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The response of Vitamin D to the Motility of Isolated Intestines in Male Rats

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ABSTRACT

Vitamin D exists in a variety of forms (vitamers). Vitamin D2 (ergocalciferol) and vitamin D3 are the two most common forms (calcitriol). VDRs (nutritional D receptors) are found in almost every tissue and cell. Gastrointestinal receptors are of therapeutic importance for the treatment of motility disorders. The present study was designed to demonstrate the modulatory effects of Vit.D on intestinal motility in adult male albino rats. Vitamin D was tested on intestinal strips with different intestinal receptor blockers (atropine sulfate, propranolol, verapamil, prazosin), followed by the addition of Vit.D on isolated intestinal strips. The obtained data demonstrated the optimal stimulatory effect of Ach on the isolated intestinal muscles for intestinal muscle contraction. Furthermore, the inhibitory effects of high-dose nicotine had no effect on the excitatory response. Therefore, it can be concluded that Vit.D has an effective stimulatory response on the isolated rat intestinal muscle.

Key words: Vitamin D, Verapamil, Atropine, Propranolol, Prazosin.

INTRODUCTION

Vitamin D protects a number of fat-soluble secosteroids that are essential for trace element absorption, such as metal, magnesium, and phosphate (Riccardi et al. 2020). Moreover, ergocalciferol contributes to multiple biological processes (Giraldi et al. 2015), such as cellular growth, immune, and inflammatory performance. Endogenous exposure to ultraviolet B radiation occurs as a result of many people's key provision of fat-soluble vitamin, which then converts 7-dehydrocholesterol in the skin to fat-soluble vitamin, which is then hydroxylated to 25-hydroxy D. i.e. 25(OH)D, a secosteroid endocrine. 25(OH)D is born-again to a minimum of one,25-dihydroxy D, or 1,25(OH)2D that is the most active component of the fat-soluble vitamin molecule (Mahendra et al. 2018). Fat-soluble vitamin supplements unit of measure is provided to treat or prevent a variety of diseases, including deficiency-induced deficiency disease and pathology (Harinarayan and Akhila 2019). For instance, as a clinical adjunct, the high incidence and poor prognosis of massive organ cancer were found to be half attributable to a lack of fat-soluble vitamins. In addition, patients with large organs with high levels of the fat-soluble Vit.D have a lower risk of process progression during neoadjuvant treatment before radical surgery (Abrahamsson et al. 2019). According to a meta-analysis conducted by Van den Blink et al. 2018 dietary supplementation reduced radiation-related bone fractures as well as the risk of avascular death in patients undergoing girdle radiation. Castro-Equiluz and colleagues suggested fat-soluble vitamins as a result of the foremost essential nutrients for cancer patients receiving chemotherapy girdle radiation (Castro-Eguiluz et al. 2018). Natural cholecalciferol is naturally produced by the skin from dehydrocholesterol, with pre-vitamin D3 produced after ultraviolet irradiation. This technique is critical for the biogenesis of fat-soluble vitamins in humans, although fat-soluble vitamins may be supplied even by diet. The fat-soluble vitamin is transported into the bloodstream and metabolized in the liver, where it is hydroxylated to produce the active form 25-hydroxyvitamin D3 (25(OH)D3). A number of P-450 protein accelerators house units converted the fat-soluble vitamin 1 to 25(OH)D3, in addition to CYP2R1, CYP27A1, and CYP2D25 (Christakos et al. 2016). Different from inhibiting the epithelial-stromal transition (EMT) in cancer cells, this active type of fat-soluble vitamin also provides protection against sickness and inflammatory organ disease.

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By regulating the catenin communication pathway, 25(OH)D3 inhabits EMT in human membrane mesothelial cells (Liu et al. 2019). This study was designed to evaluate the reaction of nutrition D doses on intestinal motility using some identified intestinal blockers.

