Acute Renal Impairment Due To a Primary Aortocaval Fistula is Normalised After a Successful Operation

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Objectives: to study renal function in patients with aortocaval fistula, before and after surgery.
Design: Retrospective study.
Material and methods: during the last 22 years nine male patients (median age 67, age range 50–72) with spontaneous aortocaval fistula in combination with AAA were operated upon. This constitutes 4% of the patients with ruptured AAA and 1.5% of all patients with AAA.
Results: a preoperative diagnosis of aortocaval fistula was established in three of the nine cases. The medium duration of symptoms prior to surgery was 5 days (range 4 h–14 days). The fistula was combined with an extravasating ruptured AAA in only three patients. Seven of the patients had acute renal insufficiency, with creatinine levels of in median 292 \( \text{mol/l} \) (IQR 218–342). Creatinine declined to 172 \( \text{mol/l} \) (IQR 170–313) on the fifth postoperative day in uncomplicated cases and to 86 \( \text{mol/l} \) at discharge. One patient died due to multi-organ failure, whereas the other left hospital well and alive with normal renal function.
Conclusion: acute preoperative renal insufficiency due to an aortocaval fistula in patients with AAA is often due to venous congestion, and is normalised after successful surgery.

Background

James Syme was the first to describe an aortocaval fistula (ACF) in a patient with luetic aortitis and this was later followed by a report by Matas in 1909, and the first reported operative case was by Cooley in 1955. Nowadays spontaneous aortocaval fistula is predominantly associated with an atherosclerotic abdominal aortic aneurysm, even though <2% of patients with AAA will develop an aortocaval fistula. For ruptured AAA, the likelihood of an aortocaval fistula is 1–8%. Other causes of aortocaval fistula are iatrogenic as well as civilian trauma.

The cardinal symptoms of an aortocaval fistula is oedema of the lower legs, venous stasis in the lower portion of the body and heart failure. A common finding is haematuria often due to pelvic congestion. The diagnosis is suspected when the patient presents with a pulsatile abdominal mass in conjunction with an abdominal bruit and a pathognomonic finding is when the bruit is pronounced even if diastole. The fistula can be verified by ultrasonography, at which the aneurysm, as well as a dilated inferior caval vein can be noted (Fig. 1). Colour-coded duplex permits the increased flow in the caval vein to be appreciated. Computed tomography (CT) scans (Fig. 2) and MRI may also directly detect the fistula, especially when the images are made with only a few millimetres between them. Furthermore, early contrast filling of the caval vein is noticed both on CT scan and especially on angiography (Fig. 3).

The importance of an increased creatinine level in a patient with an aortic aneurysm for the outcome has been a matter of debate in the literature. Some authors

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Fig. 2. (a) CT scan of an abdominal aortic aneurysm, where the aortocaval fistula (F) is seen. $A =$ abdominal aortic aneurysm. (b) The caval vein (V) is separated from the aortic aneurysm (A) showing an early filling.

Fig. 3. (a) CT scan showing early filling of the caval vein (V) and also the abdominal aortic aneurysm is appreciated (A). (b) Angiogram showing the abdominal aortic aneurysm (A) and early filling of the caval vein (V).

have found this to be associated with an increased morbidity,\textsuperscript{25–28} and mortality,\textsuperscript{26,29} whereas others have not.\textsuperscript{30–33} In emergency cases the creatinine level is most often not known at the beginning of surgery, but will be assessed during surgery and a high preoperative creatine level might then negatively influence the surgeon’s decision to persist with treatment. In the present article we demonstrate that in cases of aortic aneurysms complicated by an aortocaval fistula, the increased preoperative creatinine level may not be a negative predictor, but will be normalised after successful surgical repair of the aneurysm.

