UDC: 616.31:612.313.015:616.379-008.64 ISSN 0039-1743 COBISS. SR-ID 8417026

Promene biohemijskog sastava salive kod dijabetičara

DOI: 10.2298/SGS0604209A

Changes in The Biochemical Composition of Saliva in Diabetic Patients

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ORIGINALNI RAD (OR)
ORIGINAL ARTICLE

KRATAK SADRŽAJ

Uvod: *Kod obolelih od Diabetes mellitus-a (DM), pored brojnih akutnih i hroničnih komplikacija, dolazi i do poremećaja oralne homeostaze.*

Cilj: *Cilj rada bio je da se utvrde promene u biohemijskom sastavu salive dijabetesnih bolesnika u odnosu na zdravu populaciju radi eventualnog korišćenja salive u praćenju toka bolesti, odnosno da se utvrde promene u salivi u odnosu na tip dijabetesa.*

Materijal i metode: *Istraživanje je obuhvatilo 52 odrasla pacijenta oba pola, uzrasta 18-79 godina, obolelih od DM – tip 1 i tip 2, lečenih na Institutu za endokrinologiju, dijabetes i bolesti metabolizma Kliničkog centra Srbije. Kontrolnu grupu činilo je 67 dobrovoljaca iz beograda, studenata Stomatološkog fakulteta u Beogradu, uzrasta 19-24 godine. Sakupljana je ukupna nestimulisana i stimulisana saliva, a biohemijski parametri (glukoza, ukupni proteini, albumin, natrijum i kalijum) određeni su referentnim metodama za serum.*

Rezultati: *Dobijeni rezultati su pokazali da je u salivi obolelih od dijabetesa koncentracija kalijuma povišena, koncentracija natrijuma i ukupnih proteina snižena, a glukoze i albumina nepromenjena u odnosu na kontrolnu grupu. Koncentracije proteina i kalijuma više su kod obolelih od DM tip 2 nego kod DM tip 1, a koncentracija natrijuma viša je kod DM tip 1 (p = 0.05).*

Zaključak: *Biohemijski sastav salive je ukazao na promene kod dijabetesnih bolesnika.*

Ključne reči: dijabetes, saliva, glukoza, proteini, albumin, natrijum, kalijum

SUMMARY

Introduction: *Diabetic patients, beside numerous acute and chronic complications, often have oral manifestations of the disease.*

Aim: *The aim of the study was to establish changes in saliva of diabetic patients in relation to healthy population in order to use saliva in the disease monitoring, as well as the changes depending on the type of diabetes.*

Materials and methods: *The study comprised 52 adult patients of both sexes and at the age between 18 and 79 with Diabetes mellitus type 1 and 2 who were treated at the Institute for endocrinology, diabetes and methabolic disorders of the Clinical centre of Serbia. The control group consisted of 67 volunteers from Belgrade, students at the School of Dentistry, aged between 19 and 24. The whole of unstimulated and stimulated saliva was collected and biochemical parameters (glucose, total proteins, albumin, sodium and potassium) were determined by methods commonly used for serum.*

Results: *The results showed that salivary potassium level was increased in saliva of diabetic patients, that of sodium and total proteins was decreased, and glucose and albumin did not show changes compared to the control group. Concentrations of total proteins and potassium were higher in patients with DM type 2, and sodium was higher in DM type 1 (p = 0.05).*

Conclusion: *Diabetic patients often have changes in biochemical composition of saliva.*

Keywords: diabetes, saliva, glucose, proteins, albumin, sodium, potassium

Diabetes mellitus (DM) je oboljenje u čijoj osnovi je metabolički poremećaj koji se karakteriše hroničnom hiperglikemijom nastalom zbog apsolutnog ili relativnog nedostatka insulina. Pored poremećaja u metabolizmu glukoze, poremećen je i metabolizam lipida i proteina. Tokom trajanja dijabetesa, uz hroničnu hiperglikemiju dolazi do patoloških promena na raznim organima (oko, bubrezi, nervi, srce, krvni sudovi) (1).

