Effectiveness of Unilateral Nephrectomy for Renal Hypertension in Adults

Siew Yi Lee and Howard Lau, Westmead Hospital, Sydney, Australia.

OBJECTIVE: This study investigated the effectiveness of unilateral nephrectomy in the treatment of renal hypertension in adults with an atrophic kidney, and set out to establish whether this is an appropriate mode of treatment for renal hypertension not otherwise controlled by antihypertensive drugs or other surgical procedures.

METHODS: We conducted a retrospective review of 600 consecutive patients who underwent laparoscopic renal surgery from 1998 to 2006 by a single surgeon. Seventeen underwent unilateral nephrectomy for the management of uncontrolled renal hypertension to remove a non-functioning, scarred, and contracted kidney. All patients had normal contralateral kidneys and normal renal functions preoperatively. Results were analysed by Wilcoxon’s signed rank test. Statistically significant results ($p < 0.0001$) with a mean reduction in systolic blood pressure of 27 mmHg and diastolic blood pressure of 17.5 mmHg, more than 6 months after unilateral nephrectomy for treatment of renal hypertension were consistently maintained.

RESULTS: Of the potential modifying factors related to reduction in blood pressure, only age was found to modify the reduction in systolic blood pressure, with a Spearman’s rank correlation coefficient of $-0.538$ ($p = 0.026$). At 6 months, the mean reduction in systolic blood pressure was 27 mmHg and that for diastolic blood pressure was 17.5 mmHg ($p < 0.0001$, Wilcoxon’s signed rank test).

CONCLUSION: Our data suggest that patients with renal hypertension and unilateral kidney atrophy, treated with laparoscopic nephrectomy, have significant, effective and at least medium term blood pressure control. [Asian J Surg 2008;31(4):185–90]

Key Words: adults, effectiveness of unilateral nephrectomy, renal hypertension

This paper was based on the work of Dr Siew Yi Lee as the chief investigator and first author of the project. The ‘Effectiveness of Unilateral Nephrectomy for Renal Hypertension in Adults’, which was submitted as a dissertation that contributed to her Degree of Master of Surgery, University of Sydney, in early 2007.

Introduction

Renovascular hypertension results when blood pressure rises because of renal ischaemia. The prevalence of renal hypertension is thought to be up to 5% amongst all patients with hypertension. Its importance lies in the fact that the cause is identifiable and potentially reversible with surgical treatment, therefore reducing the need for lifelong medical therapy.

Unilateral renal ischaemia has been shown to stimulate high renin and angiotensin-dependent hypertension that can be reversed by reconstruction of the renal artery, percutaneous balloon angioplasty or nephrectomy. Renin is a proteolytic enzyme that is produced in the

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juxtaglomerular cells of the afferent arterioles. It acts on
the renin substrate, angiotensinogen, an alpha-2 globulin
that is produced in the liver, to form the decapetide
angiotensin I. Angiotensin converting enzyme (ACE) then
cleaves two amino acids from angiotensin I to form
angiotensin II. Angiotensin II is a potent arterial vasocon-
strictor. It also stimulates the zona glomerulosa of the
adrenal glands to secrete aldosterone, thereby increasing
sodium retention, which further increases blood pressure
(Figure 1). In renal hypertension, renin secretion is acti-
vated when the afferent arteriolar baroreceptors respond
to decreasing renal perfusion pressure.

The main causes of renovascular hypertension include
renal artery stenosis, which is often secondary to arte-
riosclerotic plaques (60%) or fibromuscular dysplasia
(40%). More than 70% of luminal obstruction needs to be
present to manifest clinically significant ischaemia. Other
causes of renin-dependent hypertension include obstruc-
tive uropathy, benign and malignant renal masses, and
chronic pyelonephritis, most commonly associated with
vesicoureteral reflux.

**Patients and methods**

We retrospectively reviewed 600 consecutive patients
who underwent laparoscopic renal surgery from 1998 to
2006, performed by a single surgeon. The median age of
the patients was 47 years old (mean age, 48.5 years), with
a range of 14–77 years. The ratio of male to female
patients was 8:9. Laparoscopic renal surgery encompasses
the following operations: nephrectomy (simple, donor,
radi/ureteral resection, and partial), pyeloplasty,
ureterolithotomy, adrenalectomy, and exploration and
treatment of renal cysts.