MATERIALS AND METHODS

Experimental Design

The process was essentially performed as previously described (Montgomery et al. 2016). Male albino rats (n=10) were recruited in this study. The intestines isolated from each rat were examined for their response against acetylcholine (Ach), using an organ bath due to the following: 1) Ach on tension produced by the rat small intestine: 1min of baseline contractions were recorded. 1.0 µg of diluted Ach solution was withdrawn using a syringe, ensuring that there were no bubbles. The needle tip was inserted into the bath fluid without touching the gut. The first 0.1 µg of the drug was ejected and waited for 20s to detect any effect. The solution was mixed by O_2 bubbles and waited until the effect stabilized before adding another dose. 2) (20 µg) of cholecalciferol was included alone. A baseline of 1min was recorded, and then a dose of 20µg of cholecalciferol was added. 3) The impact of propranolol on intestinal smooth muscle: At 1min of baseline was recording, then 0.1µg of propranolol was centrifuged and monitored for 20s, and then a dose of 20µg of Vit. D was added. 4) Effect of Atropine (0.1µg) on intestinal smooth muscle. After 1min of baseline, 0.1µg of atropine was added, and after 20s a dose of 20µg of ergocalciferol was added, the event was marked, and the effect was observed then the results were printed. The tub was filled with fresh, warm physiological saline right away. After 2min, it was washed again, prepared for a new baseline, and then a dose of 0.2µg of atropine was added and sitting for 20s, subsequently a dose of 20µg Vit. D was added. 5) Effect of Verapamil on intestinal smooth muscle: 1min of baseline data was recorded, 1µg of verapamil was added, and after 20s a dose of 20µg Vit. D was added. 6) Effect of prazosin on intestinal smooth muscle: 0.1µg of prazosin was ejected, then after 20s a dose of 20µg of calciferol was added. 7) Effect of Nicotine large dose on intestinal smooth muscle: 0.1 µg of Nicotine was ejected, then after 20s, a dose of 20µg of fat-soluble vitamin was added.

Statistical Analysis

The gotten result of pressure values was factually analyzed employing a SAS bundle (ver. 9.1). The implies frequently imitates were subjected to one-way ANOVA. Tukey's noteworthy distinction (HSD) studentized run test was connected for noteworthy contrasts among implies ($P<0.05$).

RESULTS

The display ponder was carried out to evaluate the pharmacological effect of Vit. D on the isolated intestinal muscles of albino rats in vitro. The addition of acetylcholine 0.64µg showed a contractile response on intestinal muscle tone with a significant increase compared to other tested drugs. Vitamin D showed a significant increase in the tension values for intestinal muscles compared to the other tested drug (atropine 0.1µg and 0.2µg, propranolol 0.1µg, verapamil 0.1µg, prazosin 0.1µg and nicotine large dose 1.78µg) followed by addition of Vit. D 20µg (Table 1). The data obtained in Fig. 1 showed the stimulatory effect of Ach on isolated intestinal muscle as a reference drug for intestinal muscle contraction. This curve revealed an increased muscle tone contraction with increased doses of Ach (0.4 to 2.56µg). Vitamin D in various doses (0.1, 0.2, 1, 10, 20, 40, 80 and 160µg) in Fig. 2 showed intestinal muscle contraction. The stimulatory response of Vit. D alone on isolated rat intestine is shown in Fig. 3. Our results showed a stimulatory response of Vit. D on isolated rat internal organs upon addition of propranolol Fig. 4. Similarly, upon addition of calcium blocker, Fig. 5 shows viscus contraction. Fig. 6 shows an elevation in the viscus response for Vit. D when adding blocker alpha-adrenergic blocker. Moreover, upon addition of mydriatic drug, the viscus muscle contracted as shown in Fig. 7 and 8. There was a stimulatory response to vitamin D followed the addition of phytotoxic giant dose (NLD) as shown in Fig. 9.

DISCUSSION

Vitamin D is essential for mineral and bone metabolism as Vit. D receptors (VDRs) are expressed in nearly every tissue and cell. There are numerous studies on the potential extra-skeletal effects of Vit. D (Uday and Högler 2018). The purpose of this study was to investigate the potential effects of Vit. D on enteral motility *in vitro* examination. The obtained results showed an elevation in enteral muscular contraction upon the addition of neurotransmitters. This result is consistent with studies that revealed that muscarinic agonist and enzyme inhibitors enhance contractions of the little gut. Cholinergic influence