Obolele od dijabetesa je značajno pratiti jer je ovo jedno od vodećih hroničnih oboljenja kako u našoj zemlji, tako i u svetu. Poslednjih godina je uočen porast incidence (naročito DM tip 2), pa se može govoriti i o pandemiji ove bolesti. Procenjuje se da je broj obolelih u našoj zemlji između 200 000 i 250 000, tj. prevalenca je oko 2.5 %, slično kao u zemljama u okruženju.(1) S obzirom na to da ne postoji nacionalni program za ranu detekciju obolelih i skrining ranih faza bolesti, pretpostavlja se da na svakog registrovanog bolesnika dolazi još jedan nedijagnostikovani slučaj, kao i u većini drugih zemalja. Podaci za Beograd ukazuju da je incidenca dijabetesa iznosila oko 0.24 %, a prevalenca 2.6 %.(2)

Dijabetes je značajan i zbog toga što je to najčešći uzrok slepila, zatim 20–25 % bolesnika sa terminalnom bubrežnom insuficijencijom su dijabetičari, ovi bolesnici imaju 15–20 puta veći rizik da dožive amputacije stopala, životni vek obolelih od dijabetesa tipa 2 kraći je za 8–10 godina, a trudnoća kod žena sa dijabetesom ne retko ima nepovoljan ishod po plod.

Klinički manifestni dijabetes se, prema različitim patogenetskim mehanizmima, može podeliti u četiri osnovne kategorije:(3)

1) Dijabetes tip 1 (nastaje propadanjem β ćelija koje vodi potpunom nedostatku sekrecije insulina, što može biti posredovano imunološkim procesom ili idiopatski)
2) Dijabetes tip 2 (kreće se od pretežno insulinske rezistencije sa relativnim deficitom do pretežno sekretornog deficita sa ili bez insulinske rezistencije)
3) Drugi specifični tipovi dijabetesa
4) Gestacijski dijabetes

Oralne manifestacije ovog oboljenja su dosta česte, a promene u sastavu pljuvačke takodje mogu biti značajan dijagnostički parametar.

Saliva je telesna tečnost koja je u stalnom i neposrednom kontaktu sa tkivima usne duplje. Sakupljanje salive je potpuno bezbolno i bezbedno, tako da je mogu sakupljati i sami pacijenti na bilo kom mestu, u bilo koje vreme. U slučaju suvoće usta, salivacija se može jednostavno stimulisati parafinskom kuglicom. Zbog toga se može koristiti za često uzorkovanje prilikom praćenja bolesti, kao i za skrining populacija.

Saliva je bistra, bezbojna tečnost, koja se lako čuva i transportuje za laboratorijsku analizu. Transparentnost salive nakon centrifugiranja pogodna je jer onemogućava interferenciju sa kolorimetrijskim metodama.

Glavne pljuvačne žlezde parotidne, submandibularne i sublingvalne i mnogo malih bukalnih žlezda dnevno

Diabetes mellitus (DM) is a disease based on a metabolic disorder characterized by chronic hyperglycemia caused by absolute or relative lack of insulin. Beside the disturbance in glucose metabolism, lipid and protein metabolism is also changed. Pathologic changes in various organs appear during diabetes mellitus (eyes, kidneys, nerves, heart, blood vessels).(1)

It is important to monitor diabetic patients because it is one of the most frequent chronic diseases in Serbia, as well as in the world. Recent years, progressive increase in incidence has been observed (especially DM type 2), so we can speak about the pandemic nature of DM. The number of patients in Serbia is estimated to be 200.000–250.000, i.e. the prevalence is about 2.5%, similarly to surrounding countries.(1) Regarding that the national program for early detection and screening of early stages of DM does not exist, it is presumed that, with every registered patient, there is one undiagnosed case, like in most other countries. Data for Belgrade shows that the incidence of DM is about 0.24 % and prevalence 2.6 %.(2)

DM is also important because it is the most frequent cause of blindness, 20–25% of patients with terminal renal failure have diabetes and 15–20 times higher risk to have foot amputation. Patients with DM type 2 live 8–10 years shorter than average and the pregnancy of diabetic women can often have unwanted outcome.

According to different pathogenic mechanisms, clinically manifested DM can be divided in four categories:(3)

1) Diabetes type 1 (occurs after the destruction of β cells and the complete lack of insulin secretion, which can be of immune or idiopathic origin)
2) Diabetes type 2 (varies from insulin resistance with a relative deficit to a secretory deficit with or without insulin resistance)
3) Other specific types of diabetes
4) Diabetes in pregnancy

Oral manifestations of this disease are rather frequent and salivary changes can be an important diagnostic parameter.

