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Trends in Utilization of Adrenalectomy in the United States: Have Indications Changed?

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Abstract. Minimally invasive approaches have dramatically reduced morbidity associated with adrenalectomy. There has been concern that an increased frequency of adrenal imaging along with the advantages of less morbidity could influence the indications for adrenalectomy. We tested the hypothesis that adrenalectomy has become more common over time and that benign diseases have been increasingly represented among procedural indications. The Nationwide Inpatient Sample (NIS) database was utilized to determine the incidence of adrenalectomy and the associated surgical indications in the United States between 1988 and 2000. All discharged patients were identified whose primary ICD-9-CM procedure code was for adrenalectomy, regardless of the specific surgical approach (laparoscopic adrenalectomy was not reliably coded). This subset was then queried for associated ICD-9-CM diagnostic codes. Linear regression and *t*-tests were utilized to determine the significance of trends. The total number of adrenalectomies increased significantly, from 12.9 per 100,000 discharges in 1988 to 18.5 per 100,000 discharges in 2000 ($p = 0.000003$). The total number of adrenalectomies with a primary ICD-9-CM code for malignant adrenal neoplasm did not increase significantly: from 1.2 per 100,000 discharges in 1988 to 1.6 per 100,000 discharges in 2000 ($p = 0.47$). The total number of adrenalectomies with a primary ICD-9-CM diagnostic code for benign adrenal neoplasm increased significantly, from 2.8 per 100,000 discharges in 1988 to 4.8 per 100,000 discharges in 2000 ($p = 0.00002$). The average percentage of adrenalectomies performed for malignant neoplasm was significantly higher during the period 1988–1993 when compared to 1994–2000 (11% vs. 9%; $p = 0.002$). The average percentage of adrenalectomies performed for benign neoplasm was significantly lower during 1988–1993 when compared to 1994–2000 (25% vs. 28%; $p = 0.015$). Adrenalectomy is being performed with increasing frequency. This is associated with an increase in the proportion of adrenalectomies performed for benign neoplasms. Assuming no significant change in disease prevalence during the study period, these data suggest that indications for adrenalectomy may have changed somewhat over that period.

Operative intervention for diseases of the adrenal gland is relatively young when considered against the background of the history of surgery. However, perhaps more than any other field, we have the seen the rapid advancement of the technologic capability in diagnosis and therapeutics played out in recent years in adrenal surgery. Biochemical, molecular genetic, and imaging advances have permitted earlier, more accurate diagnosis. The rapid development and dissemination of new surgical instrumentation and techniques have made possible operations with decreased morbidity and mortality.

The endocrine surgical community witnessed a transformation in 1992 with the first report of a laparoscopic adrenalectomy [1]. This ushered in the era of minimally invasive adrenal surgery. Since that time there have been numerous modifications, specifically regarding patient positioning and the anatomic approach [2–4]. Laparoscopic adrenalectomy has become the treatment of choice, and in some cases even the gold standard, for some adrenal pathologies. Many surgeons have reported series comparing traditional open adrenalectomy to laparoscopic adrenalectomy [2, 3, 5–12], and these reports have consistently demonstrated decreased length of hospital stay, decreased use of postoperative analgesics, increased rate of return to normal activities, and decreased late morbidity for patients who have undergone the laparoscopic procedure.

Some controversy exists about the precise indications for operation across the spectrum of pathology that can affect the adrenal glands. This is highlighted in the ongoing debate about the size at which a nonfunctional, incidentally discovered adrenal mass should be removed [13]. Moreover, as surgeons gain skill with laparoscopy, adrenal lesions once thought safe to be removed only with an open operation are being treated with a laparoscopic approach [14].

There have been few attempts to characterize practice patterns for the utilization of adrenalectomy [15–17]. It has been a concern that the increased occurrence of incidental adrenal imaging and the availability of lower morbidity procedures may have lowered the threshold or altered the indications for adrenalectomy [18, 19]. Previous reports have suggested too that the availability of minimally

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Table 1. Nationwide inpatient sample data sources, 1988–2000.

