Cost–benefit value of microscopic examination of intervertebral discs

DANA M. GRZYBICKI, M.D., PH.D., EDWARD J. CALLAGHAN, M.D., AND STEPHEN S. RAAB, M.D.

School of Health Sciences, Duquesne University, Pittsburgh, Pennsylvania; Department of Pathology, University of Iowa Hospitals and Clinics, Iowa City, Iowa; and Department of Pathology and Laboratory Medicine, Allegheny University of Health Sciences, Pittsburgh, Pennsylvania

Object. Given the virtual absence of histologically detected, clinically unsuspected disease in intervertebral disc specimens, some authors have advocated that histological examination be discontinued. However, the examination of intervertebral disc specimens remains common practice in most pathology laboratories. No cost–benefit analysis of this practice has been made; therefore, the authors’ goal in this study was perform such an analysis.

Methods. Using the University of Iowa surgical pathology database, 1109 patients who had undergone a laminectomy were identified retrospectively. These cases were classified into four categories based on the patients’ preoperative clinical diagnosis and final histopathological diagnosis: insignificant clinical diagnosis/insignificant pathological diagnosis (ICIP), significant clinical diagnosis/insignificant pathological diagnosis (SCIP), significant clinical diagnosis/significant pathological diagnosis (SCSP), and insignificant clinical diagnosis/significant pathological diagnosis (ICSP). A significant clinical diagnosis was defined as one other than a benign, noninfectious indication for laminectomy. A significant pathological diagnosis was a diagnosis other than degenerative changes. The cost–benefit value of performing a histological examination in cases with significant or insignificant clinical diagnosis was examined. The cases were classified as: 1068 ICIP, 17 SCIP, 21 SCSP, and three ICSP. On chart review, in all three cases of ICSP an epidural abscess was identified perioperatively and the subsequent histological diagnosis did not affect patient care. The costs per case of identifying a significant pathological diagnosis with a significant and an insignificant clinical diagnosis were $44.79 and $8811, respectively.

Conclusions. Histological examination of intervertebral disc specimens is cost beneficial only if there is a significant preoperative clinical diagnosis.

Key Words • cost–benefit value • intervertebral disc • histology • health care costs

The present standard of care for pathological examination of intervertebral disc material requires that both gross and microscopic pathological examinations be performed on all specimens, including discs removed for benign, noninfectious indications such as disc herniation. Two recent studies have challenged this practice, reporting in retrospective reviews the lack of a single, unsuspected, clinically significant pathological finding that affected patient care among the specimens analyzed.1,2 There are several reasons why both gross and microscopic pathological examinations are still performed. In cases in which there is a significant preoperative clinical diagnosis, such as tumor, the microscopic pathological examination often affects patient care. It is conceivable that there are cases with no significant preoperative clinical diagnoses that will have pathological diagnoses that also will affect patient care. In addition, microscopic pathological examination is performed for reasons that only indirectly affect patient care, such as quality assurance and teaching. In a managed care environment, the decision concerning whether to perform microscopic pathological examinations depends on the trade-off between the value of information gained by the examination and the cost of the examination.

The application of cost–benefit analysis to anatomical pathology is relatively recent. Using cost–benefit analysis, Netser, et al.,4 showed that the microscopic pathological examination of “routine” tonsil and adenoid specimens was not cost beneficial. Routine tonsil and adenoid specimens are similar to most intervertebral disc specimens, because both specimen types are removed primarily for benign processes and the information provided rarely affects care.

Using the University of Iowa surgical pathology data files, we assessed the cost–benefit value of microscopic pathological examination of both routine and nonroutine intervertebral disc specimens.

Clinical Material and Methods

Specimen Inclusion and Process of Review

The final pathology report for all specimens that were SNOMED (standardized nomenclature of medicine) coded as “intervertebral disc” between 1990 and 1996 at the University of Iowa Hospitals and Clinics were reviewed retrospectively. This method did not identify all laminectomy specimens received during this period be-
Cost–benefit ratio of intervertebral disc examination

cause such specimens are variously SNOMED coded; however, using this designation, 1150 cases were identified and 1109 cases were analyzed. The 41 cases that were not analyzed had specimens from the vertebrae or paravertebral soft tissue, or they were referral cases from other institutions and microscopic slides or clinical history were unavailable.

In the 1109 cases we analyzed, we collected the following data from the surgical pathology diagnostic report form: patient age, gender, and clinical history (originally obtained from the requisition form); pathological diagnosis; and microscopic description. The cases were divided into four categories based on the preoperative clinical diagnosis and the final pathological diagnosis: significant preoperative clinical diagnosis/insignificant pathological diagnosis (SCIP), significant clinical diagnosis/significant pathological diagnosis (SCSP), insignificant clinical diagnosis/significant pathological diagnosis (ICIP), and insignificant clinical diagnosis/significant pathological diagnosis (ICSP). A significant clinical diagnosis was defined as a preoperative clinical diagnosis that contained other than a benign, noninfectious indication for laminectomy (such as osteomyelitis). A significant pathological diagnosis was a final pathological diagnosis that included other than degenerative changes normally seen with disc prolapse or other degenerative disease. A specimen that was accompanied by a significant preoperative clinical diagnosis was considered a “nonroutine” specimen; a specimen not accompanied by a significant preoperative clinical diagnosis was considered a “routine” specimen.

