



Gold in semen: Level in seminal plasma and spermatozoa of normal and infertile patients



K.P. Skandhan ^{a,*}, J. Valsa ^a, B. Sumangala ^{b,1}, V. Jaya ^c

^a Department of Physiology, Government Medical College, Surat 395 001, India

^b Department of Pathology, Government Medical College, Surat 395 001, India

^c South East Alabama Medical Centre, 1108 Ross Clark Circle, Dothan, AL 36301, USA

Received 22 November 2015; revised 11 February 2016; accepted 13 February 2016

Available online 1 July 2016

KEYWORDS

Seminal gold;
Normozoospermia;
Oligozoospermia;
Oligoasthenozoospermia;
Azoospermia

Abstract The study was conducted to understand the amount of gold in semen of normal and different infertile conditions. Gold was estimated in normal (n38) and pathological conditions (n86) by employing Atomic Absorption Spectrophotometer. Gold level observed in seminal plasma was as follows: in normozoospermia (n38) – 17.0 µg% ± 9.63; oligozoospermia (n23) – 13.0 µg% ± 0.73; oligoasthenozoospermia (n44) – 20.5 µg% ± 5.58 and in azoospermia (n19) 21.5 µg% ± 7.52. Gold level in sediment (spermatozoa) of normal was almost same as observed in its seminal plasma whereas in oligozoospermia and oligoasthenozoospermia the level was low.

© 2016 Alexandria University Faculty of Medicine. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Many times clinicians are puzzled as the reason for infertility in their male patients is not known. Clinicians and scientists from basic science together try to find out other possible reasons for male infertility. Details of semen including its constituents were explored to find out the mechanism of maintenance of structure and motility of normal sperm in seminal plasma. Contribution of many organic and inorganic substances is known. Gold was detected in human semen.⁸

Reduction in this metal was thought as a probable factor for infertility.^{8,9,16}

In the present study including large number of samples we attempted to establish value of gold in normal semen and in clinical conditions.

2. Materials and methods

The glassware used in this study underwent thorough cleaning procedure.¹⁶ All donors and patients who submitted semen samples were physically and mentally, healthy. They belonged to the age group of 23–44 years and from the province of Gujarat. Details of sample collection and semen study were similar to an earlier study.^{19,20} Patients with azoospermia included in this study were not due to any obstruction in the tract. History revealed none of them was on any medicine containing gold. While collecting sample they were not wearing any gold ornament. During the study period investigators did not wear any gold ornament. After thorough evaluation²¹

* Corresponding author at: 902 VC Valley Apt., Kakanad, Cochin 684 037, India. Tel.: +91 9446507623.

E-mail address: kpskandhan@gmail.com (K.P. Skandhan).

¹ Present address: Department of Pathology, Sree Narayana Institute of Medical Sciences, Chalakka 683 594, Ernakulam, India.

Peer review under responsibility of Alexandria University Faculty of Medicine.

of each sample they were grouped according to its count and motility.¹² Otherwise, no attempts were made to find out the cause of infertility. Samples belonging to same group were added together in separate, labeled glass flasks. Semen from each flask was taken and seminal plasma was separated by centrifugation (2000 rpm \times 10 mts); to separate the sediment of spermatozoa.⁴ Seminal plasma and pellet from each group were analyzed for gold. Estimation was done by employing Atomic Absorption Spectrophotometer (AAS) (model Perkin Elmer A 373) available at Forensic Science Laboratory of Government of Gujarat at Ahmedabad. As source of flame a mixture of acetylene gas and air was used. A gold cathode lamp was in place. The wavelength was kept at 242.8 nm and slit opening was arranged at 0.7 nm. Each sample was fed for 10 s time and constantly obtained digital value was taken as the result. Preprocessing, of samples for AAS was done by wet oxidation method.¹⁰ Sensitivity of the instrument while doing estimation of an element was taken care. Reports showed, gold was not detected in semen by Direct Couple Plasma Emission Spectroscopy.¹³ Though by employing Neutron Activation Analysis,⁸ Mass Emission Spectroscopy¹¹ or by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES)⁵ gold was not detected in all samples. AAS is the most suitable method for estimating gold in semen.^{3,16}

3. Results

On the basis of semen evaluation report samples were grouped into normozoospermia (n38), oligozoospermia (n23), oligoasthenozoospermia (n44) and azoospermia (n19) (Table 1). The level of gold in seminal plasma and pellet of sperm are shown in Table 1.