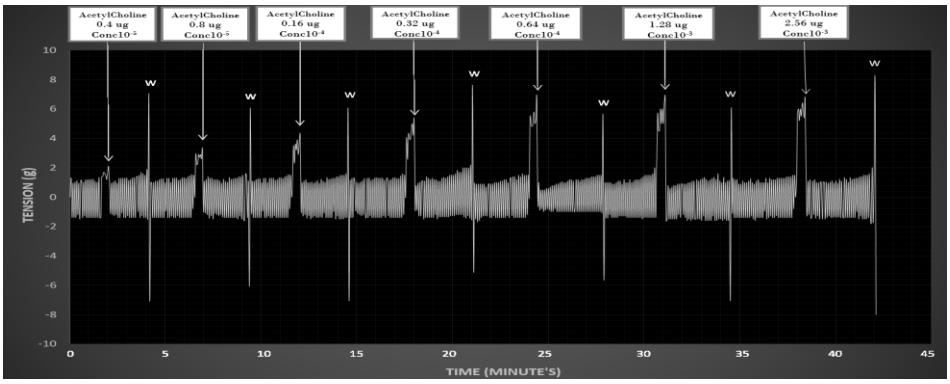

Fig. 1: Stimulatory response of different doses of Ach on the strips of rat intestine.

Table 1: Comparison of drug versus vitamin D on the intestinal muscles of rats (tension in grams)

No.	Acetylcholine (0.64µg)	Vit. D (20µg)	Propranolol (0.1µg)	Atropine (0.1µg)	Atropine (0.2µg)	Verapamil (0.1µg)	Prazosin (0.1µg)	Nicotine (1.78µg)
1	4.7	3.6	4	0.5	0.3	3.1	3.7	2.6
2	5.4	3.7	3.8	0.4	0.2	2.7	3.4	2.5
3	4.8	3.5	4.1	0.8	0.1	2.9	3.3	2.8
4	4.9	4	3.6	0.3	0.2	3	3.2	2.4
5	5.3	3.4	3.9	0.5	0.1	2.7	3.4	2.7
6	5.4	3.6	3.6	0.7	0.2	2.9	3.3	2.8
7	5.1	3.6	4.2	0.5	0.3	3	3.5	2.4
8	5.4	4	3.8	0.8	0.2	2.9	3.3	2.7
9	5.1	3.7	3.9	0.6	0.2	3.1	3.4	2.4
10	4.9	3.8	3.6	0.6	0.3	3.2	3.5	2.7
Mean±SD	5.1±0.26a	3.69±0.19b	3.85±0.21b	0.57±0.16f	0.21±0.07g	2.95±0.16d	3.4±0.14c	2.60±0.16e

Treatment with Propranolol, Atropine, Verapamil, Prazosin and Nicotine was followed by Vit. D (20µg). Data expressed as (Mean±SD). Different letters indicate statistical difference at P≤0.05 by Duncan test.

