Observation or laparoscopic adrenalectomy for adrenal incidentaloma? A surgical decision analysis

Laurent Brunaud¹, Electron Kebebew¹, Frederic Sebag¹, Rasa Zarnegar¹, Orlo H. Clark¹, Quan-Yang Duh²

¹ Department of Surgery, University California San Francisco (UCSF) and Mount Zion Medical Center, Mount Zion Medical Center, San Francisco, CA, U.S.A.
² Department of Surgery University California San Francisco (UCSF) and Surgical Service, Veterans Affairs Medical Center, San Francisco, CA U.S.A.

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Summary

Background:
The optimal strategy remains controversial for adrenal incidentaloma, 4 to 6 cm in size, nonfunctioning, and without malignant imaging characteristics. A decision analysis model was used to identify relevant variables for selecting the optimal management (observation versus adrenalectomy).

Material/Methods:
Risk/benefit analysis in tertiary care center. The probabilities of each health outcome states were determined by a review of the literature from 1980 to 2002 (n=2,844 patients); and from a retrospective review of experience at University of California San Francisco (UCSF).

Results:
The baseline probabilities of morbidity after laparoscopic unilateral adrenalectomy and a new indication developing during initial observation (hypersecretion, size increase, malignancy) were 7.8% and 3.1%, respectively. We found observation to be the preferred approach when using baseline probabilities and utilities. Laparoscopic adrenalectomy becomes the preferred approach however if: 1) The morbidity rate from laparoscopic unilateral adrenalectomy is <3.0%, 2) The probability of a new indication developing for adrenalectomy during observation is >7.5%, 3) A patient’s perspective of observation has a utility of lower than 98.6%, and 4) A patient views having a complication from adrenalectomy is not much deleterious (utility >88.1%).

Conclusions:
This decision analysis model identifies the important variables for selecting the optimal management approach for adrenal incidentalomas. These results can be used to select the optimal management strategy based on individual patient preference and surgeon-specific complication rate.

key words: adrenal glands • adrenalectomy • incidentaloma • models • statistical

Abbreviations:
CT – computed tomography; MRI – magnetic resonance imaging; P – probability; U – utility;
pA – probability of developing new indication for adrenalectomy during observation because of hormone hypersecretion, increasing size (at least 1 cm) or the development of malignant imaging feature;
pB – probability of complications from unilateral laparoscopic adrenalectomy (morbidity rate);
pC – probability of being alive after a complicated adrenalectomy;
pD – probability of being alive after uncomplicated laparoscopic adrenalectomy;
pE – probability of being alive during observation without surgery;
uA – utility of new indication for laparoscopic adrenalectomy during observation;
uB – utility of complications after unilateral laparoscopic adrenalectomy;
uC – utility of being alive after a complicated laparoscopic adrenalectomy;
uD – utility of being alive after an uncomplicated laparoscopic adrenalectomy;
uE – utility of being alive during observation without surgery

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Author’s address:
Laurent Brunaud, MD, Department of General and Endocrine Surgery, CHU Nancy Brabois (Hopital adultes), 11 allee du morvan, 54511 Vandoeuvre les Nancy, France, e-mail: l.brunaud@chu-nancy.fr
Two management strategies are compared at the time of diagnosis of an adrenal incidentaloma: observation and laparoscopic adrenalectomy. If the clinician chooses “observation”, all patients will be managed by observation. Some may need adrenalectomy later if the incidentaloma becomes functioning, malignant, or increases its size (>1 cm) (“new indication for adrenalectomy”). If adrenalectomy is selected, all patients will have laparoscopic adrenalectomy. Some may have postoperative complications. A mathematical model was constructed using a spread sheet software (Statview 5.1, Abacus Concept, Berkeley, CA). The probability of the end health outcome state from the decision node to the terminal branch is the product of the component probabilities. Furthermore, the impact of a possible outcome is weighted with the respective utility of that outcome. The total expected utility is the sum of the weighted products of all possible outcomes in the decision model. Thus, the total expected utility for each strategy in Figure 1 is:

Adrenalectomy = \( p_C \cdot u_C \cdot p_B \cdot u_B + p_D \cdot u_D \) 

Observation = \( p_C \cdot u_C \cdot p_B \cdot u_B \cdot p_A \cdot u_A + p_D \cdot u_D \cdot u(1-p_B) \cdot p_A \cdot u_A + p_E \cdot u_E \cdot u(1-p_A) \)

where \( p \) = probability of the event occurring, \( u \) = utility of health state, and \( A \) to \( E \) = different health states that are detailed below. This total expected utility is a quantitative measure of the most preferred option. The optimal management strategy is the approach with the highest total expected utility [8,10–12].