4. Discussion

Search for unknown causes of male infertility continues. Examination of male genital secretion also revealed major functions of gonads and adnexal glands. Measurement of different substances present in semen is introduced to assess functioning of prostate gland or seminal vesicle. Calcium and magnesium are the best examples.^{1,18} Zinc is rich in semen and is mainly contributed by prostate gland.^{1,2,9}

Gold is discovered in human semen in 1981.⁸ It is present inside and outside spermatozoa.^{14,15,17} Source of gold is identified as caput epididymis.¹¹ Studies employing Electron Microscope (Energy Dispersive X-ray analysis) and X-ray Diffraction Analysis, revealed presence of gold throughout the length of genital system (except at the level of seminal vesicle, by X-ray diffraction study).^{14,17} A prominent observation

is gold existed in a trimetal complex form with zinc and copper.¹⁴ It is present in normal seminal plasma and spermatozoa,^{3,16} which is less or nil in few samples where sperm motility was below normal,^{8,11,16} probably indicating the necessity of gold for motility, though no statistical difference is seen between normal and clinical conditions.¹⁶

The present study is carried out to establish the level of gold in seminal plasma and spermatozoa in normal and clinical conditions. In this detailed study 124 semen samples are included giving coverage to our population (of Gujarat Province) as well as those visit infertility clinics. In our earlier studies limited number of patients' individual sample was analyzed for gold.^{8,16} In the present study repeated analysis is done in collected sample of each group and its mean value for gold is presented (Table 1). Gold is present in all semen samples studied. The presence of gold in seminal plasma of azoospermic samples proves gold present in seminal plasma is the contribution of testes and adnexal glands.^{14,17} The entry of gold inside the cell may be during the process of spermatogenesis, its journey through the tract or both.

Gold may be one of several elements contributing a favorable medium for sperm motility and its survival. No significant difference is observed in the level of gold in semen among people who stayed in different places where gold content of soil is high or much less.⁷ Male fertility rate is high in gold mine area when compared to the control area away from mine. However level of gold in semen sample is less in area surrounding gold mine when compared to that of control.⁵

In the present study it is seen the level of gold in spermatozoa depends on its number present in pellet (Table 1). In oligozoospermia and oligoasthenozoospermia, where sperm count is less, the amount of gold is less than that of normal (Table 1). The presence of gold in sperm pellet is directly related to its number in it. The more the sperm in pellet, the more the amount of gold in it. This may be show entry of gold into sperm cell during spermatogenesis. Reduction in source of gold in testis may be one of the responsible factors for the less number of sperms. After understanding the role of gold in spermatogenesis, its entry into cell, metabolism or in motility is known, gold may be supplemented for the treatment in male infertility as being done in case of zinc. In Ayurveda, an established old system of Medical Practice, a preparation of gold – “Suvarna Bhasma (Gold ash) (SB)” – is prescribed to male in some cases of infertility. In one of our studies we observed SB improved sperm count and motility in normal adults and in many cases of infertile partners.¹⁵ Adding SB to semen increased the motility of spermatozoa (Unpublished data). Gold content in SB is seen in the range of 58–64%.⁶

In conclusion the study showed gold is present in seminal plasma and spermatozoa of normal as well as oligozoospermia and oligoasthenozoospermia. In spermatozoa pellets of nor-

Table 1 Level of gold in seminal plasma and spermatozoa of normal and different pathological groups.

Groups	Level of gold	
	Seminal plasma $\mu\text{g}/\text{dl}$	μg in spermatozoa (sediment of dl semen)
Normozoospermia(38)	17.0 \pm 9.63	17.66 \pm 5.55
Oligozoospermia(23)	13.0 \pm 0.73	6.0 \pm 0.65
Oligoasthenozoospermia(44)	20.5 \pm 5.58	11.5 \pm 1.55
Azoospermia(19)	21.5 \pm 7.52	

\pm SE (number in parentheses).

mal, gold level is almost similar to that of seminal plasma, whereas in clinical conditions gold is less. Gold present in pellet depended on the number of total sperm in it. In azoospermia gold level is equivalent to that of normal indicating the metal in seminal plasma is a contribution of adnexal glands.