Charts and microscopic slides from all nonroutine cases and routine cases with a significant microscopic pathological diagnosis were reviewed jointly by two pathologists (E.I.C and D.M.G.), one of whom was a neuropathologist (D.M.G.). To determine the percentage of potentially misdiagnosed routine cases, the microscopic slides of 111 cases (10%) of the routine cases were reviewed and the number of discrepancies between the original and review diagnoses was determined.

The usefulness of performing microscopic examinations for routine and nonroutine specimens was examined by using cost–benefit analysis. A microscopic examination was assumed to be beneficial if the diagnosis determined by this examination had a potential or an actual effect on patient care. The benefits of teaching or quality assurance were not assessed.

For routine specimens, any significant microscopic pathological diagnosis had a potential effect on patient care, because these diagnoses were assumed to be unsuspected preoperatively. Insignificant microscopic diagnoses were assumed not to affect patient care, because these diagnoses were the same as the clinical diagnosis. Only in a subset of patients with a significant microscopic diagnosis was there an actual effect on patient care, and this was determined by medical chart review. For every chart reviewed, we obtained the preoperative diagnosis, operative findings, discharge diagnosis, and effect of the microscopic pathological diagnosis on patient care.

For all nonroutine specimens, it was assumed that patient care depended on the pathological diagnosis; these specimens had been sent to the pathology laboratory to obtain diagnostic information. In a subset of these pa-

### TABLE 1

<table>
<thead>
<tr>
<th>Subclassification of benign noninfectious indications for laminectomy other than disc herniation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Diagnosis</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>cervical spondylosis</td>
</tr>
<tr>
<td>degenerative bone disease</td>
</tr>
<tr>
<td>vertebral body fracture</td>
</tr>
<tr>
<td>spinal stenosis</td>
</tr>
<tr>
<td>vertebral deformity</td>
</tr>
<tr>
<td>spondylolisthesis or other</td>
</tr>
<tr>
<td>developmental abnormality</td>
</tr>
</tbody>
</table>

tients, there was an actual effect on patient care, which also was determined by chart review.

### Cost–Benefit Analysis

The cost–benefit value of performing a microscopic pathological examination of routine specimens was determined by dividing the total cost of pathological testing associated with all routine specimens by the number of specimens in which the pathological diagnosis had a potential or an actual effect on patient care. This value was the cost per case of potential effect on patient care or the cost per case of actual effect on patient care. In other words, this was the cost per case to detect a potentially or actually significant unexpected disease.

The cost–benefit value of performing microscopic pathological examination of nonroutine specimens was determined by dividing the total pathology cost associated with all nonroutine specimens by the total number of nonroutine specimens. This value was the cost per nonroutine case to determine a pathological diagnosis that affected patient care.

All case costs consisted of a technical and a professional cost. The technical cost consisted of a cost per block submitted, whereas the professional cost consisted of a cost per part examined. It was assumed that each case consisted of one part (block). Costs were obtained from the University of Iowa pathology billing office and are reported in 1997 United States dollars. The total cost of pathological testing for a routine or nonroutine intervertebral disc specimen was $24.75.

### Results

#### Routine Specimens

Of the 1109 cases reviewed, 1068 (96%) were categorized as ICIP. The average patient age was 44 years and the male/female ratio was 1.6:1. The preoperative clinical diagnoses included: none given (35%), herniated disc (58%), and other benign, noninfectious processes (7%) (Table 1). For all cases, the final microscopic pathological diagnosis was degenerative changes. The 10% microscopic review of routine cases did not show any discrepant diagnoses between the original and review diagnoses.

Three cases (0.3%) were initially categorized as ICSP. The average patient age was 36 years (range 35–41 years) and all patients were men. All three patients had a final pathological diagnosis of pseudogout, which was not clin-
ically suspected at the time of surgery, and all had clinical histories of previous discectomies for herniated discs. All three patients experienced recurrent back pain, and the preoperative diagnosis was disc herniation. From the chart review, it was determined that the microscopic pathological diagnosis did not result in a change in patient treatment. Therefore, there were no cases identified in which a clinically unsuspected significant microscopic diagnosis affected patient care.

**Nonroutine Specimens**

Seventeen cases (1.5%) were categorized as SCIP. The average patient age was 43 years (range 12–68 years; median 44.5 years), and the male/female ratio was 1.1:1. The clinical diagnoses in these cases included: tumor (eight cases), infection (five cases), tumor or infection (two cases), and synovial cyst (two cases). All cases had a final pathological diagnosis of only degenerative changes. Chart review of all these cases revealed correlations between the final pathological diagnosis and the postoperative or discharge diagnoses, with more serious processes never observed.