Calendar year	Data sources	No. of hospitals	No. of inpatient stays ($\times 10^6$)
1988	CA, CO, FL, IL, IA, MA, NJ, WA	759	5.2
1989	Added AZ, PA, WI	882	6.1
1993	Added CT, KS, MD, NY, OR, SC	913	6.5
1995	Added MO, TN	938	6.7
1997	Added GA, HI, UT	1012	7.1
1999	Added ME, VA	984	7.2
2000	AZ, CA, CO, CT, FL, GA, HI, IL, IA, KS, KY, MA, MD, ME, MO, NC, NJ, NY, OR, PA, SC, TN, TX, UT, VA, WA, WI, WV (added KY, NC, TX, WV)	994	7.5

Only those years with a change in the number of states participating are shown. Data sources are denoted by two-letter state abbreviations.

invasive procedures may lead to earlier surgical referral [20]. The current study uses a database representative of surgical practice in the Unites States to characterize trends in the use of adrenalectomy. Our aim was to evaluate the national experience with adrenalectomy and determine if there has been a significant change in the indications for adrenal surgery over time.

Methods

The Nationwide Inpatient Sample (NIS) is a stratified, cross-sectional database that includes approximately 20% of all nonfederal hospital discharges in the United States. It is stratified by geographic region, urban or rural location, teaching status, ownership, and hospital size [21]. The NIS was born out of a federal, state, and industrial partnership and is maintained under the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality. This study's data were derived from the version of the NIS database that encompasses the calendar years 1988 through 2000. The number of states whose hospital discharges were represented varied over the study period. There were 759 hospitals in eight states in 1988 and 994 hospitals in 28 states in 2000 (Table 1). Participating hospitals provide 100% of their discharge abstracts for a particular calendar year. An average of 6.5×10^6 hospital discharges per year are included in the NIS database. The database was searched for the individual years 1988 through 2000, selecting out all hospital discharges for which the primary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code indicated adrenalectomy [22]. There were a total of five distinct codes used in our algorithm to capture all adrenal surgeries and to eliminate any bias of coding variation (Table 2). During the study period, there was no unique ICD-9-CM procedure code for laparoscopic adrenalectomy. An attempt was made to identify from among our cohort those patients who underwent laparoscopic adrenalectomy by searching for a modifier ICD-9-CM procedural code that designated laparoscopy of the abdominal region (ICD-9-CM code 5421).

The set of hospital discharge abstracts identified from the NIS were then further queried by primary ICD-9-CM diagnostic codes in an attempt to quantify adrenalectomies performed for a variety of common and uncommon adrenal disorders. The primary diagnostic codes identified were analyzed either individually or grouped depending on the association with adrenal pathology. Adrenal surgery performed for each diagnosis was expressed as the number of surgeries for the diagnosis per 100,000 hospital discharges per year. The number of procedures was normalized to account for variability in the total number of discharges per year in the NIS. In addition, the percent of total adrenalectomies for each year that was comprised by each diagnosis was determined. As an indirect method of interrogating the impact of minimally invasive adrenal surgery, the mean percentage of total adrenal surgeries performed for each diagnosis was compared between years grouped as 1988–1993 and 1994–2000, with the latter group representing a period during which laparoscopic adrenalectomy was well accepted, widely practiced, and becoming a treatment of choice.

Table 2. ICD-9-CM procedure codes used to query database.

072	Partial adrenalectomy
0721	Excision of lesion of adrenal gland
0722	Unilateral adrenalectomy
0729	Other partial adrenalectomy, NOS
073	Bilateral adrenalectomy, including excision of remaining adrenal gland
5421	Laparoscopy of the abdominal region

NOS: not otherwise specified.

Simple linear regression analysis was used to determine the significance of the trend in the number of adrenal surgeries performed in total and for each diagnosis as a function of year. Two-tailed student *t*-tests were used to compare mean percentages of adrenal surgery by diagnosis between the grouping of years before and after the introduction of laparoscopic adrenalectomy. A value of $p < 0.05$ was considered statistically significant in all final analyses. All statistical analyses were performed with SPSS version 11.5 (SPSS, Chicago, IL, USA).

Results

There were 677 patients identified in the NIS database who underwent an adrenalectomy in 1988. There were a total of 5,242,904 hospital discharges encoded in the NIS database in 1988, yielding a rate of 12.9 adrenal surgeries per 100,000 hospital discharges (Fig. 1). By 2000, there were 1378 patients whose hospital discharge included one of the five primary ICD-9-CM procedure codes for adrenal surgery. Given a total of 7,450,992 hospital discharges included in the 2000 data, this yields a rate of 18.5 adrenal surgeries per 100,000 hospital discharges. It shows a 43.4% increase in the number of adrenalectomies performed in the United States between 1988 and 2000. This represents a statistically significant increase in the frequency of adrenal operations performed per annum ($p = 0.0000029$).