Outcome variable probabilities

The probabilities of each health outcome states in the decision tree were determined by a comprehensive review of the available English and French literature from 1980 to 2002 (Medline); and from a retrospective review of experience at University California San Francisco (UCSF) from 1992 to 2002 (in a subset of 28 patients with non-secretory adrenal incidentaloma (between 4 and 6 cm) who had unilateral laparoscopic adrenalectomy). The literature review was done using a keyword search: “adrenal incidentaloma”, “adrenalectomy”, “laparoscopic adrenalectomy”, and “adrenal carcinoma”. The search was expanded by screening the bibliographies of the selected reports. Each report then was evaluated for relevant information. About 1200 articles were evaluated and 25 of them were selected for this study (Table 1). The model included three major probability variables: (1) The probability of developing new indications for adrenalectomy during observation because of hormone hypersecretion, increasing size (at least 1 cm) or the development of malignant imaging feature (pA), (2) The probability of complications from unilateral laparoscopic adrenalectomy (morbidity rate) (pB), and (3) The probability of being alive after a complicated laparoscopic adrenalectomy (pC). There values were expressed from 0 to 1 (or in percentages from 0% to 100%).

Outcome variable utilities

To determine the value individuals placed on the various health outcome states, we used the concept of utilities to measure a decision-maker’s preference for an outcome state [11,13]. This approach is based on how an individual views certain outcome states based on uncertain data balancing.
the risk-benefit ratio relative to the individual’s perspective [12]. The model included three major utility variables: (1) Utility of new indication for laparoscopic adrenalectomy during observation \((u_A)\), (2) Utility of complications after unilateral laparoscopic adrenalectomy \((u_B)\), and (3) Utility of being alive during observation without surgery \((u_E)\). These values were expressed from 0 to 1 (or in percentages from 0% to 100%). The baseline values of these utilities were estimated by best guess since no data was available in the literature [2]. Their values were initially set at 0.7, 0.7, and 1 respectively.

We also evaluated the utility of being alive during observation without surgery \((u_E)\) (corresponding to the psychosocial, health outcome and quality of life issues among patients observed with an adrenal incidentalomas) with a questionnaire in 15 endocrine surgeons (American and French). This questionnaire was as follow: “You are a patient with

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**Table 1.** Probabilities for each health outcome state in the decision model culled from review of the English and French literature and surgeons questionnaire about utility of having an incidentaloma managed by observation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Baseline (%)</th>
<th>Reported range (%)</th>
<th>Median (year)</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laparoscopic adrenalectomy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morbidity ((p_B^*))</td>
<td>7.84</td>
<td>0–11</td>
<td>–</td>
<td>[5,20–27]</td>
</tr>
<tr>
<td>Mortality</td>
<td>0.36</td>
<td>0–2</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>1 – mortality ((p_C))</td>
<td>99.64</td>
<td>98–100</td>
<td>–</td>
<td>[5,20–24]</td>
</tr>
<tr>
<td><strong>Observation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indication for adrenalectomy during observation ((p_A))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malignancy</td>
<td>2.95</td>
<td>0–13</td>
<td>4.3</td>
<td>[4,28–34]</td>
</tr>
<tr>
<td>Size increase</td>
<td>6.91</td>
<td>0–25</td>
<td>3.6</td>
<td>[2,4,28–30,32,33,35–37]</td>
</tr>
<tr>
<td>Hypersecretion</td>
<td>1.19</td>
<td>0–20</td>
<td>2.8</td>
<td>[2,4,28,30,32,33,36–41]</td>
</tr>
<tr>
<td>Overall ((p_A))</td>
<td>3.13</td>
<td>0–25</td>
<td>3.6</td>
<td>[2,4,28,30,32,33,36–41]</td>
</tr>
<tr>
<td><strong>Surgeons questionnaire</strong></td>
<td>68.00</td>
<td>30–90</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

* bleeding, wound (early and late), pulmonary, organ injury, gastrointestinal, urinary, thromboembolic, cardiac.
an adrenal incidentaloma and your surgeon tells you that you have a benign adrenal tumor and you are going to be observed (no adrenalectomy). You know that this incidentaloma is benign but it is nevertheless an adrenal tumor (potentially malignant). What would be, in this very specific situation, your utility (From 0: you are really concerned and depressed; to 1: you do not care at all)."