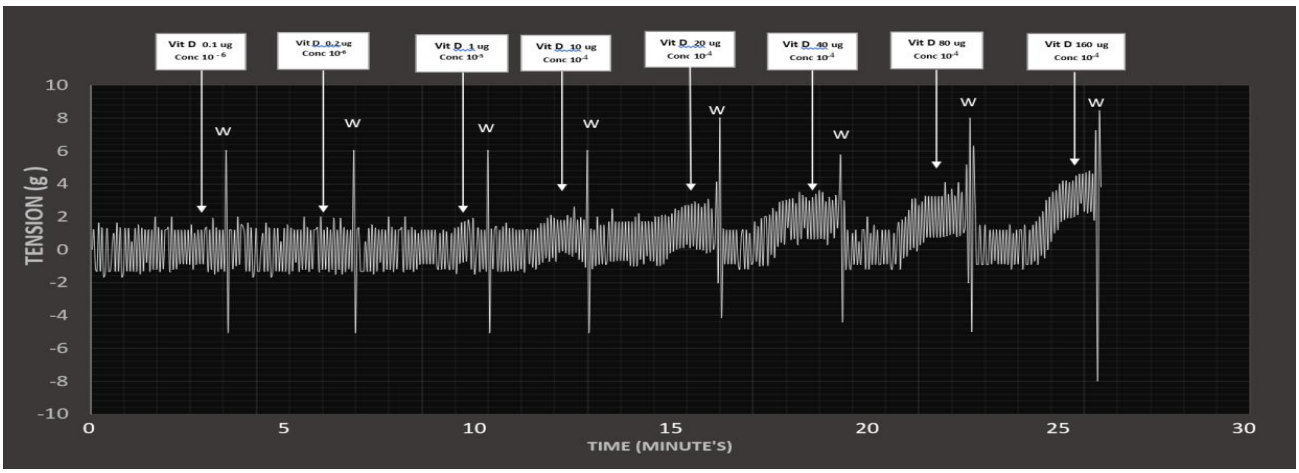

Fig. 2: Stimulatory response on the strips of rat intestine in the presence of different doses of vitamin D.

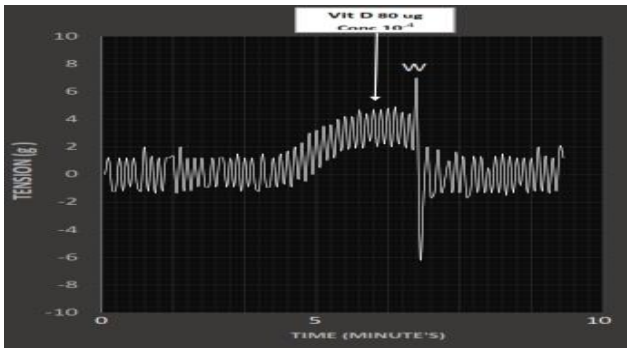

Fig. 3: Stimulatory response of vitamin D on the strips of rat intestine.

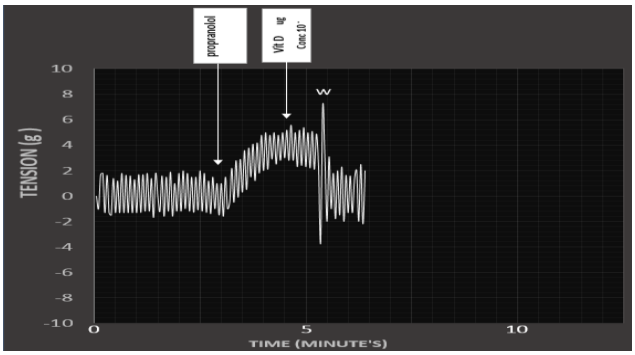

Fig. 4: Stimulatory response of vitamin D on the strips of rat intestine in the presence of propranolol.

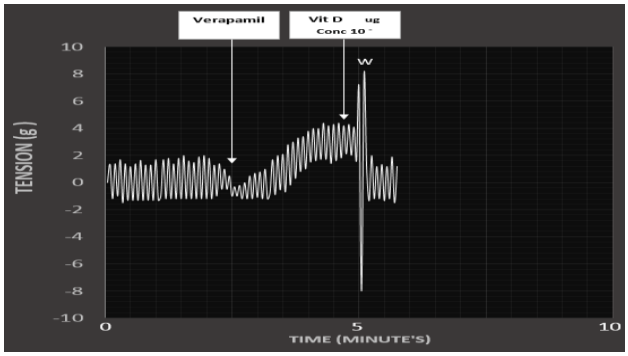

Fig. 5: Stimulatory response of vitamin D on the strips of rat intestine in the presence of verapamil.

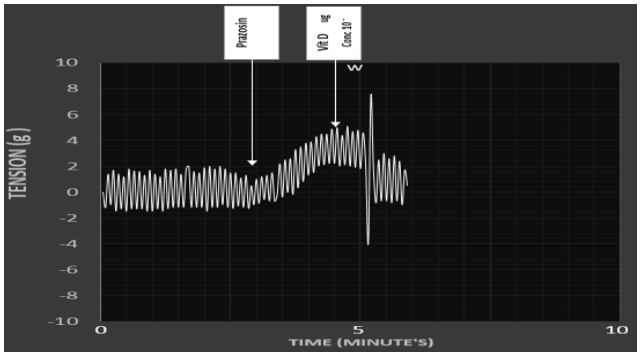

Fig. 6: Stimulatory response of vitamin D on the strips of rat intestine in the presence of prazosin.