We attempted to identify the patients whose adrenal surgery was via a laparoscopic approach. There is no unique ICD-9-CM procedure code for laparoscopic adrenalectomy, but there is a procedure code (5421) for laparoscopy of the abdominal region. Querying the cohort of adrenalectomy patients identified for each year of the study period for this additional procedure code identified a range from 1 patient (1990) to 107 patients (each 1999 and 2000) who underwent both adrenalectomy and laparoscopy. When expressed as a percent of total adrenalectomies per year, this ranged from 0.1% in 1990, 1991, and 1992 to 8.2% in 1999. There is clearly a trend toward an increase in the proportion of adrenalectomies per-

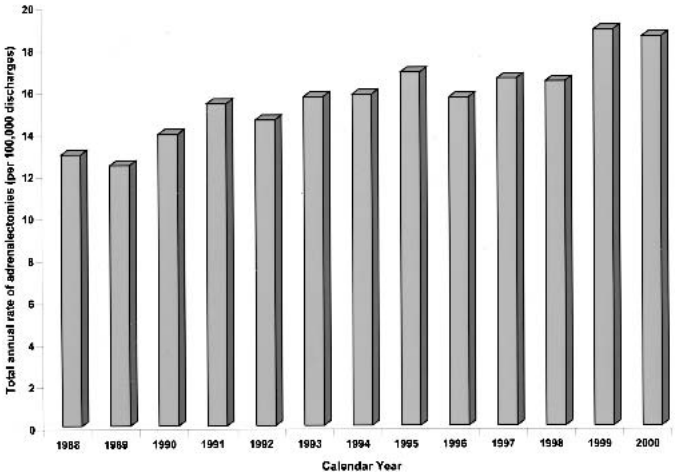

Fig. 1. Annual rate of adrenalectomies from 1988 through 2000 in the United States. Data points are the annual number of adrenalectomies per 100,000 hospital discharges.

formed via the laparoscopic approach. However, we thought that this was not a reliable method of identifying laparoscopic adrenalectomies as it still represented fewer than 10% of all adrenalectomies. Other published series [17] and personal experience argue that the percentage is significantly higher. Moreover, this method identified a laparoscopic adrenalectomy in 1990, prior to the first reported case [1].

The adrenalectomy patients identified were further classified according to their primary ICD-9-CM diagnostic code. A total of 705 unique ICD-9-CM diagnostic codes were identified as primary diagnostic codes from the NIS entries for the adrenalectomy patients identified. Many of these primary diagnostic codes were unrelated to adrenal disorders and represent an artifact of hospital coding and billing. Hospital discharge coding often reflects the overriding medical concerns of an inpatient stay and is driven by reimbursement issues rather than issues of diagnostic accuracy. The codes were then held individually or grouped for further analysis. Tables 3 and 4 include a listing of the eight major diagnostic groups analyzed. Four of them (benign neoplasm of the adrenal, malignant neoplasm of the adrenal, neoplasm of uncertain behavior of the adrenal, and secondary malignant neoplasm of the adrenal) include a single ICD-9-CM diagnostic code. The group labeled "disorders of adrenal gland hormone secretion" includes several diagnostic codes that were analyzed alone and in combination. The ICD-9-CM code 2556, medulloadrenal hyperfunction, was not represented in the data set. Neoplasms of other abdominal and thoracic organs, except urinary organs, includes multiple codes for tumors of the esophagus, lung, breast, bowel, liver, pancreas, ovary, testis, connective tissue, and retroperitoneum. Neoplasms of urinary organs include tumors of the kidney, ureter, and bladder. The group entitled "other" includes infectious etiologies, lymphomas, disease of nonadrenal endocrine organs, psychiatric disorders, traumatic injuries, complications in the puerperium, and disease of the circulatory, musculoskeletal, and cardiorespiratory systems.

