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RESEARCH ARTICLE

Evaluation of unnecessary test requests based on free prostate-specific antigen testing

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ABSTRACT

Objective: As the demand for healthcare services increases, so does the frequency of laboratory test requests, leading to a rise in unnecessary testing. In this study, we aimed to evaluate the extent of unnecessary free prostate-specific antigen (fPSA) testing by analyzing prostate-specific antigen (PSA) and fPSA test requests at our hospital.
Methods: We retrospectively reviewed PSA and fPSA test requests recorded in the hospital information system at Çanakkale Onsekiz Mart University Hospital between January 1, 2021, and December 31, 2023. Requests for fPSA were classified as unnecessary when PSA levels were either <4 ng/mL or >10 ng/mL, when fPSA was ordered alone without a PSA test, or when fPSA was ordered together with PSA at the initial request when PSA levels were between 4 and 10 ng/mL. Additionally, according to the Rational Laboratory Use Test Request Procedure, PSA tests ordered at intervals shorter than 28 days were also considered unnecessary. The distribution of test requests was analyzed by clinical department.
Results: Of the 2,728 fPSA tests, 2,522 (92.4%) were deemed unnecessary. Specifically, 2,306 (92%) of 2,507 requests from outpatient clinics and 216 (97.3%) of 221 requests from inpatient services were unnecessary. According to the Rational Test Request Procedure, 11.3% of PSA test requests were considered unnecessary.
Conclusion: Unnecessary laboratory test orders contribute to increased healthcare costs and may lead to more invasive procedures due to false-positive results. Collaboration with clinicians and the elimination of unit-specific test request forms may help reduce unnecessary test utilization.
Keywords: Diagnostic tests, prostate-specific antigen, healthcare costs

ÖZET

Serbest prostat spesifik antijen testi üzerinden gereksiz test isteminin değerlendirilmesi
Amaç: Sağlık hizmetlerine olan talebin artması ile test istemleri de artmaktadır. Bununla birlikte gereksiz istemler de artmıştır. Çalışmamızda, hastanemizde istem yapılan prostat spesifik antijen (PSA) ve serbest PSA (fPSA) testlerini inceleyerek, fPSA testi için yapılan gereksiz test istemlerini değerlendirmeyi amaçladık.
Yöntem: Çanakkale Onsekiz Mart Üniversitesi Hastanesinde 01.01.2021 ve 31.12.2023 tarihleri arasında istenmiş olan PSA ve fPSA testlerine hastane otomasyon sistemi üzerinden erişim sağlayarak retrospektif olarak inceledik. PSA değeri <4 ng/mL veya >10 ng/mL iken PSA ile istenen fPSA; PSA değeri ilk istemde 4 ng/mL ve 10 ng/mL arasında iken istenen fPSA veya tek başına istenen fPSA istemlerini 'gereksiz test istemi' olarak değerlendirdik. Ayrıca Akılcı Laboratuvar Kullanımı Akılcı Test İstemi Prosedürü'ne göre 28 günden daha sık istenen PSA değerlerini de gereksiz test istemi olarak nitelendirdik. Yapılan test istemlerinin bölümlere göre dağılımlarını inceledik.
Bulgular: İstem yapılan 2728 fPSA testinden 2522 (%92.4)'sinin gereksiz test istemi olduğunu belirledik. Polikliniklerden yapılan 2507 fPSA isteminin 2306 (%92)'sı gereksizken yataklı servislerden yapılan 221 testin 216 (%97.3)'sı gereksizdi. Akılcı Test İstemi Prosedürü'ne göre ise gereksiz PSA isteminin %11.3 olduğunu saptadık.
Sonuç: Laboratuvar testlerindeki gereksiz istemler sağlık alanındaki harcamalarının artmasının yanı sıra yanlış pozitif sonuçlardan kaynaklanan daha fazla invaziv girişimlerin de yapılmasına neden olmaktadır. Laboratuvar tetkik komisyonu klinikler ile iş birliğiyle içerisinde çalışarak ve birime özgü formlar kaldırılarak gereksiz test istemleri azaltılabilir.
Anahtar kelimeler: Tanısal testler, prostat-spesifik antijen, sağlık hizmeti maliyetleri