Material and Methods

All records of patients undergoing surgery for AAA during a 22-year experience were investigated, and data collected, with special reference to their creatinine levels. We retrieved the records of 601 (111 female, 490 male) patients with an aortic aneurysm of whom 30% were ruptured. In nine male patients (median age 67 years, range 50–72) there was an aortocaval fistula (4.3% of ruptured, 1.5% of all AAAs). They were all admitted acutely. In three cases the diagnosis was often not known at the beginning of surgery, but will be assessed during surgery and a high preoperative established preoperatively and in six cases the diagnosis was established during the operation. Among the latter, the diagnosis could be verified retrospectively by reviewing the preoperative CT scan or ultrasound investigations performed.

Results

The data of the individual patients with ACF, as well as their surgical procedures and outcome, are summarised in Table I. The median preoperative creatinine level was 292 $\mu$mol/l (IQR 218–342) declining to 172 (IQR 107–313) on the fifth postoperative day in uncomplicated cases, and to 86 $\mu$mol at discharge 5–30 days postoperatively (Fig. 4). For comparison, the pre- and postoperative creatinine levels in the last 25
### Table 1. Summary of the clinical data on nine patients with a spontaneous aortocaval fistula in combination with an aortic aneurysm during a 22-year experience. ACF = aortocaval fistula, VF = ventricular fibrillation, BKA = below-knee amputation, LL = lower limbs

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Age</th>
<th>Symptom</th>
<th>Preoperative duration</th>
<th>Preoperative creatinine (μmol/l)</th>
<th>Blood loss (ml)</th>
<th>Preoperative diagnosis ACF</th>
<th>Postoperative complication outcome</th>
<th>Creatinine discharge (μmol/l)</th>
<th>Retroperitoneal bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 AW</td>
<td>66</td>
<td>Pain, haematuria</td>
<td>4 h</td>
<td>113</td>
<td>5000</td>
<td>No</td>
<td>Well and alive</td>
<td>62</td>
<td>No</td>
</tr>
<tr>
<td>2 RM</td>
<td>67</td>
<td>Pain, cyanosis</td>
<td>6 h</td>
<td>169</td>
<td>2000</td>
<td>No</td>
<td>Multi-organ failure, dead</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3 GW</td>
<td>60</td>
<td>Haematuria, venous stasis, LL</td>
<td>3 days</td>
<td>330</td>
<td>3000</td>
<td>No</td>
<td>Multi-organ failure, dead</td>
<td>80</td>
<td>No</td>
</tr>
<tr>
<td>4 SP</td>
<td>72</td>
<td>Haematuria, fatigue</td>
<td>3 days</td>
<td>379</td>
<td>8000</td>
<td>No</td>
<td>Colonic ischaemia, well and alive</td>
<td>87</td>
<td>No</td>
</tr>
<tr>
<td>5 LW</td>
<td>50</td>
<td>Pain, heart failure</td>
<td>3 days</td>
<td>292</td>
<td>9700</td>
<td>No</td>
<td>VF, BKA, well and alive</td>
<td>110</td>
<td>Yes</td>
</tr>
<tr>
<td>6 KNL</td>
<td>76</td>
<td>Pain, venous stasis</td>
<td>4 days</td>
<td>292</td>
<td>6600</td>
<td>Yes</td>
<td>Well and alive</td>
<td>101</td>
<td>No</td>
</tr>
<tr>
<td>7 KJS</td>
<td>70</td>
<td>Pain, haematuria</td>
<td>5 days</td>
<td>237</td>
<td>2000</td>
<td>No</td>
<td>Well and alive</td>
<td>74</td>
<td>Yes</td>
</tr>
<tr>
<td>8 EL</td>
<td>60</td>
<td>Venous congestion lower body</td>
<td>14 days</td>
<td>990</td>
<td>9500</td>
<td>Yes</td>
<td>Ileus, well and alive</td>
<td>59</td>
<td>No</td>
</tr>
<tr>
<td>9 KN</td>
<td>67</td>
<td>Anuria, heart failure, venous stasis</td>
<td>14 days</td>
<td>611</td>
<td>3000</td>
<td>Yes</td>
<td>Well and alive</td>
<td>99</td>
<td>No</td>
</tr>
</tbody>
</table>
The course of creatinine in nine patients operated on with an acute aortocaval fistula. Prerupt = creatinine value in those patients, where a creatinine within 30 days prior to surgery could be retrieved. Preop = creatinine level at the time of admission immediately prior to surgery.

patients, presenting with a ruptured abdominal aortic aneurysm and shock but without any aortocaval fistula, are presented. The median preoperative creatinine level was 129 μmol/l (IQR 102–162), increasing to 145 μmol/l (IQR 110–276) 5 days postoperatively, and at 2 weeks postoperatively among the 14 survivors it was still 136 μmol/l (IQR 94–292).