The annual rate of adrenalectomies associated with a primary ICD-9-CM diagnostic code for malignant neoplasm of the adrenal gland did not significantly change: 1.2 per 100,000 hospital discharges in 1988 and 1.6 per 100,000 discharges in 2000 ($p = 0.47$) (Table 3). This is in contrast to the 71% increase in the annual rate of adrenalectomies associated with a primary ICD-9-CM diagnostic code for benign neoplasm of the adrenal gland. There was a significant increase, from 2.8 per 100,000 discharges in 1988 to 4.8 per 100,000 discharges in 2000 ($p = 0.000022$) (Table 3). There was also a significant increase in the annual rate of adrenalectomies performed for an adrenal neoplasm of uncertain behavior (0.15 per 100,000 discharges in 1988 to 0.42 per 100,000 discharges in 2000, $p = 0.00357$) (Table 3). There was a statistically significant increase in the rate of adrenalectomies with a primary coded diagnosis of hyperaldosteronism, adrenal gland disorder not otherwise specified, and secondary malignant neoplasm of the adrenal gland (Table 3). It is also interesting to note that there has been a significant increase in the rate of adrenal surgeries associated with a primary diagnostic code in the group of other abdominal and thoracic organ neoplasms. The rate of adrenalectomies performed for each of the remaining adrenal-specific diagnostic codes (Cushing syndrome, adrenogenital disorder, other corticoadrenal hyperactivity, and corticoadrenal insufficiency) did not evidence any significant trend over the course of the study period (Table 3), but many of these cases are likely coded as benign neoplasms of the adrenal gland.

Laparoscopic adrenalectomy was first reported in 1992 [1]. The technique became relatively widely disseminated by 1993. We therefore divided our study period into two groups, 1988–1993 and 1994–2000, to assess indirectly the impact of laparoscopic surgery on the use of adrenalectomy. The average annual percent of adrenalectomies performed for primary malignant neoplasms of the adrenal gland significantly decreased from 11% in 1988–1993 to 9% in 1994–2000 ($p = 0.002$) (Table 4). The average annual percent of adrenalectomies performed for benign neoplasm of the adrenal gland significantly increased: from 25% in 1988–1993 to 28% in 1994–2000 ($p = 0.015$) (Table 4). The average annual percent of adrenalectomies performed for adrenal neoplasms of uncertain behavior significantly increased as well: from 1.4% in 1988–1993 to 1.9% in 1994–2000 ($p = 0.034$) (Table 4). The remaining adrenal-specific diagnoses, as well as those procedures with a primary diagnostic code unrelated to primary adrenal pathology, did not evidence any difference in the proportion of adrenal surgeries they comprise when compared between the earlier and later years of the study period. Figure 2 shows the overall composition of adrenalectomies performed in the United States from 1988 through 2000. Percentages associated with each section of the graph represent the mean percentage for the year grouping as shown in Table 4. Figure 2a includes 6 years and 5096 total adrenalectomies. Figure 2b includes 7 years and 8133 total adrenalectomies.

Discussion

Adrenal disorders often result in the need for surgical therapy as a primary therapeutic intervention (e.g., for adrenal carcinoma and pheochromocytoma), a diagnostic maneuver (e.g., for an incidentally discovered adrenal neoplasm), or an end-stage intervention when medical therapy risks toxicity or ceases to be effective (e.g., for some cases of Cushing syndrome). The approach to adrenal surgery was revolutionized in 1992 with the introduction of the laparoscopic adrenalectomy [1]. This procedure has allowed surgeons to perform this still relatively uncommon procedure with lower morbidity and mortality. However, as is often a concern with new, successful technology, we must determine if the technology itself influences its use.

Table 3. Annual rate of adrenalectomy for selected ICD-9-CM diagnostic codes.

Diagnosis	ICD-9-CM code	1988[a]	2000[a]	p*
Malignant neoplasm of the adrenal gland	1940	1.24	1.56	0.47
Benign neoplasm of the adrenal gland	2270	2.82	4.83	0.000022
Neoplasm of uncertain behavior of the adrenal gland	2372	0.15	0.42	0.00357
Disorders of adrenal gland hormone secretion				
Cushing syndrome	2550	0.19	0.32	0.832
Hyperaldosteronism	2551	0.15	0.28	0.015
Adrenogenital disorder	2552	0.02	0.04	0.121
Other corticoadrenal overactivity	2553	0	0.03	0.43
Corticoadrenal insufficiency	2554	0.06	0.04	0.611
Adrenal gland disorder NOS	2558, 2559	0.57	0.74	0.004
Secondary malignant neoplasm of the adrenal gland	1987	0.59	0.66	0.037
Neoplasm[b] of other abdominal and thoracic organs (except urinary organs)	—	0.92	1.77	0.000021
Neoplasm[b] of urinary organs	—	3.61	4.19	0.096
Other	—	2.59	3.53	0.595

