A New transmuted Lindley Distribution for Nocturnal ghrelin and growth hormone

Geetha.T* and Thangappan.R.**

* Asst. Professor of Mathematics .K. N. Govt. Arts College for Women. Thanjavur. Tamilnadu. South India
** Asst. Professor of Mathematics .Rajah Serfoji. Govt. College . Thanjavur. Tamilnadu. South India

Abstract: In this paper we discussed new Lindley Distribution for nocturnal gherlin pulsatility and response to growth hormone. The physiological importance of endogenous ghrelin as a potential participant in the regulation of GH secretion is still unknown. In this study, the author investigated ghrelin pulsatility compared with GH during overnight fasting and eight healthy male subjects to determine ghrelin pulsatility, pattern of coupling, synchronicity to GH, and response to standard GH secretagogues, including GH releasing hormone(GHRH) aloneandin combination with arginine. Using mathematical model by the author investigated whether fluctuations in plasma ghrelin concentrations during overnight fasting exhibited pattern coupling and synchronicity to GH by use of cross-approximate entropy (X-ApEn). We analyzed ghrelin and GH concentration during overnight fasting when ghrelin and GH peak.

APPLICATION

The changes in ghrelin in response to GHRH alone and combined GHRH-arginine are shown in Fig. . With use of repeated-measures ANOVA, the ghrelin change from baseline during combined GHRH-arginine testing (_66 _ 14 pg/ml after 120 min) was significant (P = 0.001), whereas the change from baseline during GHRH alone was not significant (P =0.46). The responses to GHRH alone vs. the response to combined GHRH-arginine were compared using MANOVA and were significantly different (P =0.02;)

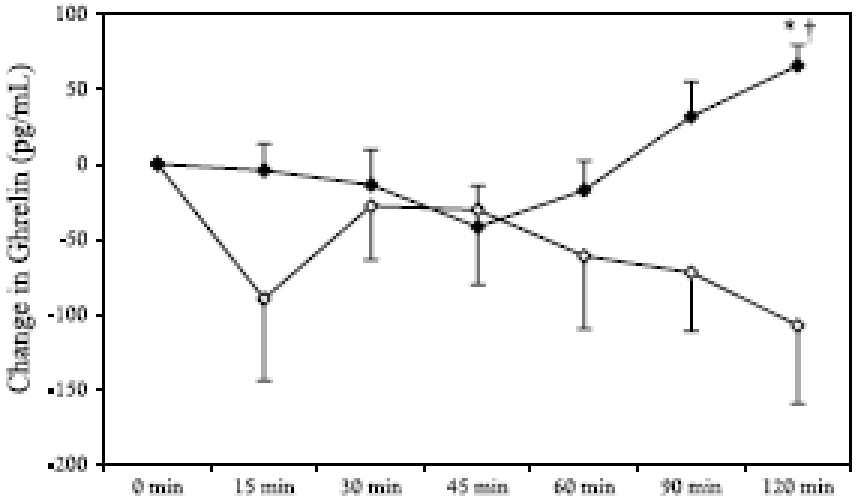

Fig. 1. Change in ghrelin from baseline during growth hormone- releasing hormone (GHRH) stimulation testing ({) and GHRH-arginine stimulation testing (}). *P = 0.001 for change frombaseline, with repeated-measures ANOVA. †P = 0.02 for comparison of ghrelin levels in response to GHRH_arginine vs. GHRH alone by MANOVA

The time course of ghrelin and GH responses to GHRHarginine are demonstrated in. InresponsetoGHRHarginine,themaximaldecrease in ghrelin and themaximalincreasein GH occurred at approximately the same time in mirror image responses (Fig. 2).