**Definitions and assumptions**

The probability of being alive after uncomplicated laparoscopic adrenalectomy (pD) was considered to be 100%. The probability of being alive during observation without surgery (pE) was considered to be 100%. The utilities of being alive after a complicated or uncomplicated laparoscopic adrenalectomy (uC and uD respectively) were considered to be 100% (or value =1). We stated that all adrenalectomized patients had laparoscopic approach and that this approach was successful (no conversion).

**Decision model analysis**

The baseline analysis was performed using the baseline probability and utility values for each health outcome state. Sensitivity analyses were conducted by varying the utilities and probabilities over the possible ranges (one-way and two-way sensitivity analysis). The threshold point was when both approaches (observation vs laparoscopic adrenalectomy) yielded an equal total expected utility (i.e., no difference exists) [14].

**RESULTS**

**Outcome variables**

In 28 patients with non-secreting adrenal incidentaloma (between 4 and 6 cm) who had unilateral laparoscopic adrenalectomy at UCSF, the complication rate was 3.6%. The overall weighted average complication rate associated with unilateral laparoscopic adrenalectomy was 7.84% (N=2,844 patients). A wide range of complications and complication rates from laparoscopic adrenalectomy have been reported (Table 1). At our institution, we have had no deaths from laparoscopic adrenalectomy in patients with adrenal incidentalomas. The overall average mortality rate from laparoscopic adrenalectomy was 0.36% (Table 1). Recently, at the NIH consensus statement conference it was stated that all adrenalectomized patients had laparoscopic approach and that this approach was successful (no conversion).

**Threshold analysis**

Threshold analyses were performed to assess the robustness of the model, as well as, to determine the important variables. Thus, the value of each variable in the model was modulated to determine if and when adrenalectomy becomes the preferred strategy. We found that if the morbidity rate after unilateral laparoscopic adrenalectomy (pB) was lower than 3.0% then laparoscopic adrenalectomy becomes the preferred strategy. We found that if the morbidity rate after unilateral laparoscopic adrenalectomy (pB) was lower than 3.0% then laparoscopic adrenalectomy becomes the preferred approach (Figure 2). If the probability of a new indication for laparoscopic adrenalectomy developing after observation (pA) was higher than 7.5%, laparoscopic adrenalectomy becomes the preferred approach. We also performed threshold analysis by varying the utility values. Laparoscopic adrenalectomy becomes the preferred approach if: 1) the utility of being alive during observation

![Graph](attachment:image.png)
Brunaud L et al – Incidentaloma and decision model

Table 2. Threshold table.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sensitive</th>
<th>Total adrenalectomy/observation (Baseline)</th>
<th>Threshold value</th>
<th>Baseline</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>P* of new indication for adrenalectomy (pA)</td>
<td>Yes</td>
<td>0.976/0.990</td>
<td>0.0748</td>
<td>0.0313</td>
<td>0–0.25</td>
</tr>
<tr>
<td>P of complications after adrenalectomy (pB)</td>
<td>Yes</td>
<td>0.976/0.990</td>
<td>0.0303</td>
<td>0.0784</td>
<td>0–0.11</td>
</tr>
<tr>
<td>U** of complications after adrenalectomy (uB)</td>
<td>Yes</td>
<td>0.976/0.990</td>
<td>0.8815</td>
<td>0.70**</td>
<td>0.60–1**</td>
</tr>
<tr>
<td>U of being alive during observation (uE)</td>
<td>Yes</td>
<td>0.976/0.990</td>
<td>0.9858</td>
<td>1**</td>
<td>0.90–1**</td>
</tr>
<tr>
<td>P of being alive after complicated adrenalectomy (pC)</td>
<td>No</td>
<td>0.976/0.990</td>
<td>NT†</td>
<td>0.9964</td>
<td>0.98–1</td>
</tr>
<tr>
<td>P of being alive after non complicated adrenalectomy (pD)</td>
<td>No</td>
<td>0.976/0.990</td>
<td>NT†</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>P of being alive during observation (pE)</td>
<td>No***</td>
<td>0.976/0.990</td>
<td>0.9858</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>U of new indication for adrenalectomy (uA)</td>
<td>No***</td>
<td>0.976/0.990</td>
<td>0.2152</td>
<td>0.70**</td>
<td>0.60–1**</td>
</tr>
<tr>
<td>U of being alive after complicated adrenalectomy (uC)</td>
<td>No</td>
<td>0.976/0.990</td>
<td>NT†</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>U of being alive after non complicated adrenalectomy (uD)</td>
<td>No</td>
<td>0.976/0.990</td>
<td>NT†</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>

* probability; ** utility; *** variable that affect the model but with threshold value outside the plausible range; † no threshold; ‡‡ best guess.

without surgery (uE) was <98.6% and 2) the utility of having a complication from laparoscopic adrenalectomy (uB) was >88.2% (Table 2).