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INTRODUCTION

Medical laboratory tests play a vital role in disease diagnosis, monitoring clinical progress, guiding appropriate treatment strategies, and informing clinical decision-making [1]. Recently, advancements in technology that enable rapid test results, increased life expectancy leading to a higher prevalence of chronic diseases, and improved access to healthcare have significantly expanded the utilization of laboratory services [2]. Alongside this growing demand, healthcare expenditures have also risen. This growth has not only driven efforts to improve healthcare quality but has also generated pressure to reduce costs. Although laboratory services represent a relatively small portion of total healthcare expenditures, their costs are more easily quantifiable, making them a focal point for cost-control measures [3]. One of the most readily measurable aspects of laboratory-related healthcare spending is the frequency of unnecessary test utilization [4]. Tests are often requested for patients with a low probability of disease. For instance, when 20 independent tests are ordered for healthy individuals, there is a 64% chance that at least one result will fall outside the reference range [5].

Prostate-specific antigen (PSA) is a protein produced by both normal prostate epithelial cells and malignant cells originating from the prostate gland. In the bloodstream, PSA exists either bound to protease inhibitors, such as alpha1-antichymotrypsin, or in an unbound form as free PSA (fPSA). PSA is widely used as a serum biomarker for the diagnosis and staging of prostate cancer and remains one of the most commonly utilized tumor markers in clinical practice [6]. However, PSA levels may also fluctuate in response to benign conditions such as benign prostatic hyperplasia (BPH), as well as due to factors including age, race, and prostate volume. The proportion of fPSA tends to be higher in benign conditions compared to prostate cancer, thereby improving diagnostic specificity [7]. Various strategies have been developed to minimize unnecessary prostate biopsies prompted by elevated PSA levels. These include molecular PSA subtyping, PSA density measurements, monitoring PSA kinetics over time, and calculating the free-to-total PSA (fPSA/PSA) ratio [8]. The fPSA/PSA ratio is commonly employed to distinguish between benign and malignant prostate conditions, particularly in patients with PSA levels in the "gray zone" (4–10 ng/mL), where the estimated cancer risk is approximately 20–25% [9]. A lower fPSA/PSA ratio is associated with a higher likelihood of malignancy [10]. fPSA testing performed outside of this gray zone is generally regarded as unnecessary.

In this study, we aimed to evaluate unnecessary test utilization by analyzing PSA and fPSA test requests performed in the Medical Biochemistry Laboratory of Çanakkale Onsekiz Mart University Hospital.

MATERIALS and METHODS

This retrospective study was approved by the local ethics committee on May 9, 2024 (Decision No: 07/08).We evaluated PSA and fPSA test requests from both inpatient and outpatient clinics at Çanakkale Onsekiz Mart University Hospital between January 1, 2021, and December 31, 2023. We obtained data from the laboratory information system. At the initial test request for each patient, the following situations were defined as unnecessary test orders:

Requesting free PSA (fPSA) testing when the total PSA level is <4 ng/mL or >10 ng/mL;

Requesting fPSA testing concurrently with the initial total PSA measurement when the total PSA value is between 4 ng/mL and 10 ng/mL;

Requesting only fPSA testing without total PSA.

Additionally, based on the guidelines of the Rational Laboratory Use and Rational Test Request Procedure, PSA tests ordered at intervals shorter than 28 days were also considered unnecessary testing [11].

Collected data were recorded in an Microsoft Excel spreadsheet and pre-processed for analysis. The proportion of unnecessary test requests was calculated using the following formula:

Unnecessary Test Rate = (Number of Unnecessary Tests / Total Number of Tests) × 100.

The distribution of test requests across clinical departments was also examined. Descriptive statistics were expressed as absolute numbers and percentages.

RESULTS

Retrospective analysis identified a total of 13,713 test requests between January 1, 2021, and December 31, 2023, including 10,985 PSA tests and 2,728 fPSA tests. Among the fPSA requests, 2,522 tests (92.4%) were classified as unnecessary (Table 1).