Saliva is body fluid in permanent and direct contact with oral tissues. Its collection is painless and safe, so patients themselves can collect it any time and any place. In case of xerostomia, salivation can be easily stimulated with a piece of solid paraffin. For these reasons saliva can be used for frequent collection in diabetes monitoring and population screening.

Saliva is transparent, colorless liquid, easy to store and transport to a laboratory. Transparency of saliva after centrifugation is convenient because the interference with colorimetric methods is disabled.

Main salivary glands parotid, submandibular and sublingual and many minor salivary glands secret 500-600 mL of saliva daily. Salivary pH is 6–7.

Total saliva is obtained from the mouth by expectoration. Parotid saliva is secreted by parotid salivary izluče 500-600 mL salive, čija je pH vrednost 6–7. Ukupna saliva (mešovita saliva) je tečnost dobijena iz usta ispljuvavanjem. Parotidna (serozna) saliva je tečnost koju sekretuju parotidne pljuvačne žlezde i dobija se direktno iz otvora parotidnog kanala. Nestimulisana saliva (bazalna sekrecija) je saliva sekretovana u odsustvu spoljašnje gustativne, mastikatorne ili mehaničke stimulacije, a stimulisana saliva sekretuje se kao odgovor na mehaničku, farmakološku ili gustativnu stimulaciju.(4)

Protok i sastav salive zavise od brojnih faktora (hidratacije organizma, položaja tela, doba dana i godine, izloženosti svetlosti, olfaktornih stimulansa, trajanja i prirode stimulacije, veličine pljuvačnih žlezda, bolesti, lekova), koje je neophodno zabeležiti prilikom uzorkovanja.

Izvesni autori salivu nazivaju ogledalom opšteg zdravstvenog stanja organizma, jer se brojna sistemska oboljenja reflektuju na pljuvačne žlezde i biohemijski sastav salive (Sjegrenov sindrom, reuma, autoimuno odbacivanje transplantata, sarkoidoza, cistična fibroza, hipertenzija, hiperlipidemija, alkoholna ciroza, malnutricija, diabetes, pankreatitis, oboljenja kore nadbubrega, tiroiditis, akromegalija, parkinsonizam, cerebralna paraliza).(4)

Cilj rada je bio da se utvrde promene u biohemijskom sastavu salive dijabetesnih bolesnika u odnosu na zdravu populaciju radi eventualnog korišćenja salive u praćenju bolesti, kao i praćenje promena u salivi u odnosu na tip dijabetesa.

Materijal i metode

Pacijenti koji su učestvovali u stidiji podeljeni su u dve grupe:

Eksperimentalnu grupu činila su 52 odrasla pacijenta, starosti 18–79 godina, oba pola (33 žene i 19 muškaraca), obolela od diabetes mellitus-a tip 1 (35 pacijenata) i tip 2 (17 pacijenata), lečena u Institutu za endokrinologiju, dijabetes i bolesti metabolizma Kliničkog centra Srbije.

Kontrolna grupa formirana je od 67 dobrovoljaca iz Beograda, studenata Stomatološkog fakulteta Univerziteta u Beogradu, starosti 19–24 godine, oba pola (47 ženskih i 20 muških), bez parodontopatije i sistemskih bolesti.

Mešovita (ukupna) saliva sakupljana je direktno iz usta ispitanika, metodom sukcije i pljuvanja. Kod metode sukcije pacijentu je objašnjeno da udobno sedne, ispere usta vodom, otvori oči, glavu nagne blago napred, bez orofacijalnih pokreta i gutanja pljuvačke. Posle nekoliko minuta uzorak se aspirira sa poda usne duplje automatskom pipetom od 1 mL u čistu obeleženu epruvetu. Sakupljanje je trajalo 10-20 minuta, zavisno od intenziteta salivacije pacijenta. Metoda pljuvanja sastoji se u akumuliranju pljuvačke na podu usne duplje i pacijent treba da ispljune svaka 2-3 minuta u čistu epruvetu, dok se ne sakupi dovoljna količina uzorka.

glands and obtained directly from a parotid duct orifice. Non-stimulated saliva (the basal secretion) is secreted in the absence of exogenous gustatory, masticatory or mechanical stimulation. Stimulated saliva is secreted in response to mechanical, pharmacologic or gustatory stimulation.(4)

Salivary flow rate and composition depend on numerous factors (body hydration, body position, time of day, season, light exposure, olfactory stimuli, duration and type of stimulation, salivary glands' size, diseases, drugs), which are necessary to note prior saliva collection.

