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Effect of iodine-containing antiseptics on urine iodine levels of surgical staff after iodization

İyodizasyon sonrası, iyot içeren antiseptiklerin cerrahi personelin idrar iyot düzeylerine etkisi

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Abstract

Background: The routine use of topical iodinated antiseptic could be a possible cause of iodine contamination. This study was aimed to determine urinary iodine status of operation-room staff who routinely use iodine-containing antiseptics for cleansing of the hands after salt iodization.

Materials and methods: The study included 40 operation-room staff who use surgical hand-scrub solutions. Participants applied an iodized brush for a minimum of three times a day on weekdays and were iodine-free on the weekends. Morning urine samples from all volunteers to analyze the urinary iodine concentration (UIC) twice a week. Modified microplate method of Sandell-Kolthoff reaction used to measure UIC.

Results: The UICs were significantly higher on Friday (median 194 μg/L (70–396 μg/L)) compared to the Monday concentrations (median 125 μg/L (62–264 μg/L), p < 0.001). Mild iodine deficiency occurred in 32.5% of the subjects on Monday, in 5% on Friday. On Monday, there were no subjects with UIC > 300 μg/L, but on Friday, 7.5% of the subjects had UIC > 300 μg/L.

Conclusion: Despite both the use of iodized antiseptic solution and mandatory iodization, operation-room staff had only median iodine levels with low risk of iodine intoxication.

Keywords: Surgery; Povidone-iodine; Hand disinfection; Urine; Turkey.

**Amaç:** Topikal iyotlu antiseptiklerin rutin kullanımı, iyot kontaminasyonunun olası bir nedeni olabilir. Bu çalışmada, tuzların iyodizasyonu sonrasında, el temizliği için rutin olarak iyot içeren antiseptik kullanılar ameliyathane personelinin idrar iyot durumunun belirlenmesi amaçlanmıştır.

**Gerce ve Yöntem:** Çalışmaya cerrahi el yıkama solüsyonları kullanılan 40 ameliyathane personeli dahil edilmiştir. Katılımcılar, hafta içinde en az üç kez iyotlu fırça ile uygulama yapmış ve hafta sonları iyotlu solüsyon kullanmamışlardır. İdrar iyot konsantrasyonu (UIC) analiz etmek için tüm günlerden haftada iki kez sabah idrar örnekleri alınmıştır. İdrar iyot konsantrasyonunun ölçümü için Sandell-Kolthoff reaksiyonunun modifiye mikroplaka metodu kullanılmıştır.

**Bulgular:** Cuma günü saptanan UIC’ler (median 194 μg/L (70–396 μg/L)), pazartesi günü konsantrasyonlarına göre (median 125 μg/L (62–264 μg/L), p < 0,001) anlamlı olarak daha yüksektir. Pazartesi günü deneklerin %32,5’
inde, cuma günü ise %5’inde hafif iyot eksikliği belirlenmiştir. Hiçbir günde pazartesi günü UIC > 300 μg/L olmakken, cuma günü deneklerin %7,5’inde UIC > 300 μg/L’dir.

Sonuç: Iyotlu antiseptik solüsyonların kullanımına ve zorunlu iyodizasyona rağmen, ameliyathane personelinin yalnızca medyan iyot seviyelerine sahip olduğu ve iyot intoksikasyonu riskinin düşük olduğu saptanmıştır.

Anahtar Kelimeler: Cerrahi; Povidon iyot; El dezenfeksiyonu; İdrar; Türkiye.

Introduction

Thyroid hormones are synthesized in the presence of iodine, and the recommendation dose of iodine intake is 150 μg per day for adults [1]. Therefore, the determination of iodine concentration in the urine urinary iodine concentration (UIC) reflects the daily intake of iodine, and the recommended method for measuring the UIC is the Sandell-Kolthoff reaction [2, 3]. According to World Health Organization (WHO) guideline in 2007, the median UIC should be between 100–199 μg/L for sufficient daily iodine intake [4]. Before iodization in Turkey, using iodinated antiseptics by operating room staff provided only adequate iodine levels (125 μg/L) but did not lead to toxic doses [5]. After the table salt iodization becomes mandatory in 1998, the median UICs was 87 μg/L, 117 μg/L and 130 μg/L in 2001, 2004, and 2007, respectively. These results suggested that the median iodine intake is sufficient in Turkey after iodization [6–8].