[a]Number of adrenalectomies per 100,000 hospital discharges.
[b]Includes benign, malignant, uncertain behavior, and secondary neoplasms.
*Simple linear regression.

Table 4. Average annual percentage of adrenalectomies for selected ICD-9-CM diagnostic codes.

Diagnosis	ICD-9-CM code	1988–1993[a] (%)	1994–2000[a] (%)	p*
Malignant neoplasm of the adrenal gland	1940	10.89 ± 1.07	8.96 ± 0.68	0.002
Benign neoplasm of the adrenal gland	2270	24.88 ± 2.03	28.01 ± 1.88	0.015
Neoplasm of uncertain behavior of the adrenal gland	2372	1.38 ± 0.31	1.91 ± 0.46	0.034
Disorders of adrenal gland hormone secretion				
Cushing syndrome	2550	1.76 ± 0.55	1.31 ± 0.31	0.101
Hyperaldosteronism	2551	1.04 ± 0.16	1.17 ± 0.48	0.515
Adrenogenital disorder	2552	0.14 ± 0.01	0.18 ± 0.07	0.502
Other corticoadrenal overactivity	2553	0.10 ± 0.00	0.11 ± 0.04	0.837
Corticoadrenal insufficiency	2554	0.60 ± 0.19	0.56 ± 0.29	0.763
Adrenal gland disorder NOS	2558, 2559	3.74 ± 0.68	4.14 ± 0.61	0.288
Secondary malignant neoplasm of the adrenal gland	1987	3.98 ± 0.83	4.04 ± 0.68	0.874
Neoplasm[b] of other abdominal and thoracic organs (except urinary organs)	—	9.01 ± 1.27	9.58 ± 0.86	0.355
Neoplasm[b] of urinary organs	—	30.15 ± 2.44	29.18 ± 3.75	0.60
Other	—	12.20 ± 4.08	10.98 ± 3.96	0.593

[a]Values are ± standard deviation.
[b]Includes benign, malignant, uncertain behavior, and secondary neoplasms.
*Two-tailed Student's *t*-test.

This study demonstrates that the annual rate of adrenal surgery has significantly increased in the United States between 1988 and 2000. This trend has also been found in several smaller series examining a variety of aspects of adrenal surgery [17, 23, 24]. What may account for this increase in the use of adrenal surgery? Others have postulated that it may reflect an increase in the incidence of adrenal imaging [18, 19]. Much of this imaging is done incidentally during examinations for other abdominal or retroperitoneal pathology. Furthermore, the quality of imaging technology has improved such that subtle adrenal cortical irregularities are being detected at a higher rate [18].

The increased total annual number of adrenal surgeries may also represent a trend toward surgical referral earlier in the course of the disease. One study looking at adrenalectomy for aldosterone-secreting adrenocortical tumors demonstrated that both the level of diastolic blood pressure elevation and the extent of hyperkalemia were less severe in a group of patients treated between 1993 and 1998 when compared to a comparable group of patients treated from 1975 to 1986 [20]. Such earlier referral for surgery was thought to be secondary to the actual and perceived decreased morbidity from minimally invasive surgical intervention. Although no studies have addressed this possibility to date, it may be that the morbidity due to minimally invasive adrenal surgery for primary hyperaldosteronism has decreased enough such that there is now a threshold at which the risk of morbidity from sustained exposure to antihypertensive medications may exceed the risk from surgery.

The composition of the disease-specific indications for adrenalectomy has changed too between 1988 and 2000. The total annual rate of adrenalectomies for benign neoplasms of the adrenal gland and for neoplasms of uncertain behavior has increased significantly, whereas the rate of adrenalectomies for primary malignant neoplasms of the adrenal gland has not. Furthermore, adrenalectomy for malignancies metastatic to the adrenal gland is being performed at a significantly higher rate relative to that in 1988. In agreement with previous studies [20], the rate of adrenal surgery for hyperaldosteronism increased from 1988 to 2000. The other specific disorders of adrenal hormone secretion did not demonstrate a significant change over the time period reviewed. However, it must be noted that the absolute numbers of procedures for these other diagnoses are small and that many of the diagnoses were likely coded as benign, irrespective of hormonal function.