Some authors consider saliva as a mirror of the body, because numerous systemic diseases affect salivary glands and the biochemical composition of saliva (Sjögren's syndrome, rheumatoid diseases, graft versus host disease, sarcoidosis, cystic fibrosis, hypertension, hyperlipidaemia, alcoholic cirrhosis, malnutrition, diabetes mellitus, pancreatitis, adrenal-cortical diseases, thyroiditis, acromegaly, parkinsonism, cerebral palsy).(4)

The objectives of this study were to establish changes in the biochemical composition of saliva in diabetic patients compared to healthy population (with aim to use saliva in disease monitoring), as well as salivary changes related to type of diabetes.

Materials and Methods

Patients involved in this study were divided into two groups: the experimental group consisted of 52 adult patients, 18–79 years of age, both sexes (19 men, 33 women), with diabetes mellitus type 1 (35 patients) and type 2 (17 patients), treated at the Institute for Endocrinology, Diabetes and Metabolic Disorders, Clinical Center of Serbia; the control group was formed of 67 volunteers from Belgrade, students of Dental School, University of Belgrade, 19–24 years of age, both sexes (20 men, 47 women), who had no periodontitis or systemic diseases.

Total saliva was collected directly from patient's mouth, by suction or spitting method. In the suction method, the patient was instructed to sit comfortably, rinse mouth with distilled water, with eyes opened and head tilted forward, without facial moves and swallowing of saliva. After few minutes the sample was aspirated from the floor of the mouth with an automatic pipette of 1mL in clean labeled container. The collection lasted 10–20 minutes, depending on patient's salivation. In the spitting method patient accumulated saliva on the floor of the mouth and spitted it every 2–3 minutes in clean labeled container, until sufficient amount was collected.

Sakupljana mešovita saliva kod dijabetesnih bolesnika sa izraženom kserostomijom salivacija je stimulisana žvakanjem čvrstog parafina.

Imajući u vidu da protok i sastav salive zavise od brojnih faktora, kod svakog pacijenta je provereno i potvrđeno da 1-2 sata pre uzorkovanja nije jeo, pio niti pušio. Zabeleženi su, takođe, ostali bitni uslovi sakupljanja salive: doba dana, da li su ispitanici prethodno oprali zube, stanje usta i zuba (karies, inflamatorni procesi, parcijalne ili totalne proteze i slično).

U slučaju da uzorak salive nije odmah analiziran, čuvan je u zamrzivaču (-18 ^{o}C). Pre analize svež ili odleđen uzorak ponovo je centrifugiran na 3500 obrt/min tokom 10 minuta i korišćen je bistar supernatant (bez tragova mucina).

Za određivanje glukoze u salivi korišćena je enzimska metoda sa glukoza-oksidazom uz fenol i 4-aminofenazon (GOD-PAP test firme Randox). Rastvori uzoraka, standarda i slepe probe promešani su na vorteks mešalici, pa inkubirani 10 minuta na 37 ^{o}C. Izmerena je apsorbancija analiza i standarda na 546 nm (spektrofotometar Philips PU 8630). Korišćen je standardni rastvor glukoze koncentracije 5.50 mmol/L.

Proteini su određeni su biuretskom metodom, a korišćen je standardni rastvor za proteine u urinu firme Randox koncentracije 5 g/L. Sadržaj epruveta promešan je na vorteks mešalici, stajao je 15 minuta na sobnoj temperaturi, a zatim su izmerene apsorbancije analize i standarda prema slepoj probi na 546 nm na spektrofotometru Gilford.

Albumini su određivani metodom vezivanja organskih boja za albumin, i to sa bromkrezolzelenim (BCG) firme Dialab. Sadržaj epruveta promešan je na vorteks mešalici, a apsorbancije standarda i analiza merene su odmah, na 630 nm, na spektrofotometru Gilford.

Natrijum je određen emisionom plamenom spektrometrijom na aparatu Instrumentation Laboratory 943. Kao interni standard korišćen je rastvor CsCl koncentracije 1.5 mmol/L, a za kalibraciju standard sa 140 mmol Na^{+}/L.

