Optimization of Utilization of Serum Protein Analysis
Role of the Electronic Medical Record in Promoting Consultation by Pathology

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Key Words: Laboratory utilization; Monoclonal gammopathies; Serum protein electrophoresis; Serum immunofixation electrophoresis; Serum free light chain assays; Electronic medical records

Abstract

Screening for monoclonal gammopathies is usually done by serum protein electrophoresis (SPEP) and serum free light chain tests. SPEP may be followed by immunofixation electrophoresis (IFE). IFE may be ordered by the treating physician or be at the discretion of the pathologist. We examined the appropriateness of IFE ordering by treating physicians and report on our findings, follow-up changes to the ordering process, and results of the change. We retrospectively analyzed the data from our laboratory from April 2009 through July 2012. In April 2009, 3 options for test ordering were available for the clinicians: SPEP with reflex IFE, SPEP only, and SPEP with IFE. This test ordering option was limited to SPEP with reflex IFE only in April 2010. We compared the rates of SPEP and IFE performed in the 2 periods (ie, April 2009 through April 2010 and May 2010 through July 2012). There was a substantial drop in the IFE/SPEP ratio from 0.47 to 0.21. Review of electronic medical records by the consultant pathologist was instrumental in improving the utilization and enhancing the value of pathology consultation. Possible impacts on laboratory costs, revenue, and overall health care are also presented.

Monoclonal gammopathies are conditions or diseases characterized by abnormal synthesis and release of immunoglobulins into the circulation. These immunoglobulins can be intact molecules or just light and/or heavy chain fragments. These are usually caused by clonal proliferative lymphoplasmacytic disorders. A subset of plasma cell disorders are nonsecretory and do not cause obvious monoclonal gammopathies. Lymphoplasmacytic disorders that may cause monoclonal gammopathies include malignant diseases such as multiple myeloma (MM), plasmacytoma, plasma cell leukemia, and Waldenström macroglobulinemia (WM); premalignant and potentially malignant conditions such as monoclonal gammopathy of undetermined significance (MGUS) and smoldering multiple myeloma (SMM); and monoclonal immunoglobulin deposition diseases such as primary amyloidosis (AL), light chain deposition disease (LCDD), heavy chain deposition disease, light and heavy chain deposition disease, and POEMS syndrome (polyneuropathy, organomegaly, endocrinopathy, monoclonal gammopathy, and skin changes).

The disorders associated with monoclonal gammopathies often have few or only subtle symptoms, especially in the early stages. Therefore, it is prudent to identify monoclonal gammopathies early to provide monitoring and/or meaningful interventions. An armamentarium of laboratory testing is offered clinically, but none of these tests alone has sufficient sensitivity to be used individually as a reliable screening test. Several testing panels have been suggested by different authorities to screen for or diagnose monoclonal gammopathies with variable results; others have suggested a reflex testing approach. In panel testing, multiple tests are ordered simultaneously at the outset, and the interpretation is based on
all results, whereas in reflex testing usually the serum protein electrophoresis (SPEP) test is ordered first and the decision to proceed to further testing is based on abnormal or suspicious SPEP findings and/or clinical information.

One of the most recent suggested screening algorithms for investigation of monoclonal gammapathies are SPEP and serum free light chain (SFLC) tests. SPEP may be followed by serum immunofixation electrophoresis (IFE). Urine protein electrophoresis (UPEP) and urine immunofixation may be performed more selectively. IFE may be ordered by the caregiver or physician as a part of a panel or be at the discretion of the pathologist (ie, as a reflex test). We examined the appropriateness of IFE ordering by physicians and report on our findings, follow-up changes to the ordering process, and results of the change in the utilization of laboratory tests. We also analyzed the role of pathologists’ review of patients’ clinical information and prior testing history via the electronic medical record (EMR) to help guide the reflex testing. The data were also analyzed to assess the possible impact on laboratory costs, revenue, and impact on overall health care costs in the United States.

Materials and Methods

This study was carried out at a 592-bed (300 acute care) tertiary care, medical school–affiliated, level 1 trauma center, safety net hospital, in an inner city in the Midwestern United States. Approval for the study was obtained from the Institutional Review Board of the University of Missouri–Kansas City School of Medicine (Kansas City) and the Privacy Board and Research Administration of Truman Medical Centers (Kansas City, MO). The EMR system (Cerner, Kansas City, MO) was used to extract test and clinical data. We retrospectively analyzed the data from our laboratory from April 2009 through July 2012.

We included test data of all patients for whom we received requests for serum protein analysis in the indicated period. A total of 1192 episodes of testing were included, with no exclusions. SPEP was performed with agarose gel electrophoresis (Hydrasys-Sebia/Hydragel 7 protein and Hydragel 15 protein [Sebia Electrophoresis, Norcross, GA]) with resolution of 6 classic protein zones: albumin, α-1, α-2, β-1, β-2, and γ. An abnormal SPEP was defined by the presence of a visible M-spike, fuzzy band(s), hypogammaglobulinemia, increased β fraction or increased α-2 fraction. The serum IFE was also performed with agarose gel (Hydrasys-Sebia/Hydragel 2 IF and Hydragel 4 IF [Sebia]) to assess the migration patterns for γ, α, μ, κ, and λ immunoglobulin chains. We sent all of our quantitative SFLC assays to a reference laboratory.