In this model, the outcome of adrenalectomy compared to observation was not sensitive to changes in the probability of: 1) being alive after a complicated laparoscopic adrenalectomy (pC), 2) being alive after an uncomplicated adrenalectomy (pD), or 3) being alive during observation without surgery (pE) (Table 2). Similarly, the outcome was not sensitive to changes in the utility of: 1) new indication developing for laparoscopic adrenalectomy during observation (uA), 2) being alive after a complicated laparoscopic adrenalectomy (uC), and 3) being alive after an uncomplicated laparoscopic adrenalectomy (uD). This is because variations in these variables over a plausible range did not change the nature of the preferred management strategy.

Two- and three-way sensitivity analyses

Two-way sensitivity analyses were performed to determine whether changing the values of two variables simultaneously would result in a change in the preferred option. In Figure 3 the trade-off between the probability of a complication occurring from unilateral laparoscopic adrenalectomy (pB) and the probability of new indication developing for adrenalectomy during observation (pA) is illustrated.

For example, if the probability of a complication (pB) was at baseline (7.84%) then observation was the preferred management approach if the probability of new indication arising during observation (pA) was <7.49%. However, if pA was higher than 7.49%, laparoscopic adrenalectomy becomes the preferred approach.

Since the baseline values for uA, uB, and uE used in the decision model were estimated (best guesses), we also determined how the threshold values of the two probabilities pB and pA may change when uA, uB, and uE were modified. The trade-off analysis between the probability of complication from laparoscopic adrenalectomy (pB) and the utility of being alive during observation without surgery (uE) is illustrated in Figure 4. Laparoscopic unilateral adrenalectomy was the preferred choice regardless of the values of utility of being alive during observation without surgery (uE), if only the complication rate after adrenalectomy (pB) was lower than 3.2%. Furthermore, if the utility of complications after unilateral adrenalectomy (uB) was shifted from 0.7 (baseline) to 0.9, then laparoscopic unilateral adrenalectomy becomes the preferred approach when the complication rate from adrenalectomy (pB) was less than 9.3%. This was valid regardless of the utility value for being alive during observation without surgery (uE). Changing the utility of a new indication developing for adrenalectomy during observation (uA) only change the threshold values of pB and uE by less than 1%.

Similarly, the relationship between the probability of a new indication developing for laparoscopic adrenalectomy during observation (pA) and the utility of complications after unilateral laparoscopic adrenalectomy (uB) was estimated. We determined that laparoscopic adrenalectomy becomes the preferred approach regardless of uB only if pA was higher than 22.1% (reported range in literature, 0–25%). Furthermore, if the utility of being alive during observation without surgery (uE) was 0.92 (baseline =1.0), then adrenalectomy becomes the preferred approach regardless of the value of pA.