The NIS is a well validated database used to perform research on health care delivery and resource utilization [25–31]. It provides a cross-sectional survey across all payers. However, the database is not inclusive of all surgical practice in the United States. Its 20% sample does not include procedures performed at Veterans Ad-

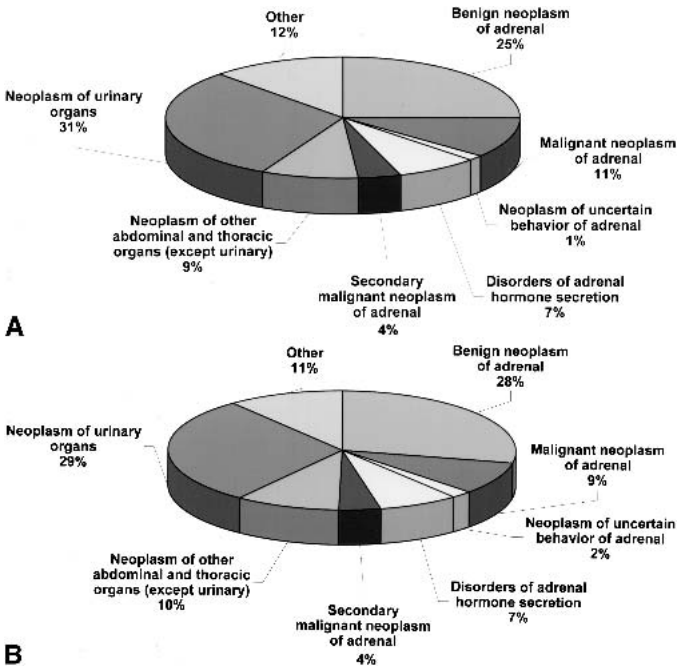

Fig. 2. Average annual percent of adrenalectomies by selected ICD-9-CM diagnostic codes from 1988 through 1993 (**A**) and from 1994 through 2000 (**B**).

ministration hospitals, for example. Furthermore, some of the centers of excellence in endocrine surgery across the United States, from which many of the large published series are generated, are currently geographically excluded from the NIS. Therefore it is necessary to extrapolate the significant patterns and trends that have been detected in the NIS database.

The clinical detail of the NIS is somewhat limited by available coding systems. This study identified 705 ICD-9-CM codes listed as the primary diagnostic code of the adrenalectomy patients. The breadth of these diagnostic codes suggests that they may be the primary reason for the hospital stay rather than the indication for the original procedure. This variability in hospital coding is inherent in the use of administrative databases. However, the variability in coding appears constant over the time period studied, with 50% to 51% of the adrenalectomies during each period (1988–1993 and 1994–2000) being associated with a diagnostic code that grouped them in "neoplasm of other abdominal and thoracic organs," "neoplasm of urinary organs," and "other." Thus the relative rates and percentages of adrenalectomies for specific diagnoses would not be affected. The current iteration of the ICD codes does not include a procedural code for laparoscopic adrenalectomy [22]. Attempts in the current study to identify directly those patients who underwent adrenalectomy via a laparoscopic approach were not successful, likely due to variability in the use of modifier procedure codes (e.g., laparoscopy of the abdominal region). We identified as possible laparoscopic adrenalectomies only a maximum of 8% of procedures per year. Current estimates place the number at closer to 60% [17].

An alternative, indirect method to profile adrenal surgery is to examine trends over time. As laparoscopic adrenalectomy became the preferred approach during the latter half of the last decade, we chose to look at the change in the percentage of adrenal surgery being performed for a variety of indications before and after 1993. The results demonstrate a significant change in the percentage of adrenal surgery performed for benign versus malignant adrenal pathology. There was a divergence in the relative percentages of these two indications, as the percentage of adrenalectomy for primary benign neoplasms significantly increased and that for adrenalectomy for primary malignant neoplasm significantly decreased. These two specific diagnostic ICD-9-CM codes are the most informative to examine, as the remainder of the diagnostic codes studied do not specifically indicate the nature of the adrenal mass. Notably, however, the percentage of adrenalectomies performed for lesions characterized as uncertain behavior also increased after 1993.

