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Cost minimization analysis for combinations of sampling techniques in bronchoscopy of endobronchial lesions

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Summary
Background: The choice of sampling techniques in bronchoscopy with sampling from a visible lesion will depend on the expected diagnostic yields and the costs of the sampling techniques.
Aims: The aim of this study was to determine the most economical combination of sampling techniques when approaching endobronchial visible lesions.
Methods: A cost minimization analysis was performed. All bronchoscopies from 2003 and 2004 at Haukeland university hospital, Bergen, Norway, were reviewed retrospectively for diagnostic yields. 162 patients with endobronchial disease were included. Potential sampling techniques used were biopsy, brushing, endobronchial needle aspiration (EBNA) and washings. Costs were estimated based on registration of equipment costs and personnel costs. Sensitivity analyses were performed to determine threshold values.
Results: The combination of biopsy, brushing and EBNA was the most economical strategy with an average cost of Euro 893 (95% CI: 657, 1336). The cost of brushing had to be below Euro 83 and it had to increase the diagnostic yield more than 2.2%, for biopsy and brushing to be more economical than biopsy alone. The combination of biopsy, brushing and EBNA was more economical than biopsy and brushing when the cost of EBNA was below Euro 205 and the increase in diagnostic yield was above 5.2%.
Conclusion: In the current study setting, biopsy, brushing and EBNA was the most economical combination of sampling techniques for endobronchial visible lesions.
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Introduction

Bronchoscopy is the main diagnostic method for endobronchial visible lesions.[1–3] A biopsy allows for a histological sample, which inherently has more information than a cytological sample. However, in many instances, a cytological sample can be sufficient for the establishment of a malignant diagnosis in the airways, and most physicians will prefer to take cytological samples in addition to biopsies when encountering an endobronchial lesion. The choices for cytological sampling are brushing, endobronchial needle aspiration (EBNA), and washings. The optimal combination of all sampling techniques is still debated, due to differences in yield and cost.

The previous recommended combinations have been biopsy, brushing and washing,[4–7] biopsy and brushing,[8–10] biopsy, brushing or washing,[11,12] biopsy, brushing and EBNA,[13–15] or EBNA alone with rapid on-site cytological evaluation (ROSE) combined with supplemental techniques if negative.[16] So far, the diagnostic yield has been the most important criterion for the recommendations. However, the costs of the different sampling techniques vary greatly, and the overall cost of the procedure will in a large part be dependent on how each center organizes its diagnostic procedures. The main weakness of the current recommendations is the lack of data on true costs. Although some studies of bronchial washings have included costs,[11,12] the most economical combination of all sampling techniques has yet not been settled.

The aim of this study was to determine the most economical combination of sampling techniques in bronchoscopy of endobronchial visible lesions, using a cost minimization analysis.

Methods

Study design

The bronchoscopies included in the current study were performed in 2003 and 2004 at Haukeland University Hospital, Bergen, Norway. Haukeland University Hospital is responsible for the diagnosis and treatment of lung cancer in a geographical area comprising 380 000 inhabitants, and serves as a referral center for surrounding smaller hospitals comprising 950 000 inhabitants. Most patients examined on suspicion of lung cancer are admitted to a day ward at the hospital.

A total of 1438 bronchoscopies were performed in 2003 and 2004, of which 551 were performed on suspicion of malignant disease. The sampling and execution of these investigations, with their diagnostic yields, have been published previously.[17] For the current study, all 162 patients with an endobronchial visible lesion deemed suspicious of malignancy upon inspection were included. The bronchoscopies were performed by 22 different physicians.

Sample collection

The investigations were performed with Olympus BF 1T 160 bronchoscopes, using Boston ''Radial Jaw3'' for biopsies, Boston 21 Gauche ''Stifcor'' transbronchial aspiration needle for EBNA, and Boston ''Cellebrity'' for brushings. EBNA was taken directly from the endobronchial lesions. Washings were performed with aspiration of fluid from the entire procedure and a sample of the fluid was sent to the pathological department for investigation. In some cases small volume lavage (SVL) was performed. However, SVL was too seldom performed to warrant inclusion in the current analyses. The physicians determined which sample techniques to employ, and in which order, during the bronchoscopies. Thus, not all patients had all possible sample techniques performed, and the order may vary.

Costs

All costs were transformed to the 2004 NOK value according to the Consumer Price Index in Norway and transformed to Euro with the interbank rate of 8.39760 on 01.01.2004.

All available costs for equipment in the department of thoracic medicine and the department of pathology were included. The average equipment cost of the bronchoscope and its cleaning were based on an average of 715 investigations yearly and an average duration of bronchoscopes of 7 years and average duration time for the washing machine of 10 years.

To estimate the time cost of physicians and nurses in the bronchoscopy lab, the time consumption of all present personnel was registered in detail for 24 bronchoscopies. The personnel costs were calculated based on the median value for time, the average number of personnel present, and the average wages per personnel category. The estimates were compared with registration of personnel use in a larger prospective register in our bronchoscopy lab, and found to be representative.

The estimation of the personnel cost for examining biopsies at the department of pathology was based on a detailed registration of 25 examined samples by the pathologist. The time consumption in the cytopathology lab was based on 11 detailed registrations and expert opinion that assumed that the average time consumption for the pathology technician was 5 min for preparation of all slides, and 4 min for investigation of each slide. The time consumption was based on an average number of slides examined per sampling technique for the bronchoscopies performed in 2004.

The average cost of a stay at the day ward was estimated by the average diagnosis related group (DRG) refund divided by the average days spent in the day ward for patients admitted in 2007 and adjusted to 2004 value. The results of the bronchoscopy samplings were presented by the pathologists at an interdisciplinary meeting every Friday. The cost of a false negative sample was assumed to be another five days in the day ward plus the cost of a repeated bronchoscopy.

Cost minimization analysis

A cost effectiveness analysis compares how the increase in costs of a new clinical strategy compares with the existing strategy. If the average cost for increased effectiveness is below the willingness to pay, the new strategy is cost effective. Usually the effectiveness is measured in quality adjusted life years (QALY). However, it is difficult to measure a difference in QALY based on the results of bronchoscopy.

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