Kalijum je određen na plamenom fotometru Instrumentation Laboratory 943, metodom kao za natrijum. Korišćen je standardni rastvor koji sadrži 5.0 mmol K^{+}/L. Imajući u vidu da je koncentracija jona kalijuma u salivi znatno veća nego u serumu, a da bi izmerene koncentracije K^{+} bile u opsegu linearnosti aparata, svi uzorci salive su pre merenja razblaženi pet puta destilovanom vodom, što je uzeto u obzir prilikom izračunavanja.[5]

U statističkoj analizi korišćeni su Kolmogorov-Smirnov test, *t*-test, regresiona i korelaciona analiza, te χ^2 test.

Non-stimulated total saliva was collected and in diabetic patients with xerostomia salivation was stimulated by chewing a piece of paraffin wax.

Since salivary flow rate and composition depended on numerous factors, each patient was asked not to eat, drink or smoke 1–2 hours before saliva collecting. Other important conditions of saliva collection were noted too: time of the day, teeth brushing, condition of the teeth and mouth (caries, inflammation, partial or full dentures).

In an event that saliva sample was not analyzed immediately, it was kept on –18^{o}C. Prior to analysis, fresh or unfrozen sample was centrifugated at 3500 rpm for 10 minutes and lucid supernatant, without traces of mucines, was used.

For salivary glucose level measurement, the method with glucose-oxydaze and phenol-4-aminophenazonum was used (GOD-PAP test, Randox). Solutions of samples, standard and blind were mixed then incubated on 37^{o}C for 10 minutes. The absorbance of analyses and standards were measured on 546 nm (Philips PU 8630). Standard glucose solution of 5.50 mmol/L was used.

Total proteins were measured by the biuret method. Standard solution for proteins in urine 5 g/L was used (Randox). After mixing and incubation at room temperature for 15 minutes, the absorbance of analyses and standard were measured on 546 nm (Gilford).

Albumin was determined by binding of organic color bromcresolgreen for albumin (BCG, Dialab). After mixing of solutions, the absorbance of analyses and standard were measured immediately on 630 nm (Gilford).

Sodium was determined by emission flame spectrometric method (Instrumentation Laboratory 943). Solution of CsCl 1.5 mmol/L was used as an internal standard and a calibration standard was solution with 140 mmol Na^{+}/L.

Potassium was also determined by emission flame spectrometric method (Instrumentation Laboratory 943). Standard solution with 5.0 mmol K^{+}/L was used. Since potassium concentration in saliva was significantly higher than in serum, all saliva samples were diluted five times with distilled water and this was taken into account.[5]

Statistic methods Colmogorov-Smirnov test, Student *t*-test, χ^2 test and linear regression and correlation were used.

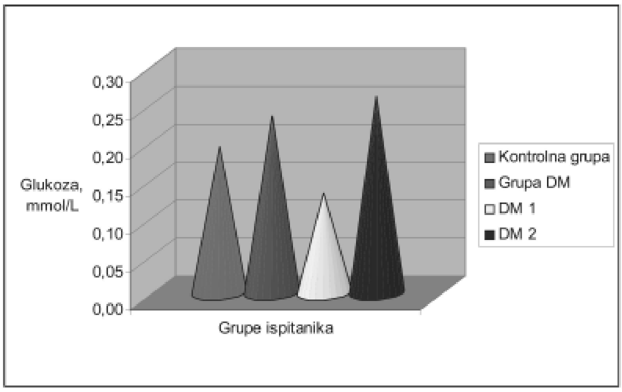
Rezultati

Na grafikonu 1 prikazani su statistički parametri za koncentraciju glukoze (mmol/L) u salivi obolelih od diabetes mellitus-a (DM) oba tipa u odnosu na zdravu populaciju. Iz prikazanih rezultata može se uočiti da je koncen-

Results

In Figure 1 statistic parameters for glucose concentration (mmol/L) in saliva in patients with diabetes mellitus (both types) compared to healthy population are shown. From these data we can see that glucose concentration in tracija glukoze u salivi dijabetesnih bolesnika blago povišena u odnosu na zdravu populaciju, ali ova razlika nije bila statistički značajna (t = 0.451; p = 0.05).

saliva of diabetic patients was mildly increased compared to healthy population, but this difference was not statistically significant (t = 0.451, p = 0.05).