When the distribution of unnecessary fPSA requests across departments was examined, it was found that 2,306 of the 2,507 fPSA tests ordered in outpatient clinics (92%) were unnecessary. The highest rates of unnecessary ordering (100%) were observed in the outpatient clinics of the Hospital Medical Board, Family Medicine, Neurosurgery, Physical Medicine and Rehabilitation, Gastroenterology, General Surgery, Pulmonology, Cardiology, and Organ Transplantation. In inpatient services, 216 of 221 fPSA requests (97.3%) were unnecessary. Notably, all fPSA requests submitted by the departments of General Surgery, Pulmonology, Cardiology, and Neurology were deemed unnecessary. In contrast, none of the fPSA tests ordered by the Endocrinology Outpatient Clinic were classified as unnecessary (Figure 1).

Evaluation of PSA tests according to the Rational Laboratory Use and Rational Test Request Procedure revealed that 1,239 of the 10,985 PSA tests (11.3%) were unnecessary due to being ordered at intervals of less than 28 days. The Department of Urology submitted the highest number of premature repeat PSA requests (917 tests), whereas the Department of Otorhinolaryngology had the fewest (one test).

Reason For Unnecessary Test Request	fPSA Count (n)	Rate (%)
Requests for fPSA when the PSA value was either <4 ng/mL or >10 ng/mL,	1707	67.7
Requests for fPSA along with PSA values between 4 ng/mL and 10 ng/mL in the initial request	189	7.5
Requests for only fPSA	626	24.8

fPSA, free prostate specific antigen ; PSA, prostate specific antigen ; n, count

Table 1. Numbers and rates of unnecessary test requests by reason

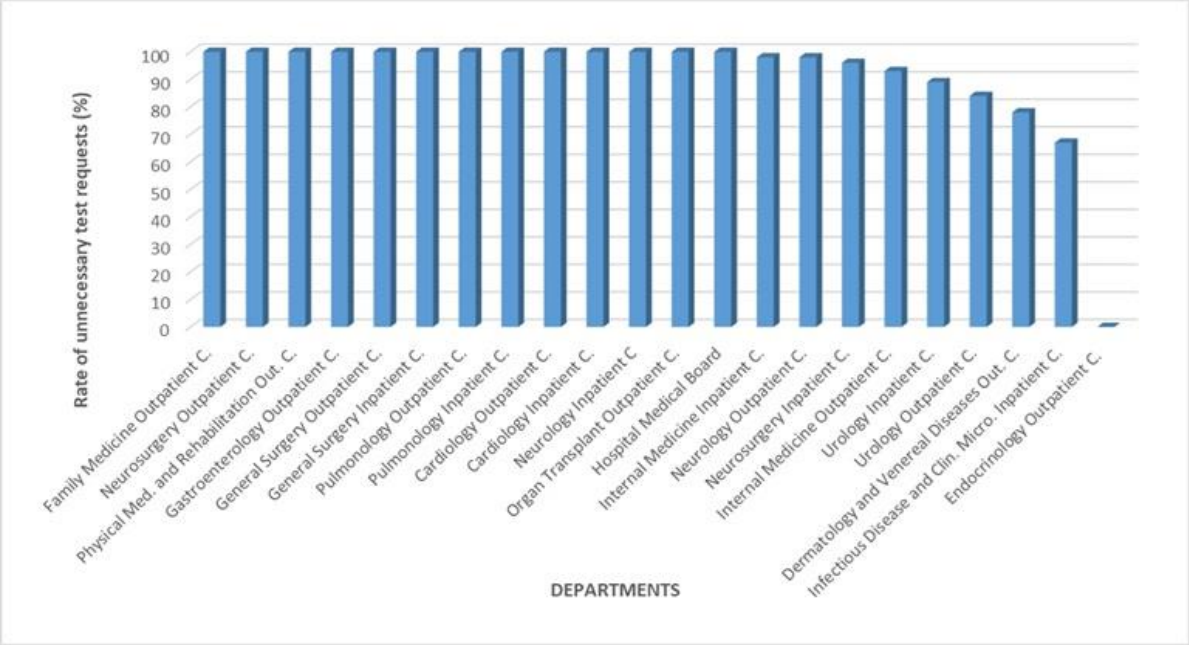

Figure 1. Distribution of unnecessary test orders by department

DISCUSSION

With ongoing advancements in medical technology, the utilization of laboratory tests in healthcare has grown substantially. Various innovations within the healthcare sector and the increasing use of medical resources have contributed to rising healthcare expenditures [12]. According to data from the Turkish Statistical Institute, healthcare expenditures increased by 71.5% in 2022, reaching 606.8 billion TL [13]. Laboratory testing constitutes a significant portion of these costs. Several factors drive the growing number of test requests, including persistent demands from patients and their families, expansion of preventive healthcare services, professional experience, defensive medicine practices aimed at avoiding criticism, difficulties in accessing prior test results, and insufficient awareness of test request guidelines [14]. However, not all test requests are clinically justified, and unnecessary testing imposes an additional financial burden on healthcare systems. Numerous studies have examined various parameters to identify redundant laboratory tests [15–19]. For example, a