Of these 600 patients, 17 underwent unilateral nephrec-
tomy for the management of uncontrolled renal hyper-
tension, which involved removal of one atrophic and
scarred kidney. The other main reasons to undergo the
operation were to address pain and recurrent infections
that were present in 10 of 17 patients. All 17 patients had
normal contralateral kidneys and normal renal function
preoperatively. A transperitoneal approach using three or
four ports was adopted. On the left, the left colon and
spleen were mobilized as one unit. On the right, the liver
was retracted superiorly, and the right hepatic flexure and
duodenum were mobilized to expose the renal hilum. The
renal artery and vein were then isolated and ligated indi-
vidually. The kidney was then mobilized with the divided
ureter. The kidney was put in a sterile bag and removed
through a muscle splitting incision.

The aetiology of unilateral kidney atrophy is shown in
Table 1. Blood pressure and medication requirements
were compared before and after surgery to assess treat-
ment efficacy. The demographic features of the patients
including age, sex, ethnic group, comorbidity, risk factors for hypertension (obesity, smoking, and family history), and creatinine level were obtained. The reduction in blood pressure and number of antihypertensive drugs, postoperative renal function, and potential blood-pressure-modifying factors were analysed statistically. The patient demographics are shown in Table 2. The mean length of follow-up was 18.5 months (range, 6–58 months).

The reduction in blood pressure was analysed using the statistical package SPSS (SPSS Inc., Chicago, IL, USA). As the initial plot of the reduction in blood pressure showed a non-normal distribution and the sample size was small, Wilcoxon’s signed rank test for paired data was used to analyse the results. This is a distribution-free method that makes no assumption of how the variable is distributed; it uses the order of the data when the values are put in ascending order of magnitude. In a situation in which the normality assumption does not hold, this test is superior to the corresponding $t$ test.

### Results

All patients had normal and stable serum creatinine levels postoperatively.

Statistically highly significant results ($p < 0.0001$) were a mean reduction in systolic blood pressure of 27 mmHg and a diastolic blood pressure reduction of 17.5 mmHg at 6 months after unilateral nephrectomy for treatment of renal hypertension.

There was a significant and sustained reduction in systolic and diastolic blood pressure at various times after unilateral laparoscopic nephrectomy (Figure 2). Of the

<table>
<thead>
<tr>
<th>Table 1. Aetiology of unilateral kidney atrophy</th>
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<tbody>
<tr>
<td>Obstruction</td>
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<td>Endometriosis</td>
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<td>Tuberculosis</td>
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<td>Retroperitoneal fibrosis</td>
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<td>Iatrogenal</td>
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<tr>
<td>Burn out pelviureteric junction</td>
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<td>Xanthogranulomatous pyelonephritis</td>
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<tr>
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<tr>
<td>Renal artery stenosis</td>
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<tr>
<td>Myointimal fibroplasia</td>
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<td>Reflux</td>
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<th>Table 2. Patient demographic characteristics</th>
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<tr>
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</table>

BP = blood pressure; SBP = systolic BP; DBP = diastolic BP; Preop = preoperative; Postop = postoperative; L = left; R = right; PUJ = pelviureteric junction.
various potential modifying factors related to blood pressure reduction, only age was found to modify the reduction in systolic blood pressure, with a Spearman’s rank correlation coefficient of $-0.538$ ($p = 0.026$) (Figure 3).

For systolic blood pressure, the reduction in blood pressure is significant as age increases but the magnitude of decrease is smaller in the older patients. The magnitude of reduction in diastolic blood pressure did not show an age-modifiable pattern (Figure 4). One of the reasons for this is that arterial atherosclerosis in the older age group decreases arterial wall elasticity and compliance, therefore, when subjected to the same blood pressure, the older patients will demonstrate a higher measured systolic blood pressure compared with the younger age group. We have one outlier in the value of the reduction in diastolic blood pressure. This was a patient who developed acute kidney obstruction with severe hypertension (220/180 mmHg) shortly after caesarean section.

We had six patients who were taking a combination of two antihypertensive agents, which was reduced to a single agent (Table 3). All six patients had a significant, sustained reduction in blood pressure compared with that prior to surgery. One patient was taking three antihypertensives, which was reduced to two at 6 months. One patient was taking one antihypertensive agent preoperatively, and was not required to take any antihypertensive medication postoperatively at 12 months. Both

<table>
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<tr>
<th>Antihypertensives, n</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>Patients, n</th>
<th>Significant decrease in SBP and DBP ($p &lt; 0.001$)</th>
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<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>No change in BP</td>
</tr>
</tbody>
</table>

SBP = systolic blood pressure; DBP = diastolic blood pressure.
patients had a sustained reduction in blood pressure compared to preoperatively.