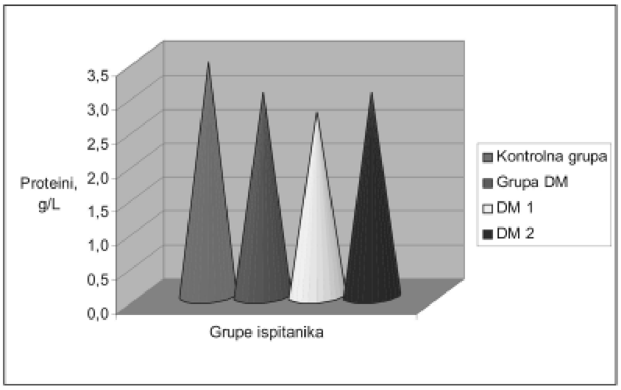
Grafikon 1. Srednja koncentracija glukoze u salivi (mmol/L)
Figure 1. Mean values of glucose concentration in saliva (mmol/L)

Kada se posmatra koncentracija glukoze u salivi u odnosu na tip dijabetesa, može se zaključiti da je ona nešto viša kod DM tip 2, ali bez statističke značajnosti (t = 0.849; p = 0.05).

Koncentracija ukupnih proteina u salivi niža je u grupi dijabetesnih bolesnika nego u kontrolnoj grupi (t = 4.756; p = 0.05) i niža je kod dijabetesa tip 1 u odnosu na tip 2 (t = 2.021; p = 0.05) (Grafikon 2).

Salivary glucose concentration related to type of diabetes was a bit higher in DM type 2, but without statistical significance (t = 0.849, p = 0.05).

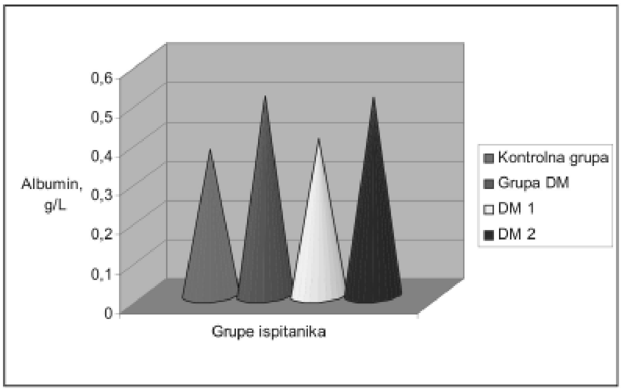
Total protein concentration in saliva was lower in diabetic group than in control group (t = 4.756, p = 0.05) and lower in DM type 1 compared to DM type 2 (t = 2.021, p = 0.05) (Figure 2).



Grafikon 2. Srednja koncentracija ukupnih proteina u salivi (g/L)
Figure 2. Mean values of total protein concentration in saliva (g/L)

Koncentracija albumina u salivi ne razlikuje se značajno kod obolelih od dijabetesa i zdravih (t = 1.814; p = 0.05), kao ni po tipu dijabetesa (t = 1.137; p = 0.05) (Grafikon 3).

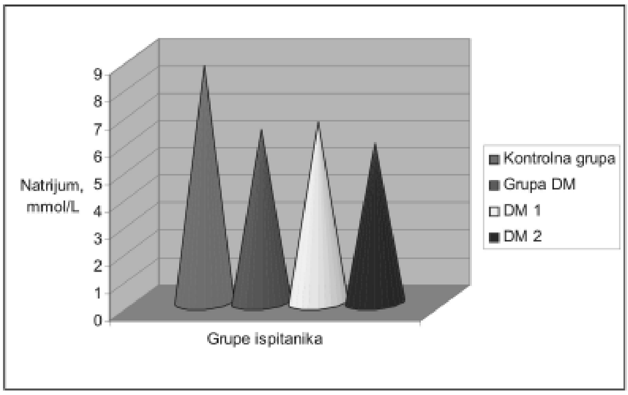
Salivary albumin concentration did not differ significantly in diabetic and control group (t = 1.814, p = 0.05), as well as in DM type 1 and DM type 2 groups (t = 1.137, p = 0.05) (Figure 3).



Grafikon 3. Srednja koncentracija albumina u salivi (g/L)
Figure 3. Mean values of albumin concentration in saliva (g/L)

Koncentracija natrijuma u salivi niža je u grupi dijabetesnih bolesnika u odnosu na zdrave (t = 31.297; p = 0.05) i niža je kod obolelih od dijabetesa tip 2 u odnosu na tip 1 (t = 5.342; p = 0.05) (Grafikon 4).