The test ordering pattern for serum protein analysis was examined. In-house testing for SPEP and serum IFE was initiated in April 2009, when 3 options for test ordering were available for the clinicians: SPEP with reflex IFE, SPEP only, and SPEP with IFE. Reflex IFE was meant to provide discretion to the consultant pathologist to determine if IFE was warranted. The SFLC assay ordering was at the discretion of the clinician.

Over the course of the following year, it appeared that SPEP with IFE was ordered excessively and sometimes inappropriately. To validate this premise, we conducted a retrospective review of the SPEP with IFE orders. From April 2009 through April 2010, we identified 92 orders for SPEP with IFE. Without revealing the results of the IFE, we asked our clinical pathologist (G.S.) whether, given the SPEP findings and his review of the clinical history, he would have performed an IFE. He reviewed all SPEP cases and their pertinent clinical information from the EMR and identified 18 cases in which he would have performed an IFE, and in 10 of those 18 cases, there was a positive finding on IFE. It is noteworthy that IFE was noncontributory in all the remaining 74 cases. Based on this finding and following discussion with the medical leadership, the ordering option was limited to SPEP with reflex IFE only, with no change in the option for SFLC assays. This change was put in place at the beginning of May 2010. There was an explicit understanding that if the attending physician wanted an IFE, the laboratory would honor the request. We compared the rates of SPEP, IFE, and SFLC assays performed in the 2 periods: April 2009 through April 2010 and May 2010 through July 2012. Data were compared using the 1- and 2-tailed t test.

As was his usual practice, the consultant pathologist (G.S.) reviewed the findings of SPEP and the medical record of the patient (this was feasible because of the availability of the EMR) to determine if an IFE was warranted. The EMR was consulted to review progress notes with a special focus on current problem lists, consultations, and reports of previous serum protein testing and imaging studies, if any. Time spent in reviewing the EMR for pertinent clinical information was variable but for most cases ranged from 2 to 10 minutes. The time was dependent on both the complexity of the clinical information and the often slow speed of the intranet service. If an IFE was done earlier and the identity of the monoclonal band, if present, was known, the densitometrically estimated quantity of the band was reported. It is a practice in our institution to use SPEP to monitor trends in M-spike as a follow-up to the treatment; we did not follow serum quantitative immunoglobulins to monitor the response to treatment of lymphoproliferative disorders. If a monoclonal band was not evident on SPEP for a patient under treatment for myeloma, an IFE was done to facilitate the early detection of a recurrent monoclonal spike. Other criteria for performing an IFE were as described earlier. If the review of the EMR disclosed any findings consistent with or suggestive of a plasma cell disorder (eg, lytic bone lesions, hypercalcemia, unexplained
neuropathy, AL, elevated free serum light chains, monoclonal spike on urine protein electrophoresis) or when there was any doubt about the diagnosis, an IFE was performed.

Results

From April 2009 through April 2010, a total of 451 SPEP (~35 per month) and 210 serum IFE (~16 per month) tests were performed with an IFE/SPEP ratio of 0.47. From May 2010 through July 2012, a total of 741 SPEP (~27 per month) and 160 serum IFE (~6 per month) tests were performed with an IFE/SPEP ratio of 0.21. There was a 22.8% decline in the use of SPEP and a 62.5% decline in the use of IFE. From April 2009 through April 2010, 37 SFLC tests were ordered (~3 per month), and from May 2010 to July 2012, 135 SFLC tests were ordered (~5 per month). SFLC test orders increased somewhat, but this was offset by an overall decrease in test volume, and the increase was not statistically significant. This reduced laboratory personnel time and resource utilization.

The prevailing cost of performing the tests and the reduction in laboratory costs due to the change in the practice and frequency of testing are shown in Table 1. With a reduction in the volume of testing, there was a commensurate decrease in the billing and collections received by the laboratory. No separate billing for testing was done for hospitalized persons (ie, inpatients). The laboratory billed the ambulatory patients for these tests at the rates shown in Table 2. The volumes and revenue changes given in Tables 1 and 2 are based only on the ambulatory testing volume and not the total testing volume. In brief, the reduction in testing costs was calculated to be $14,553 per year, and collections, not billing, from the ambulatory patient population were estimated at $2,952 per year. The actual reimbursements were approximately 30% of the billed amount in our laboratory located at a city-county–style hospital. It is obvious that the reduction in costs more than makes up for the lost revenue. We have not addressed the “lost” revenue to the pathologist from part B billing as our laboratory has not implemented this billing.