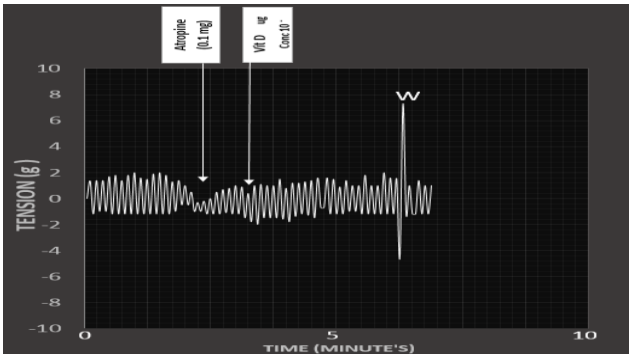

Fig. 7: Stimulatory response of vitamin D on the strips of rat intestine in the presence of atropine.

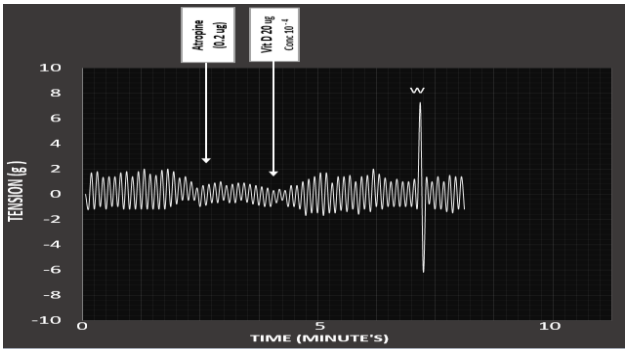

Fig. 8: Stimulatory response of vitamin D on the strips of rat intestine in the presence of atropine (0.2µg).

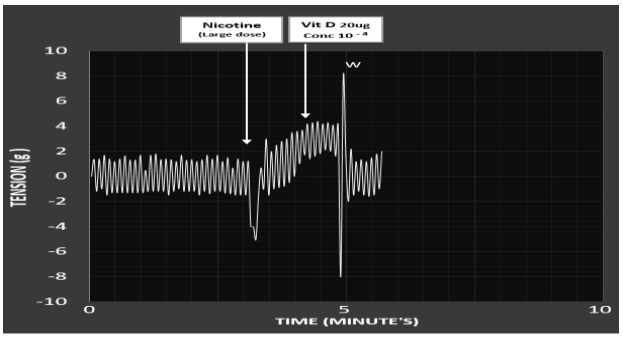

Fig. 9: Stimulatory response of vitamin D on the strips of rat intestine in the presence of NLD.

is due to the fact that muscarinic receptor blockade inhibits the peristaltic reflex, which is important for propulsive enteric motility with an antispasmodic (Matsui et al. 2002). The presence of Vit.D receptors in gut muscle cells indicates that Vit. D may act locally, influencing mineral concentration in the organism and contributing to the contraction-relaxation regulation of intestinal muscle cells. (Giraldi et al. 2015). The current results revealed an elevation in enteral muscular contraction upon the addition of various doses of Vit.D. United Nations agency declared that Vit.D is especially necessary for optimal absorption of intestinal minerals and physiological condition. Whereas, Vit.D deficiency leads to decreased bone stiffness, and it is commonly associated with bone pain and muscle weakness. The findings of the current study are consistent with (Bikle 2016) United Nations agency which demonstrated that Vit.D plays an indirect role in the contraction mechanism. However, further studies are required to demonstrate the role of the receptors in the mechanism of action of Vit.D. However, as a universal population-wide screening tool, it should be used only in people who are at high risk of developing Vit.D deficiency. According to some dose-response analyses of RCTs, a supplemental dose of 800 IU of Vit.D/day should be comfortable for almost all people to achieve proper blood serum 25(OH)D concentrations of 50nmol/L and to produce beneficial clinical effects (Pilz et al. 2018; Bouillon and Carmeliet 2018).

Conclusion

The current consideration proposes that supplemental vitamin D may be valuable as intestinal treatment of solid tone for invigorating typical intestinal motility.

Author's Contribution

Nabil A. Soliman, Sherif Wagih, Safaa E. Nassar and Aya Shawky designed the experiments and reviewed the manuscript. Reem Adly performed the practical parts of this study.

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