In our previous study, the median UIC was 167 μg/L at least 13 years after iodization in adults, which suggested that iodine prophylaxis is still sufficient in Istanbul [9]. However, as a result of the widespread use of amiodarone and iodinated radiological contrast agents in clinical practice, humans are exposed to high doses of exogenous iodine [10]. Furthermore, many surgical hand sterilization solutions contain a large amount of iodine, which has been reported to be absorbed from the skin or mucosa [11–15]. Therefore, the routine use of topical iodinated antiseptic could be a possible cause of iodine contamination after iodization. However, there are some studies reporting contradictory results on the effect of iodine-containing antiseptics solutions on urinary iodine concentration [5, 12, 16, 17].

This study is aimed to re-evaluate the concentration of iodine in operation-room staff who routinely used iodine-containing antiseptics for cleansing of the hands after a long period of iodization.

Materials and methods

Our study was carried out between November 2017 and February 2018 with the operating-room staff of Istanbul University Faculty of Medicine. Forty surgeons and surgical nurses who routinely use iodine-containing surgical hand brushes (Surgical Hand Brush Impregnated with 7.5% povidone-iodine) were included in this study. Participants applied the iodized brush for a minimum of three times a day for 3–5 min. The exclusion criteria were the use of intravenous iodinated contrast, the use of iodized medications, the use of thyroid hormone replacement, and salt restrictions. This research is in accordance with all relevant national regulations, institutional policies and principles of the Helsinki Declaration. For our study, approval was obtained from the Ethics Committee of Istanbul University Faculty of Medicine (No: 2017/1127). Participants were included in the study after completing the written consent form. Volunteers were used iodine-containing sterilization solutions on weekdays and were iodine-free on the weekends. Early-morning spot urine samples from all volunteers to analyze the UIC twice a week: once at the beginning of the working period (the washout period of the antiseptic) and once at the end of the working period (the antiseptic exposure period). Urine samples were placed in deionized test tubes which had tight lids and transported to the laboratory immediately. The samples were acidified and stored at −80°C until analysis.

UICs determination were performed with the Sandell Kolthoff reaction in a Modified Microplate Method as recommended by the CDC’s Ensuring the Quality of Urinary Iodine Procedures (EQUIP) booklet with minor modifications [18, 19]. Briefly, urine samples were dissolved at room temperature and incubated with ammonium persulfate (0.9 M final concentration) at 95°C on a thermal cycler for 30 min. After cooling, 50 μL of digested urine samples were pipetted into microplate wells. 100 μL of 0.05 M arsenious acid solution was added to each well and mixed. Finally, 50 μL of 0.019 M ceric ammonium sulfate solution was added to each well. After incubation for 30 min at 25°C, absorbance at 405 nm was recorded. UICs were determined using a standard curve and expressed in μg/L.

Patients urine samples were collected in urine pools (high level: 350 μg/L, low level: 80 μg/L) for internal quality control analysis and the pools portioned and stored at −80°C. For every step of the control two level of portions of urine samples were used. Interval variability coefficients (CV%) were 8.65% for low level and 11.1% for high level for iodine measurements. The detection limit of the method was 15.9 μg/L. Iodine deficiency levels were
Urine samples, and the significancy level was $p < 0.05$. The Wilcoxon test was used to compare the median UICs in two frequency (%) rate were used for discrete variables. The Wilcoxon test was used to compare the median UIcs in two urine samples, and the significance level was $p < 0.05$.

**Results**

The sample included 38 female and 2 male operation-room staff, and their mean age was $37.32 \pm 9.34$ years. According to the UIC value, $32.5\%$ (n:13) of the subjects had mild deficiency (UIC=$50–99$ μg/L) at the beginning of the workdays (Monday), and $5\%$ (n:2) had a mild deficiency at the end of the working days (Friday). No one had a UIC concentration >$300$ μg/L at the beginning of the workdays, but UIC values exceeded $300$ μg/L ($362, 365, and 396$ μg/L) in $3$ subjects ($7.5\%$) at the end of the working days (Figure 1).

The median UIC levels was $194$ μg/L ($70–396$ μg/L) at the end of the working period and $125$ μg/L ($62–264$ μg/L) at the beginning. The UIC was significantly higher at the end of the working period than at the beginning of the working period ($p < 0.001$).