There was an increase in the proportion of adrenalectomies performed in the United States for benign disease and disease of uncertain behavior, a code that may be chosen by physicians before the pathology is known. It is unlikely that the prevalence of these pathologic entities changed appreciably during the 13-year time span of this study. Therefore it appears that more adrenal surgery is being performed for at least some lesions that have historically been simply observed or perhaps never detected. The NIS database does not include information about the size of the adrenal lesions removed, but it is unlikely that all of the additional benign lesions removed were > 6 cm in diameter. This increase correlates well with the introduction of minimally invasive adrenal surgery. It is a reasonable conclusion, then, that the low morbidity of laparoscopic adrenalectomy has led many surgeons to remove adrenal lesions that were previously only observed using serial imaging or biochemical testing. This may be somewhat patient-driven. Minimally invasive surgery is now often marketed directly to patients. Moreover, many patients prefer a definitive disposition to longitudinal follow-up and the psychological stress of knowing that the lesion might represent something other than a completely benign adenoma.

Increased utilization of adrenal imaging is now detecting lesions that are asymptomatic [18, 19]. However, it remains for the surgeon to decide which lesions warrant operative intervention and which ones can be simply observed. Without novel, long-term studies on the natural history of adrenal lesions, we should not widen the indications for surgery [4, 32, 33]. Some have argued to the contrary. There have been proposals that any nonfunctioning tumor is an indication for laparoscopic adrenalectomy [34]. Some have compromised and stated that any adrenal tumor > 2.5 cm in diameter should be removed [35]. All of these arguments rely on the safety of laparoscopic adrenalectomy. Although the laparoscopic approach has been shown repeatedly to have a better morbidity profile than the traditional open approach, it is not without risk [2, 3, 6, 10–12]. The traditional teaching of an acceptable negative appendectomy rate [36] should not apply to adrenalectomy. There can be significant deleterious consequences of an "exploratory" adrenalectomy.

Natural experimentation with new technologies allows the spread of its use. It is in this context that some adrenal lesions initially not considered candidates for minimally invasive surgery (e.g., pheochromocytoma) have been successfully removed via the laparoscopic approach [14]. The appeal of laparoscopic adrenalectomy is likely to encourage a continued trend toward increased use of adrenalectomy. The currently demonstrated shift in indications for adrenalectomy is statistically significant, though still relatively small in magnitude. The clinical significance of this trend is not yet fully known. Further prospective study, including the use of more clinically oriented databases (e.g., the National Surgical Quality Improvement Project) is needed to address these issues so we can

prevent future overtreatment with a rational, evidence-based approach.

Conclusions

The total number and rate of operations for adrenal disease are increasing in the United States, as is the percent of adrenalectomies performed for benign or uncertain disease. The latter appears to account for most of the rise in frequency of adrenal surgery. This increase was most marked during the period after the introduction of minimally invasive adrenal surgery. It is during this time period as well that incidental adrenal imaging became more commonplace. Assuming that the prevalence of adrenal disease has not changed over the last one-and-a-half decades, it appears that the utilization of adrenalectomy has increased. We must be cautious not to alter the indications for operation without pathophysiologic evidence of need solely because our technical and surgical skill allow safer operations—or if we do, it should be with both good reasons and strong evidence, and it should be prospectively monitored and studied.