Eight patients were not receiving antihypertensive medication pre- or postoperatively. One patient elected to have diet control and lifestyle modification for control of hypertension, and the other had a problem with medication compliance. The remaining six of these patients were younger, ranging from 14 to 36 years of age. Two of them were reported to have intermittent hypertension, pain and recurrent infection as their main indications for laparoscopic nephrectomy. The other four patients did not want to take long-term antihypertensive therapy.

Our most elderly patient, a 77-year-old male, demonstrated no change in blood pressure or the number of antihypertensive agents pre- and postoperatively. At 6 months postoperatively, one patient was lost to follow-up as she went overseas.

Discussion

The role of unilateral nephrectomy in the treatment of renal hypertension in adults has not been widely studied. Our literature search indicated two paediatric and one adult series, which indicated that complete or partial success of unilateral nephrectomy in the control of renal hypertension of these patient populations were achieved from retrospective analysis.

The importance of treating renovascular hypertension lies in the fact that the cause is identifiable and reversible with surgery, which reduces the need for lifelong medical treatment. Hypertension is a major risk factor for cardiovascular events and kidney diseases, in both young and old patients. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure emphasizes that the relationship between blood pressure and risk of cardiovascular events is continuous, consistent, and independent of other risk factors.7 The higher the blood pressure, the greater the chance of acute myocardial infarction, heart failure, stroke, and kidney diseases.

An impressive accumulation of evidence shows that greater attention should be paid to the importance of systolic blood pressure as a major risk factor for cardiovascular events. The European Working Party on High Blood Pressure in the Elderly performed the double-blind, placebo-controlled, Systolic Hypertension in Europe Trial to test the hypothesis that antihypertensive drug treatment reduces the incidence of fatal and non-fatal stroke in older patients (≥60 years old) with isolated systolic hypertension.8 Their pre-protocol analysis suggested that treating 1,000 patients for 5 years would prevent 24 deaths, 54 major cardiovascular endpoints, 29 strokes, or 25 cardiac endpoints.

The aim of the PROGRESS trial was to establish the precise effects that a blood-pressure-lowering regimen based on ACE inhibitors would have on stroke risk in patients with a history of transient ischaemic attack or minor strokes. Compared with placebo, perindopril (4 mg/day), with or without indapamide (2–2.5 mg/day), reduced systolic blood pressure by 9 mmHg and diastolic blood pressure by 4 mmHg, and the occurrence of stroke by 28% and major cardiovascular complications by 26%.9 Based on our current understanding of the pathophysiology of renovascular hypertension treated by unilateral nephrectomy, the results of the PROGRESS trial reaffirm that unilateral nephrectomy in patients with renovascular hypertension is worthwhile in reducing cardiovascular morbidity and mortality.

Blood pressure pattern changes with increasing age. The rise in systolic blood pressure continues throughout life, compared with diastolic blood pressure, which predominates before 50 years of age, alone or in combination with elevation in systolic blood pressure.11–14 Diastolic blood pressure rises until about 50 years of age, and then tends to level off over the next decade, and may remain the same or decrease later in life.15,16 Diastolic blood pressure is a more potent cardiovascular risk factor than systolic blood pressure until the age of 50 years, thereafter systolic blood pressure is more important.17 The prevalence of systolic hypertension increases with age, and above the age of 50, it represents the most common form of hypertension.18 Elderly patients often have isolated systolic hypertension, which is related to loss of arterial elasticity or compliance with ageing, and is more recalcitrant to treatment than essential hypertension is, as in the case of the oldest patient in our series.

All our patients underwent laparoscopic nephrectomy and there were no postoperative complications. This operation offers the benefits of minimally invasive surgery, such as shorter hospital stay and convalescence time, minimal loss of productivity, better cost-effectiveness, reduction in analgesic requirement, and better cosmetic results. Based on the benefits of laparoscopic versus open nephrectomy, we justified the use of laparoscopic nephrectomy to reduce the risk of possible lifelong medical
treatment for renovascular hypertension. In addition, many of these patients have co-existing pain and recurrent infections from the non-functioning kidney, another important indication to perform unilateral nephrectomy.

We performed a retrospective study and recognize the limitations of such a study in terms of data collection and patient follow-up. We propose that a multicentre, prospective study should be conducted. Patients with renal hypertension and unilateral kidney atrophy treated with laparoscopic nephrectomy have significantly improved blood pressure control ($p < 0.0001$). The decrease in systolic blood pressure was more prominent in the younger compared with the older age group. The reduction in diastolic blood pressure did not show an age-modifiable effect. Laparoscopic nephrectomy is a worthwhile treatment option in patients with renal hypertension and unilateral kidney atrophy. Patients need to understand that their blood pressure may not be completely normalized.

References