**Discussion**

Iodine is an essential factor of production of adequate thyroid hormones, which is considerable in maintaining health. People are thought to have sufficient iodine uptake if the median UIC are $100 – 199$ μg/L according to the WHO [4]. One of the most important public health practices to reduce iodine deficiency is salt iodization, which became mandatory in Turkey in 1998 [20]. Turkey is no longer an iodine-deficient area, as confirmed by the median UIC [8]. However, mild iodine deficiency is still prevalent in some regions [21–23].

After 13 years of iodization in Turkey, we stated that median levels of urinary iodine (167 μg/L) were higher in 2015 compared to the previous study (107 μg/L) in 2007. Median iodine levels were measured in the morning spot urine samples which were collected from 24 cities and school-age children and from seven regions in Turkey [7]. Therefore, we can conclude that iodine consumption is sufficient in Istanbul.

Povidone-iodine which is used as a skin disinfectant is a water-soluble solution. It has a long-lasting antiseptic effect against a broad spectrum of germs [10]. Nesvadbova et al. examined the skin absorption of iodine from povidone-iodine solutions used by surgical staff, and they emphasized the importance of considering that iodine may have skin permeability, especially when used for more than 20 applications per day [24]. However, our study shows that iodine was rapidly absorbed through intact skin when operating-room staff used a minimum of three applications of iodine-containing hand-scrub solutions on 4 consecutive days within a week.

Before iodization was practiced in Turkey, Yarman et al. [5]. showed that scrubbing with iodine-containing solutions did not result in toxic levels among operation-room staff in Istanbul University Hospital. The median levels of UIC was $110.5$ μg/L on weekends and increased to $125$ μg/L on workdays ($p < 0.05$). Thus, the use of iodized antiseptic provided the optimal level of urine iodine in the staff. Similarly, the median UIC value of 78 surgical personnel who routinely scrub with iodine-containing solutions was found to be $166$ μg/L in a study from the Anatolia region of the country [17].

In our study, the median UIC reached $194$ μg/L but not toxic levels when we reevaluated urine iodine levels among operation-room staff in Istanbul University Hospital, who have continued using iodized antiseptic solution after 19 years of iodization in Istanbul. After iodine prophylaxis, the results of the two previous studies from two different geographic areas of Turkey show that the median UIC level increased within normal limits between 15 [17] and 19 years after iodization.

In the Erdoğan et al. [17] study reported that $39\%$ of operation-room staff have UIC> $300$ μg/L and calorimetric ceric ion arsenous acid wet ash method based on the Sandell-Kolthoff reaction were used to determine the UIC. In contrast, the rate was lower (75%) in our study.

![Figure 1: UIC results of operation-room staff.](image-url)
The difference could be attributed to the fact that it is not mentioned how frequently iodine solutions were used or which concentration (10% or 7.5%), which might differ from those used in our study. Michalaki et al. [12] investigated the effect of iodized antiseptic solutions (povidone-iodine 10%, 4–20 times a week for 3–5 min each time) on surgical personnel in Greece; they measured UIC via by Sandell–Kolthoff reaction. There was no significant difference between the urinary iodine values of participants who used and not used of iodine based antiseptic solutions. We only performed urine iodine measurements on personnel using iodine solution. However, Michalaki et al. [12] performed the urine iodine assay on two different days and obtained mean values, but they did not specify whether the 2 days were specific days (such as washout or contamination periods). In our study, we took urine samples on specific days (Monday and Friday), and the mean UIC levels on these days were 125 μg/L and 194 μg/L, respectively. We observed that the median urinary iodine concentration significantly decreased when iodized solution was not used (p < 0.001).

Conclusion

Overexposure of iodine could cause thyroid dysfunction and thyroid autoimmunity. Despite both the use of iodized disinfectant solution and mandatory iodization, operation-room staff only had median iodine levels without risk of iodine intoxication. Nevertheless, our study groups are quite small and were from a large cosmopolitan city. Thus, better-designed studies with more geographic regions of the country are needed to clarify the results. In addition, only UIC measurement is not enough for assessment of thyroid status in the operating room staff whom exposure excess iodine. Further studies are needed to evaluate the high iodine exposure on thyroid function test and thyroid antibodies in these persons.

Conflict of interest: We have no conflict of interest on this article.

References