Discussion

It is clear that adoption of the new diagnostic algorithm made a measurable reduction in laboratory utilization of SPEP and IFE testing. The decline in serum IFE and SPEP volume. It is worth noting that from May 2010 to the present, no attending physician has contacted the laboratory to perform an IFE when it was deemed by the pathologist to not be needed.
testing was statistically significant ($P < .05$). The decline in SPEP testing was smaller and may be attributable to random variation in the patient population that needed testing in the first place or may have reflected an effect of awareness by the clinicians of monitoring of testing orders. The decline in serum IFE testing was attributable to the new physician test ordering pattern as well as the pathologist’s continuing review of patients’ clinical and testing history in the EMR. Patients with abnormal SPEP and a previously identified paraprotein on serum IFE did not have reflex testing to repeat the serum IFE, with exceptions described earlier, thus saving laboratory resources. Usually, testing on a previously diagnosed patient with monoclonal gammopathy is performed to monitor the disease progression and/or quantitative response to therapy; this can generally be achieved with SPEP only. We did not perform the comprehensive screening panel for monoclonal gammapathies in our patient population, so we could not measure the diagnostic sensitivity of our newly adopted screening strategy. We do not know if we missed any patients using this new approach. However, multiple recommendations and studies have highlighted the satisfactory diagnostic sensitivity of this screening panel.1,11,12

International Myeloma Working Group guidelines1 recommended that the SFLC assay in combination with SPEP and serum IFE testing was sufficient to screen for pathologic monoclonal plasma cell proliferative disorders other than immunoglobulin light chain AL, which requires all serum monoclonal plasma cell proliferative disorders other than IgG.13 MGUS in patients with an abnormal SFLC $\kappa/\lambda$ ratio and increased serum M-protein size can potentially be picked up by SPEP and SFLC tests.

In a recent retrospective study of 113 patients with plasma cell proliferative disorders, Hwang and colleagues12 demonstrated that the diagnostic sensitivity of SPEP and SFLC assays was 87.6% and 84.1%, respectively. The sensitivity of a combination of both these tests was 100%.

In our laboratory, we were able to reduce the total yearly cost of doing SPEP and IFE testing because of a reduction in testing volume. An associated result of this was a drop in revenue, as presented in Table 2. But this drop in revenue was more than offset by a drop in overall combined costs. This drop was also mitigated by the fact that our laboratory is a part of city-county–style hospital, and actual reimbursements are approximately 30% of the billed amount. If we extrapolate our premises, there is an estimated savings of about $20 million nationwide. As mentioned earlier, we have not addressed part B billings as our laboratory is not engaged in such billing. However, it is noteworthy that the threat of losing part B billings would invoke a perverse incentive in pathologists to not promote practices that may reduce testing volume, especially in the population suitable for part B billing.

Health care expenditures per capita and as a percentage of gross domestic product in the United States are the highest in the world.14 Most analysts expect that health care costs will continue to rise above the rate of inflation as the nation’s population ages and technology advances.15 Increased spending on health care has not produced commensurate improvements in access to health care, health outcomes, or the quality of services delivered by the health care system. Estimates suggest that up to one-third of the more than $2 trillion that we now spend annually on health care is considered a waste.16,17 Some of the waste includes overuse of laboratory resources. Laboratory services account for about 2.3% of annual health care expenditures and 2% of Medicare expenditures in the United States,15 and the influence of laboratory medicine on
the quality and cost of health care as a whole is much greater because laboratory test results influence most patient care decisions.\textsuperscript{10} Optimization of laboratory utilization is one area that may reduce the health care costs. Although the estimated national cost savings of the proposed practice, at $20 million, is less than “budget dust” in the multitrillion-dollar US health care enterprise, the acceptance of the responsibility for any cost savings may be more important in principle, and it is hoped that such thinking may become part of the national health care psyche and practice.

Conclusion

Our experience exhibited that pathologists’ review of the EMR to access patients’ clinical and testing history to guide reflex testing is one example of a “meaningful use” of the EMR that helped curtail the unnecessary serum IFE testing in patients with previously known paraproteins or identify those who did not warrant an IFE. Our experience and review of the literature also exhibited that provider order for serum IFE and urine studies can be excluded from the screening panel for monoclonal gammopathies, thus significantly reducing the laboratory workload. SPEP and SFLC assays constitute a sensitive screening panel for monoclonal gammopathies. Analysis of multiple studies exhibits that test sensitivity is not compromised with this algorithm. Serum IFE and urine studies can be performed at the discretion of the pathologist if the initial SPEP is suggestive of some abnormality. The change will reduce the number of serum IFE tests performed, thus improving the efficiency of the laboratory. Even with an increase in SFLC tests, the total volume of tests for investigating monoclonal gammopathies can be reduced.

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Funding: This study was supported by the Department of Pathology, Truman Medical Centers, Kansas City, MO.

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Acknowledgments: We are grateful to Masha Nzabi, MD, for initiating the study and Ken Keim, MT(ASCP), for technical assistance.

References