study evaluating iron deficiency anemia screening found that 56% of combined hemogram and iron studies were unnecessary [15]. Kocatürk et al. assessed serum lipid panels and reported unnecessary test request rates of 5.16% for total cholesterol, 10.93% for HDL cholesterol, and 7.90% for LDL cholesterol [16]. In another investigation, Tekçe et al. evaluated thyroid function tests, reporting that 25,505 tests contributed to avoidable healthcare expenses [17].

In the present study, PSA and fPSA test requests were retrospectively analyzed using data extracted from the hospital's Medical Biochemistry Laboratory information system. Over a three-year period, 2,522 fPSA tests (92.4%) were identified as unnecessary, and 1,239 PSA tests (11.3%) were requested at intervals shorter than 28 days. Similarly, Karakoyun et al. reported that 78.8% of 9,759 fPSA test requests over five years were unnecessary, while Kocatürk et al. found that 86% of 2,924 fPSA tests were ordered unnecessarily [16, 18]. Another study assessing total PSA requests found that 427 of 1,794 tests (12.5%) were repeat orders classified as unnecessary [19]. Collectively, these findings suggest that fPSA tests are frequently ordered inappropriately. Variability in these rates across institutions may reflect differences in physician experience and practice patterns, the total number of test requests, and the use of distinct test ordering panels within hospitals.

The continuous rise in laboratory test utilization has made it one of the most commonly employed medical procedures. A significant contributor to this trend is unnecessary testing, which not only increases healthcare expenditures but also exposes patients to avoidable invasive procedures and repeated biological sample collections, regardless of clinical necessity [20]. Moreover, unnecessary testing may yield false-positive results, which can subsequently lead to malpractice claims. Gandhi et al. reviewed 307 malpractice cases, of which 181 caused patient harm and 30% resulted in death. The most frequent cause of malpractice—accounting for 55% of cases—was failure to order the appropriate tests [21].

To ensure appropriate laboratory utilization and minimize diagnostic errors, various international initiatives have promoted rational test ordering practices. Multiple guidelines recommend minimum retesting intervals, determined by physiological parameters, biological half-lives, levels of clinical evidence, and follow-up or treatment requirements. For example, the 2021 Clinical Biochemistry and Laboratory Medicine guidelines advise repeating PSA testing after six weeks to monitor disease progression, followed by retesting every three months for the first one to two years and every six months thereafter [22]. In Turkey, the "Rational Laboratory Use Project" was first introduced in 2018 by the Ministry of Health's General Directorate of Health Services, Department of Diagnostic and Testing Services [23]. As part of this initiative, the "Rational Test Request Procedure" was established to improve diagnostic accuracy, enhance clinical utility of laboratory results, and reduce unnecessary test requests. This procedure specifies recommended retesting intervals for various laboratory tests. For PSA testing, the recommended minimum interval is 28 days. Physicians requesting tests at shorter intervals must provide justification, which is then evaluated by laboratory test committees formed within hospitals.

This study has several limitations. The data were obtained retrospectively from the hospital's laboratory information system and only included tests processed within our institution. Tests performed at external facilities, if any, were not incorporated. Additionally, the study focused exclusively on PSA and fPSA testing, which may not fully represent unnecessary testing practices in other clinical departments.

In conclusion, the clinical utility of laboratory testing increases when ordered at appropriate intervals and for the correct patient population. Several factors influence test-ordering behavior, including automated test panels integrated into hospital systems, physicians' professional experience and concern over potential errors, and persistent demands from patients or their relatives. To address unnecessary testing, clinicians should receive targeted education on rational laboratory utilization, and unit-specific automated panels should be replaced by disease-focused test menus. Furthermore, interdisciplinary laboratory test committees—comprising both laboratory specialists and clinicians—should be established within hospitals to systematically monitor test ordering practices.

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