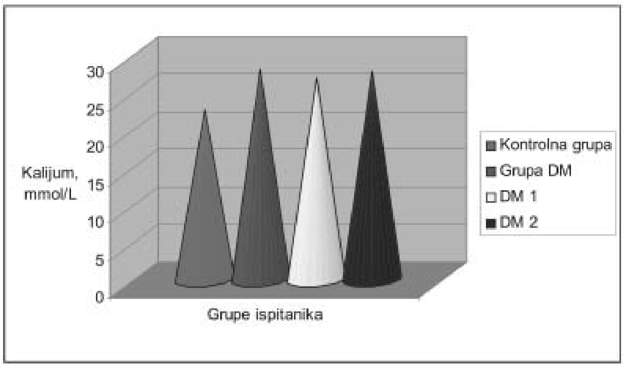
Sodium concentration in saliva was lower in diabetics than in healthy persons (t = 31.297, p = 0.05) and also lower in DM type 2 than in DM type 1 (t = 5.342, p = 0.05) (Figure 4).



Grafikon 4. Srednja koncentracija natrijuma u salivi (mmol/L)
Figure 4. Mean values of sodium concentration in saliva (mmol/L)

Koncentracija kalijuma u salivi viša je kod dijabetesnih bolesnika u odnosu na zdrave (t = 127.070; p = 0.05) i viša je kod dijabetesa tip 2 nego tip 1 (t = 16.763; p = 0.05) (Grafikon 5).

Potassium concentration in saliva was higher in diabetics than in healthy persons (t = 127.070, p = 0.05) and higher in DM type 2 than in DM type 1 (t = 16.763, p = 0.05) (Figure 5).



Grafikon 5. Srednja koncentracija kalijuma u salivi (mmol/L)
Figure 5. Mean values of potassium concentration in saliva (mmol/L)

Diskusija

Prema podacima za 2002. godinu u Beogradu je živelo 1 576 124 stanovnika. Registrovano je 3 806 stanovnika obolelih od diabetes mellitus-a, što čini 0.24 % beogradske populacije. Procenat dijabetesnih bolesnika najveći je na opštinama u kojima živi stanovništvo najveće prosečne starosti.(2)

Podaci iz literature ukazuju da još uvek nema saglasnosti o tome koje bi parametre trebalo određivati u salivi, što se odnosi i na konkretan slučaj diabetes mellitus-a. Lopez i saradnici statističkom analizom su utvrdili da bi salivarni markeri dijabetesa mogli biti ukupni šećeri, glukoza, ukupni proteini, urea i kalcijum.(6)

Izvesni autori utvrdili su da je koncentracija glukoze u salivi dijabetesnih bolesnika povišena (6-11), dok su drugi zaključili da nema značajne razlike između obolelih i zdravih.(12) Koncentracija glukoze u salivi dijabetesnih

Discussion

According to 2002 data, 1 576 124 inhabitants lived in Belgrade. There were 3806 inhabitants with diabetes mellitus or 0.24 % of Belgrade population. The greatest percentage of diabetic patients was in communities with older population.(2)

There is still no consensus about which parameters should be followed in saliva of patients with diabetes mellitus. Some investigators established by statistical analysis that salivary markers of diabetes could be total sugars, glucose, total proteins, urea and calcium.(6)

Some authors suggested that glucose concentration in saliva of diabetic patients was increased (6-11) while others concluded that there was no significant difference between ill and healthy persons.(12) Salivary glucose conbolesnika raste jedan sat posle doručka, ali ne u stepenu koji bi se mogao detektovati.(13)

Glukoza se određuje u salivi kao pokušaj da se pronađe neinvazivan i bezbolan način za često praćenje glikemije kod dijabetesnih bolesnika, ali se tu kao problem javlja znatno niža koncentracija glukoze nego u krvi (14), kao i činjenica da koncentracije glukoze u salivi i serumu nisu u značajnoj korelaciji.(6,9,15)

Koncentracije ukupnih proteina u salivi koje su dobijene u ovom radu u saglasnosti su sa literaturnim podacima i iznose 0.25–10 g/L.(16,17) Albumin najčešće čini 5–8 % ukupnih proteina u salivi. Izvesni radovi ukazali su da kod obolelih od diabetes mellitus-a značajno raste koncentracija ukupnih proteina u salivi (srednja vrednost 2.41 g/L), ali nema značajne razlike u koncentraciji zavisno od tipa dijabetesa.(18) Ukupni proteini u salivi određeni su biuretskom metodom .(19)