Conflicts of interest

We have no conflict of interest.

Acknowledgment

The study was supported by a research grant from the Government of Gujarat.

References

- Eliasson R, Lindholmer C. Functions of male accessory genital organs. In: Hafez ESE, editor. *Human semen and fertility regulation in man*. Saint Louis: CV Mosby Company; 1976.
- Homonnai ZT, Matzkin H, Fainman N, Paz G, Kraicer PF. The cation composition of the seminal plasma and prostatic fluid and its correlation to semen quality. *Fertil Steril* 1978;**29**:539–49.
- Jain V, Rai A, Misra S, Singh KM. Seminal gold content in healthy fertile men in India. *Int J Ayur Res* 2010;**1**:172–4.
- Mann T. *The biochemistry of semen and of the male reproductive tract*. London: Matheun and Company Ltd; 1964.
- Prasad BS, Singh G, Skandhan KP. Fertility potentiality and seminal plasma gold concentration among male population of gold mine and non-gold mine areas a survey study. *KLEU Health Sci J* 2010;**3**:41–7.
- Prasad BS, Skandhan KP, Singh G. Analytical study of “Suvarna Bhasma” (gold ash), an ayurvedic medicine. *Int J Drug Develop Technol* 2011;**1**:99–101.
- Sahab Khan P, Skandhan KP, Ajesh K, Siraj MVP. Gold inhuman semen around and away from a gold deposit area. *Biol Trace Elem Res* 2011;**142**:302–8.
- Skandhan KP. Gold in human semen. *Andrologia* 1981;**13**:78–82.
- Skandhan KP. Importance of zinc in the semen quality of different fractions of split ejaculate. *Infertility* 1981;**4**:67–81.
- Skandhan KP. Copper in seminal plasma: comparison of two processing method for atomic absorption spectrophotometer. *Arch Androl* 1986;**16**:243–5.
- Skandhan KP, Abraham AC. Presence of several elements in normal and pathological human semen samples and its origin. *Andrologia* 1984;**15**:587–8.
- Skandhan KP, Mazumdar BN. Interdependence of count and motility of spermatozoa. *Acta Eur Fertil* 1983;**49**:54–8.
- Skandhan KP, Pandya CB. Direct couple plasma emission spectroscopic study on human seminal plasma. *Adv Contra Dely Syst* 1986;**2**:256–7.
- Skandhan KP, Amith S, Avni KPS. X-ray diffraction study on human male reproductive tract and semen. *Urologia* 2009;**76**:198–202.
- Skandhan KP, Singh G, Prasad BS, Thakur AB, Godatwar PR, Rao N, et al. Veracity of “Severna Bhasma” (god ash), an ayurvedic preparation, as a therapeutic agent for male infertility. *J Ayur* 2009;**33**:83–6.
- Skandhan KP, Valsa J, Sumangala B. Level of gold in normal and pathological semen. *Urologia* 2010;**77**:254–6.
- Skandhan KP, Sumangala B, Amith S, Avni KPS. Electron microscopic (energy dispersive X-ray analysis) study of human male reproductive organs and semen. *Biol Trace Elem Res* 2011;**141**:91–5.
- Valsa J, Skandhan KP, Sahab Khan P, Avni KPS, Amith S, Gondalia M. Calcium and magnesium in male reproductive system I. Level in normal human semen, seminal plasma and spermatozoa. *Urologia* 2014. <http://dx.doi.org/10.5301/Urologia.500003>, 02.
- Valsa J, Skandhan KP, Sumangala B, Amith S, Avni KP. Effect of different timings of the day on semen and calcium and magnesium in it. *Urologia* 2016 (In press).
- Valsa J, Skandhan KP, Sumangala B, Jaya V. Time bound changes (in 24 hour) in human sperm motility and level of calcium and magnesium in seminal plasma. *Alexandria Med J* 2016;**52** (3):235–41.
- World health organization. Laboratory manual for the examination and processing of human semen, 5th ed. Switzerland: WHO; 2010.