**Discussion**

Seven of the nine patients in the present report had an increased creatinine level at the time of surgery, and which returned to normal range in all but one, who developed multi-organ failure and succumbed. The latest two patients had a creatinine level within the normal range decreasing by two-thirds of the preoperative value after the operation.

The pathophysiology behind the increased creatinine level has been debated. Heart failure with decreased renal blood flow has dominated, but increased venous pressure has also been suggested. In experimental aortocaval fistulae created in dogs, the circulating atrial natriuretic peptide is increased due to salt and water retention, but fails to increase the urinary output. In rats the renal natriuretic peptide is called urodialtin and increases GFR and diuresis. In addition, there is an activation of the renin angiotensin system, which can be blocked by angiotensin-blockers. The sympathetic system is also stimulated and may be blocked by beta-blockers, which partly compensates for the drop in blood pressure induced by the increased workload of the heart. A lowered arterial blood pressure was registered despite an increase in cardiac output. Thus, the lowered arterial blood pressure in conjunction with the increased venous blood pressure leads to a lowered renal perfusion pressure, which seems to be the most likely explanation for the impaired renal function.

The time-span between the formation of the fistula and the operation is of importance for the severity of the symptoms. If the fistula occurs at the time of aneurysm rupture into retroperitoneum, the classical signs for aneurysm rupture will be present, and in
addition a systolic and diastolic murmur. If, on the other hand, there is only an aortocaval fistula, the size and time to diagnosis will determine the presenting symptoms. The central venous pressure increases and leads to swelling of the lower part of the body within 24–48 h. This is then normally followed by congestive cardiac failure. Haematuria is usually a late sign and has been suggested to be the result of small vessel rupture in the urinary bladder mucosa due to venous congestion.\(^{17}\) The increase in creatinine is normally seen within 24–48 h and depends on the size of the fistula as well as the primary renal function. In rare cases, although a fistula is present, it is covered by luminal thrombus. This does not produce any of the above findings, but severe venous bleeding will occur when the aorta is opened and the thrombus inside the sac is removed. None of the presented cases, though, belonged to such a group.

The operation can be carried out in a standard fashion, but with some precautions as the venous pressure is increased and the veins are dilated. It is advisable to perform a midline incision in order to reduce the venous bleeding. The aneurysm neck is mobilised with extreme care taken not to manipulate the aneurysm, which may lead to lethal lung embolisation. Paradoxical embolisation from the thrombus in the aneurysm through vena cava has been reported.\(^{40}\) The latter, as well as the massive bleeding that can occur on opening the aneurysm sac, can be prevented by using occluding balloon catheters in the caval vein.\(^{16,41}\) Clamping of the aorta leads to a reduced venous pressure, as well as venous return flow to the heart, which may decompensate the increase in arterial pressure. This may be of importance for the anaesthesiologist when making the haemodynamic corrections normally performed during aortic surgery. It has been suggested that continuous haemofiltration is a good preoperative method to improve the renal status of the patient, but the present data suggest that the best method is to close the aortocaval fistula. This may be done by open surgery, but with newer, less invasive techniques, like transhemorally placed endoluminal grafts (TPEG), blood loss may be reduced even further.\(^ {42,43}\) Whether this proves to be better than conventional surgery needs to be determined.

References


Acknowledgements

This study was supported by grants from the Medical Research Council (no. 12661) and the Funds of Malmo University Hospital.


38 O’Rourke MF. *Arterial Function in Health and Disease.* Edinburgh: Churchill and Livingston, 1982; 23–33.


Accepted 10 June 1998