Što se tiče koncentracije proteina posle stimulacije salivacije, ona može biti čak i niža nego u nestimulisanoj salivi, ali to nema statistički značaj.(20) Koncentracija ukupnih proteina ne zavisi od trajanja i intenziteta stimulacije, npr. čvrstim parafinom.(21)

Na koncentraciju ukupnih proteina u salivi verovatno ima uticaja vrsta sakupljane salive, način stimulacije, protok, metode određivanja, dnevne varijacije. Takođe mogu uticati stres, inflamacija, infekcija, menstruacija i trudnoća – kratkoročni faktori. U dugoročne faktore spadaju starenje, sistemske bolesti, lekovi. Trebalo bi razmotriti i uticaj faktora kao što su različitost populacija, razlike u interakciji protein-mikroorganizam, proteinski polimorfizam, sinergističke i antagonističke interakcije proteina.(22)

Podaci o promeni koncentracije jona kalijuma u salivi dijabetesnih bolesnika su protivrečni. Neki autori pokazali su da je koncentracija K^+ povišena u mešovitoj nestimulisanoj i stimulisanoj salivi (8,9,12), a drugi da je snižena.(18) Isti autori slažu se da u koncentraciji Na^+ nema značajne razlike između dijabetesnih bolesnika i zdravih. Pacijenti sa parodontopatijom imali su povišenu koncentraciju Na^+ u mešovitoj salivi, a nepromenjenu koncentraciju K^+ u odnosu na kontrolnu grupu.(23)

Sastav mešovite salive podložan je i dnevnim promenama (24), a osim zbog diabetes mellitus-a menja se i sa starenjem, kao i usled parodontopatije (25,26), a sva tri faktora javljaju se kod dijabetesnih bolesnika.

centration in diabetic patients slightly increases one hour after breakfast.(13)

Glucose is determined in saliva as an attempt to find non-invasive and painless way for frequent monitoring of glucose level in diabetic patients, but the problem is significantly lower concentration of glucose in saliva than in blood (14) as well as the fact that glucose concentrations in saliva and serum are not significantly correlated.(6,9,15)

Total protein concentrations in this investigation were in accordance with literature data: 0.25–10 g/L.(16,17) The albumin most often makes 5–8 % of total proteins in saliva. Some investigations showed that salivary protein concentration was significantly increased in diabetic patients (mean value 2.41 g/L), but there was no significant difference depending on the type of diabetes.(18) Total proteins in saliva were measured by biuret method.(19)

Concentration of proteins in stimulated saliva can be even lower than in non-stimulated, but without statistical significance (20). Total proteins' concentration doesn't depend on duration and intensity of stimulation with solid paraffin (21).

The salivary concentration of total proteins is mostly influenced by saliva type, the way of stimulation, salivary flow rate, methods of determination, daily variations. Stress, inflammation, infection, menstruation and pregnancy can also influence as short-term factors. Long-term factors are getting old, systemic diseases, medicines. The influence of populations, protein-microorganism interaction, protein polymorphism and protein interactions should also be taken into consideration.(22)

Data about changes of potassium concentration in saliva of diabetic patients is somewhat contradictory. Some authors showed that potassium concentration was increased in non-stimulated and stimulated whole saliva (8,9,12) and according to others it was decreased.(18) Same authors agreed that sodium concentration did not differ between diabetic and healthy subjects. Patients with periodontal disease, which often follows diabetes, have increased sodium concentration in whole saliva and unchanged potassium concentration compared to control group.(23)

Total saliva composition may exhibit daily changes(24) and apart from diabetes, it also changes older population and periodontal disease (25,26) and all these factors are present in diabetic patients.

Zaključci

Na osnovu ovog istraživanja može se zaključiti da se biohemijski sastav salive menja kod obolelih od diabetes mellitus-a: koncentracija ukupnih proteina i natrijuma opada, kalijuma raste, a glukoze i albumina uglavnom ostaje nepromenjena.

Biohemijski sastav salive menja se i zavisno od tipa dijabetesa. Tako je kod dijabetesa tip 1 koncentracija ukupnih proteina i kalijuma niža, a natrijuma viša u odnosu na tip 2.

Conclusions

This investigation has showed that the biochemical composition of saliva changes in diabetic patients: concentrations of total proteins and sodium decrease, potassium increases, glucose and albumin are unchanged.

Biochemical composition of saliva changes depending on the type of diabetes: in DM type 1, concentrations of total proteins and potassium are lower, and sodium concentration is higher than in DM type 2.

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