Résumé. La chirurgie mini-invasive (CMI) a radicalement réduit la morbidité de la surrénalectomie. Un des soucis est que l'augmentation de la fréquence de l'imagerie des surrénales combinée avec les avantages d'une morbidité réduite par CMI pourraient influencer les indications de la surrénalectomie. Nous avons testé l'hypothèse que la fréquence de la surrénalectomie et que la prévalence de surrénalectomie pour maladie bénigne ont augmenté avec le temps. On a utilisé la banque de données « Nationwide Inpatient Sample (NIS) » pour déterminer l'incidence de la surrénalectomie et les indications pour chirurgie aux Etats-Unis entre 1988 et 2000. Toute sortie de patient portant un code ICD-9-CM de procédé primaire pour surrénalectomie, indépendamment de l'approche chirurgicale (l'approche laparoscopique n'a pas été enregistrée avec précision) a été ensuite comparée aux codes de diagnostic ICD-9-CM. On a analysé la signification des tendances par régression linéaire et le test-t. Le nombre total de surrénalectomies a augmenté de façon significative de 12.9 pour 100000 sorties en 1988 à 18.5 pour 100000 sorties en 2000 (p = 0.000003). Le nombre total de surrénalectomies avec un code ICD-9-CM primaire pour néoplasme surrénalien malin n'a pas augmenté de façon significative, passant de 1.2 pour 100000 sorties en 1988 à 1.6 pour 100000 sorties en 2000 (p = 0.47). Le nombre total de surrénalectomies avec le code diagnostic primitif ICD-9-CM pour maladie bénigne de la surrénale a augmenté de façon significative de 2.8 pour 100000 sorties en 1988 à 4.8 pour 100000 sorties en 2000 (p = 0.00002). Le pourcentage moyen de surrénalectomies réalisées pour maladie maligne était significativement plus élevé pendant la période 1988–1993 comparé à la période 1994–2000 (11% vs. 9%; p = 0.002). Le pourcentage moyen des surrénalectomies réalisées pour maladie bénigne était significativement plus bas pendant la période 1988-1993 comparé à la période 1994-2000 (25% vs. 28%; p = 0.015). La surrénalectomie se réalise avec une fréquence croissante, au dépens d'une augmentation de la proportion de surénalectomies réalisées pour maladie bénigne. En assumant qu'il n'y a eu aucune modification significative dans la prévalence de la maladie pendant la période de l'étude, ces données suggèrent que les indications de la surrénalectomie ont changé pendant cette période de l'étude.

Resumen. Los abordajes mínimamente invasores han reducido la morbilidad de la adrenalectomía en forma dramática. Ha habido preocupación acerca de si la incrementada frecuencia de la imaginología suprarrenal junto con las ventajas de un procedimiento de menor morbilidad podrían tener influencia sobre las indicaciones reales de la adrenalectomía. Nos propusimos poner a prueba la hipótesis de que la adrenalectomía se ha hecho más común con el transcurso del tiempo y que las entidades benignas han venido a ser crecientemente frecuentes como indicación para realizar el procedimiento. La base de datos de la Nationwide Inpatient Sample (NIS) fue utilizada para determinar la incidencia de la adrenalectomía y sus indicaciones en los Estados Unidos en el periodo 1988 a 2000. Se identificaron todos los egresos cuyo código de procedimento ICD-9-CM fuera para adrenalectomía, sin importar la vía de abordaje (adrenalectomía laparoscópica no fue un código confiable), y el subgrupo fue luego subdividido según los códigos diagnósticos ICD-9-CM asociados. Se utilizaron pruebas de análisis de regresión y t-tests para determinar la significancia de las tendencias. El número total de adrenalectomías aumentó en forma significativa desde 12.9 por 100.000 egresos en 1988 a 18.5 por 100.000 egresos en 2000 (p = 0.000003). El número total de adrenalectomías con el código diagnóstico ICD-9-CM primario de neoplasma maligno no aumentó en forma significativa, de 1.2/100.000 egresos en 1988 a 1.6/100.000 egresos en el 2000 (p = 0.47). El número total de adrenalectomías con el código diagnóstico ICD-9-CM primario de neoplasma suprarrenal benigno no aumentó significativamente de 2.8/100.000 egresos en 1988 a 4.8/100.000 egresos en el 2000 (p = 0.00002). El porcentaje promedio de adrenalectomías practicadas por neoplasmas malignos fue significativamente más alto en el periodo 1988-1993 que en 1994-2000 (11% vs. 9%, p = 0.002). El porcentaje promedio de adrenalectomías por neoplasmas benignos fue significativamente inferior en el periodo 1988-1993 que en el 1994–2000 (25% vs. 28%; p = 0.015). La adrenalectomía está siendo practicada con creciente frecuencia, y esto se asocia con un incremento en la proporción de adrenalectomías por neoplasmas benignos. Asumiendo que no ha habido variación en la prevalencia durante el periodo del estudio, estos datos sugieren que las indicaciones para la adrenalectomía puedan haber sufrido algunos cambios en el curso de tal periodo.

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