**DISCUSSION**

When an adrenal mass is discovered incidentally, the clinician must decide between an operative and a nonoperative management strategy. The decision process includes assessment of the radiographic appearance, the endocrine function of the tumor, and the likelihood of malignancy [4]. If an adrenal incidentaloma is nonfunctioning and not worrisome for a malignancy, there is a general consensus that an adrenalectomy is indicated for all adrenal masses greater than 6 cm and that observation is indicated for tumors size less than 4 cm in greatest dimension. Laparoscopic
adrenalectomy is then the standard approach and conversion rate to open adrenalectomy is less than 10%. For adrenal tumors between 4 and 6 cm, either close follow up or adrenalectomy is considered a reasonable approach (NIH Consensus Statement, 2002) [2]. Proponents for adrenalectomy cite the following reasons: 1) Adrenal cortical carcinoma accounts for 6% of adrenal masses between 4 and 6 cm, 2) Five to 25% of adrenal masses increase in size by at least 1 cm, 3) Up to 20% of patients with adrenal incidentaloma have subclinical hormonal oversecretion, 4) The potential psychosocial impact of observation in a patient with adrenal incidentaloma should be taken into account, and 5) Biochemical and radiographic studies are necessary during follow up for observation of adrenal incidentalomas and they cost more than adrenalectomy in the long term (2). In contrast, advocates of observation propose the following rationale: 1) Two-thirds of clinically inapparent adrenal masses are benign tumors (i.e. cortical adenoma), 2) Surgical series of adrenal incidentaloma pathologic findings overestimate the prevalence of adrenal cortical carcinoma because a suspicion for adrenal cortical carcinoma is often the indication for an operation, 3) There is no clear evidence that early detection of adrenal cortical carcinoma decreases the mortality rate even if it has recently been shown that lower stage disease is more likely to be cured by operation [15]. 4) The adrenal tumor size increase is part of the natural history of an incidentaloma and the risk of malignancy in this case is estimated to be 1 in 1000, 5) Although patients with subclinical hormonal oversecretion may represent a population at a higher risk for metabolic disorders and cardiovascular disease; it is not known if this group of patients will benefit from an adrenalectomy, and 6) The potential negative psychosocial impact on the patient with an adrenal incidentaloma is not known [2].

It is not surprising that the optimal management strategy in patients with adrenal incidentaloma remains controversial. The recent NIH Consensus Conference for “management of the clinically inapparent adrenal mass” acknowledged the lack of randomized prospective controlled studies that could resolve some of these issues [2]. However, such a study would require multicenter enrollment, recruitment of a large number of patients, a long follow up time and co-

operation among specialist with differing opinions. There is also a need for developing additional criteria than adrenal tumor size alone when determining the optimal management strategy [6]. Given the lack of data in the literature and a lack of consensus in the optimal management of patients with adrenal incidentaloma between 4 and 6 cm, we believe a decision analysis of the relevant clinical outcome variables provides a rational and practical framework to evaluate the optimal management strategy [7,8,12]. This decision analysis model allows for the determination of the important variables that would influence the decision between observation and adrenalectomy and those that would not. We found that adrenalectomy is preferable to observation in any of the following situations: 1) If the complication rate from unilateral laparoscopic adrenalectomy is less than 3.0%, 2) If the probability of developing a new indication for adrenalectomy during observation is greater than 7.5%, 3) If the patient’s perspective on observation has a utility of less than 98.6%, and 4) If the patient views having a complication from laparoscopic adrenalectomy has a utility greater than 88.1% (meaning that how this patient feels or experiences this postoperative complication is not much deleterious). In all other situations, observation was the preferred approach.

It should be emphasized that among these four scenarios, the patient’s perspective of observation was the most critical variable since a decrease of only 2% of this utility is sufficient to make the surgical strategy preferable. In more practical terms, unless a patient is totally unconcerned about having an adrenal incidentaloma, adrenalectomy is the preferred approach. Unfortunately, there are no available studies evaluating the psychosocial, health outcome and quality of life issues among patients observed with an adrenal incidentaloma [2]. The average utility assigned by the surgeons in this study for this outcome variable was 68% (Range 30–90%). Although this group of survey participants are probably biased towards adrenalectomy and are not patients, it suggests that most patients would probably assign a utility of less than 98% for being observed with an
adrenal incidentaloma. Therefore, laparoscopic adenalec- 
tomy would probably be the preferred approach for the 
majority of patients.

The quality of a decision analysis depends on a repre-
sentative model being used and the use of accurate data 
to estimate outcome variables [9]. The four threshold 
values above were determined by using probability and 
utility values from the literature or were estimated when 
not available in the literature. Limitations of these con-
clusions are assumptions and utility estimations used in 
this model. It is possible that there could be some disa-
greement over the baseline values used in this analysis. 
However this decision analysis model can be used by oth-
ers using institution specific outcome data. Furthermore, 
each surgeon can use his/her complications rate and each 
individual patient’s preference (e.g. utility of complica-
tions after operation) to make patient, surgeon and med-
ical center specific decisions. More practically, we pro-
pose that surgeons should at least discuss with patients 
the four main variables in this model at the time of diag-
nosis before deciding on the appropriate management 
strategy. We suggest that these results should be consid-
ered in future studies since this analysis has allowed us 
to define which variables are important in the decision-
making process.

