11] The activity also seems to be similar to the national level but is the volume enough to maintain the needed experience ? The risk of death following surgery seems to be inversely associated with the volume of operations, and ten operations annually has been suggested as a minimum.[15] Our department performed 20–24 operations per year.

The mortality after elective surgery of 4% was similar that from others reports,[10,11] whereas the mortality observed after acute operations without rupture was considerably lower than the 25% quoted other reports.[10,11] The mortality of 32% after operation for ruptured AAA is also considerably lower than the 40–50% found in most other reports.[3,4,11–13,16] The Vascular Section of the Scandinavian Surgical Society has recommended standards for quality in surgery for AAA. Elective postoperative mortality must be below 5–7%, and less than 50–60% after rupture. Early reoperation after elective procedure because of bleeding must not exceed 5–6%.[17] We found that 5.5% were reoperated because of bleeding but 2/3 of the operations were on emergency basis. So the Unit seems to fulfil these standards. The low postoperative mortality could be explained by the extensive experience of the surgeons.[4,13,18] The number of AAA-operations needed to keep a vascular surgeon experienced is unknown but mortality is inversely associated with the number of operations per year.[19] Each of our vascular surgeons performed 10–14 AAA-operations per year.

Although all symptomatic AAA had an acute operation, selection may have occured, e.g. at the primary receiving hospital so that only the most haemodynamically stable patients with a relatively good prognosis were transferred resulting in a low postoperative mortality. However we found an overall mortality of 66% due to ruptured AAA compared with 76% in the rest of Denmark[11] and 85–90% in most other reports.[3,4,9] Furthermore, considerably more acute operations were carried out in the county than in Denmark (38/million/year vs. 12). The low mortality after acute operations is not therefore because of selection. No emergency operations were carried out at the primary receiving hospitals.

The importance of transport distance for patients with ruptured AAA is difficult to evaluate because of diagnostic delay and selection. Haemodynamically stable patients with few symptoms can survive long transport times while a short transfer time may lead to patients in a poor condition reaching operation resulting in a higher postoperative mortality.[13,14] 28% with

ruptured AAA died outside hospital in our study and 50% reached operation. Armour[12] found that only 33% reached operation and Mealy and Salman[3] found 64% died outside hospital. A recent Swedish investigation showed that 50% died outside hospital and only 30% reached operation and concluded this was an essential factor if mortality was to be reduced. The regional placement and organisation of our unit seems to have improved survival after ruptured AAA by 20% compared with Sweden and 10% compared with the rest of Denmark.

The frequency of operations for ruptured AAA increased significantly after the establishment of the peripheral vascular unit and there were twice as many acute operations without rupture compared with the rest of Denmark.[11] These changes could be a consequence of the regional placement of the vascular surgical unit. In 1986–88 only 38% of the ruptures were diagnosed at the county hospitals whereas in 1989–91, 72% were diagnosed. In 1986–88 19% of the ruptured AAA diagnosed at hospital were operated on and in 1989–91 68%. This change could be a result of different selection for operation between the two periods or be a consequence of the shorter travel distance, (mean 1 h).

The advantages of regional operation for AAA in the County of Viborg have been a high number of patients reaching surgery with a relatively low frequency of serious complications and low mortality.

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