Twenty-one cases (1.9%) were categorized as SCSP. The average patient age was 60 years (range 20–80 years; median 65 years), and the male/female ratio was 1.6:1. The clinical indications for laminectomy included: tumor, vertebral fracture, synovial cyst, pseudogout, discitis, epidural abscess, and osteomyelitis (Table 2). For all 21 cases, the final pathological diagnosis correlated with the clinical diagnosis. Three of these 21 cases had no clinical diagnosis provided at the time of specimen receipt in the pathology laboratory. These cases could have been classified as ISCP, although based on chart review, all three patients had an operative diagnosis of an epidural abscess. No alteration in patient care resulted from the final pathological diagnosis in any of these three cases.

**Cost-Benefit Analysis**

The total cost for the microscopic pathological examination of all routine specimens was $26,507.25. The average cost per routine case to detect a significant pathological diagnosis was $8,835.75 (1071 cases with an insignificant clinical diagnosis multiplied by $24.75 per case divided by three cases with a significant pathological diagnosis). There were no cases in which patient care was altered because of the results of the microscopic pathological examination.

The total cost for the microscopic pathological examination of all nonroutine specimens was $940.50. The average cost per nonroutine case was $44.79 (38 cases with a significant clinical diagnosis multiplied by $24.75 per case divided by 21 cases with a significant pathological diagnosis). This cost also was the cost to detect potentially clinically significant disease.

**Discussion**

The results of this study show that the performance of routine microscopic pathological examination of intervertebral disc material obtained by laminectomy in addition to gross examination for disc herniation or other benign, noninfectious indications fails to provide information that affects patient management. Two previously published studies1,2 have addressed this issue; however, both were smaller studies, each reviewing approximately 500 cases. Here we reviewed twice as many cases. It can be inferred from these data that the microscopic examination of intervertebral disc specimens in patients who do not have a clinical suspicion of an infectious or neoplastic disease process may not be warranted and that gross examination in these cases is probably sufficient.

The argument for continued microscopic examination is that if microscopic examination is not performed, a rare,
Cost–benefit ratio of intervertebral disc examination

Clinically significant disease may go undetected and detection is paramount to cost. Using decision analysis, a method to synthesize existing data, Raab has determined the “needed” incidence of discordant disease (clinically significant, previously undiagnosed disease, the detection of which leads to a gain of 1 year of life expectancy) that warrants microscopic examination for any specimen type. That study suggests that if a clinically unsuspected disease is not detected once every 2000 examinations, microscopic examination should be discontinued. In light of these data, the power of the present study is limited, given that only 1109 disc specimens were reviewed; however, one proof of the universal rarity of undiagnosed disease in routine disc specimens is the lack of case reports in the literature documenting such cases.

Compared with the overall cost of treatment for the average patient undergoing laminectomy, the cost of microscopic examination of disc material is low. In this study, the cost to detect three cases of potentially clinically significant disease in which there was an insignificant preoperative clinical diagnosis was only $26,407.25. (In retrospect, these patients had a diagnosis of pseudogout and patient care was not altered by these diagnoses.) However, approximately 208,000 laminectomies are performed annually in the United States. Assuming that 96% of the specimens are routine, using University of Iowa cost data, approximately $5 million ($4,942,080) is spent annually for microscopic examination of these specimens, a procedure that this study confirms is of uncertain medical and cost–benefit value.

The practice of eschewing microscopic examination in patients without a significant preoperative clinical diagnosis should be evaluated on a “per institution” basis by the appropriate tissue committee, and the examination should be discontinued only if appropriate clinical history is provided. In this study, if microscopic examination had not been performed in cases with no clinical history given (the assumption being the clinical diagnosis was insignificant), the three cases of abscess would have been missed. In this study, no history was provided in 35% of cases. If clinical history is not provided, the pathologist cannot be certain that the clinical diagnosis is insignificant.

This study also showed that if a significant disease is suspected clinically, there is a high probability that the microscopic pathological examination will confirm this process. In these cases, performing the histological examination is important because treatment often depends on the pathological diagnosis. Also, the cost–benefit value of the histological examination in these cases is remarkably low—$44.79 per detection of a case with significant disease—compared with other laboratory tests. Even if the diagnosis in these cases does not affect patient care, performing the histological examination is important to exclude more serious disease. Thus, microscopic examination should not be discontinued for these specimens.

Conclusions

Disc specimens fall into two main categories: those in which a clinically significant disease is suspected and those in which a benign, noninfectious process is suspected. In terms of cost–benefit value, microscopic examination probably should only be performed for those specimens in the first category.

References


Manuscript received December 29, 1997. Accepted in final form May 4, 1998.

Address reprint requests to: Dana M. Grzybicki, M.D., Ph.D., School of Health Sciences, Duquesne University, 130 Health Sciences Building, Pittsburgh, Pennsylvania 15282-0001.