One weakness in this model is that it does not take into ac-
count the effect of time. The baseline values were deter-
mined from the literature and corresponded to an average 
follow-up time of 3.6 years. Complex transitions and events 
that occur with uncertain timing are difficult to handle with 
simple decision trees [7]. The findings in our decision anal-
ysis model are therefore only valid for an average follow up 
time of 3.6 years and cannot be extrapolated to a longer 
time frame. For example, the finding that adenalec-
tomy is preferable if the probability of developing a new indica-
tion for adenalecctomy during observation is greater than 
7.5% implies that this notion is only valid within 3.6 years 
after the incidentaloma diagnosis. The effect of time using 
an incidence per year (e.g. what if we observe a patient for 
15 years) and age of patients at diagnosis (modification of 
in incidentaloma prevalence and natural overall life ex-
pectancy) needs to be considered also [16,17]. Another issue 
is that we did not take specifically into account opera-
tive conversions to open adenalecctomy. However, this is-
ue is attenuated by the fact that probability and utility of 
operative conversions with consecutive morbidity can also 
be considered a posteriori as being part of the probability 
of complications from unilateral laparoscopic adenalec-
tomy (pB) and its utility (uB) (taking conversion into ac-
count for morbidly). Thus, conversion issue can be consid-
ered as being adressed by this model even not specifically 
designed in decision tree model. We also acknowledge that 
this model does not consider the consequences on surviv-
al of a delay in performing adenalecctomy for an adrenal 
masse that secondarly prove malignant under the obser-
vation strategy. Finally, a cost-benefit analysis was not con-
sidered in our study but could be an important variable in 
determining the optimal management strategy [3,18]. For 
example, laparoscopic adenalecctomy could be associated 
initially with a higher cost but may be warranted because of 
the cost of follow up and delay in adenalecctomy in some 
patients [18,19].

CONCLUSIONS

In conclusion, this risk/benefit analysis identifies four impor-
tant variables for selecting the most effective management 
approach for adrenal incidentalomas. We believe this mod-
el is a useful decision making tool for both patients and sur-
geons. These results can be used to select the optimal man-
agement strategy based on individual patient preference and 
surgeon-specific complication rate. We propose that surgeons 
should discuss with patients these variables before deciding 
on the appropriate management strategy and suggest that 
these results should be considered in future studies.

REFERENCES:

905–13
2. NIH State-of-the-Science Statement on management of the clinically 
inactive adrenal mass (“incidentaloma”). NIH Consensus State 
2002adrenalincidentaloma02PDF.pdf
Endocr Rev, 1999; 20: 69–90
4. Barry MK, van Heerden JA, Farley DR et al: Can adrenal incidentaloma-
5. Brunot LM: The positive impact of laparoscopic adenalecctomy on com-
Coll Surg, 2002; 195: 364–71
7. Petitti D: Meta-analysis. Decision analysis and cost-effectiveness analy-
8. Detsky AS, Naglie G, Krahm M et al: Primer on medical decision anal-
9. Petitti D: Meta-analysis, decision analysis, and cost-effectiveness analy-
sis: methods for quantitative synthesis in medicine. Monogr Epidemiol 
Biostat, 1994; 24: 20–32
10. Detsky AS, Naglie G, Krahm M et al: Primer on medical decision anal-
11. Naglie G, Krahm M, Naimark D et al: Primer on medical decision anal-
12. Kebebew E, Duh QY, Clark OH: Total thyroidectomy or thyroid lohe-
tomy in patients with low-risk differentiated thyroid cancer: Surgical 
decision analysis of a controversy using a mathematical model. World 
13. Powe NR, Danese M: Decision analysis in endocrinology and metabo-
lism. Endocrinol Metab Clin North Am, 1997; 26: 89–97
15. Barnett CC, Varma DG, El-Naggar AK et al: Limitations of size as a cri-
2001; 25: 914
17. Dwamena BE, Kloos RT, Duh QY et al: Diagnostic evaluation of the 
adrenallectomy: small savings in an expensive process. J Laparoendosc 
19. Hobart MG, Gill IS, Schweizer D et al: Financial analysis of needlescop-
20. Kebebew E, Sperberstein A, Duh QY: Laparoscopic adenalecctomy: The 
22. Toniato A, Piotto A, Pagetta C et al: Technique and results of laparo-
scopic adenalecctomy. Langenbecks Arch Surg, 2001; 386: 200–3
learned from 274 consecutive procedures. Ann Chir, 2002; 
127: 512–19
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