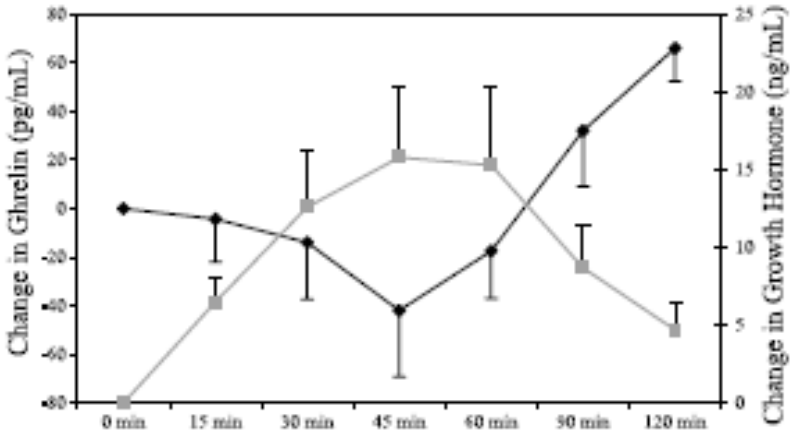

Fig. 2. Change in ghrelin (dark line) and GH (light line) from baseline during GHRH_arginine stimulation testing.

The results of the present study suggest that ghrelin is secreted in a pulsatile fashion in humans. Rhythmicity of ghrelin secretion dynamics was detected by two objective and independent methods: Cluster and ApEn. We used every 20-min sampling, and more frequent sampling may have greater sensitivity to detect ghrelin pulsatility. Nonetheless, the determination of pulsatility in seven of eight subjects provides good initial evidence that ghrelin is pulsatile in humans.

In addition, different results might be obtained investigating the dynamic regulation during feeding or by sampling throughout the day. We measured ghrelin and GH during the night, when GH levels are known to be maximal. The average ghrelin ApEn value for our data series provides strong evidence that ghrelin is secreted in a nonrandom model. Taken together, our findings suggest a nocturnal rise using more frequent sampling will be necessary to determine the exact pulse frequency of and a nonrandom, pulsatile pattern of ghrelin discharge in humans during overnight fasting.

MATHEMATICAL MODEL

A NEW TRANSMUTED LINDLEY DISTRIBUTION

DEFINITION 1: Let (x) be the cumulative distribution function (cdf) of a non-negative absolutely continuous random variable, $G(x)$ be strictly increasing on its support, and $G(0)=0$ define a new cdf, F(x), out of $G(x)$ as

$$F(x)=(1+\lambda)[G(x)]\delta-\lambda[G(x)]\alpha,x>0,$$

where $\alpha,\delta>0$ for $0>\lambda>-1$ and $\alpha>0$,$(\alpha+\alpha/4)\geq\delta\geq(\alpha/2)$ for $0<\lambda<1$

A lot of distributions have been made using cumulative distribution function (cdf)(x), probability density function (pdf)$g(x)$, or survival function $\bar{G}(x)$ that one can rely on, as a baseline distribution, to introduce new models. The Exponentiated generalization is the first generalization allowing for non-monotone hazard rates, including the bathtub shaped hazard rate. The cdf of the new distribution is defined by $(x)=G\propto(x)$, where $\propto>0$. The exponentiated exponential distribution has been introduced by Ahuja and Nash (1967), and further studied by Gupta and Kundu (1999). The first generalization allowing for nonmonotone hazard rates, including the bathtub shaped hazard rate, is the exponentiated Weibull (EW) distribution due to Mudholkar and Srivastava (1993), and Mudholkar et al. (1995)..

An interesting idea of generalizing a distribution, known in the literature by transmutation, is derived by using the Quadratic Rank Transmutation Map (QRTM) introduced by Shaw and Buckley (2009). Merovci (2013) introduced transmuted Lindley distribution. According to the transmutation generalization approach, the cdf satisfies the relationship

$$(x)=(1+\lambda)G(x)-\lambda[G(x)]2,$$

where G(x) the cdf of the baseline distribution.

DEFINITION 2: A random variable X is said to have the Lindley distribution with parameter θ if its probability density is defined as

$$f(x)=\theta^2/\theta+1(1+x)e^{-\theta x}{}_{,x>0,\theta}$$

The corresponding cumulative distribution function (cdf) is:

$$F(x)=1\_\theta+1+\theta x/\theta+1 \quad e^{-\theta x}{}_{,x>0,\theta>0}$$

Now using the above equation we have the cdf of a new transmuted Lindley distribution

$$(x)=(1+\lambda)[1-\theta+1+\theta x/\theta+1e-\theta x]\delta-\lambda[1-\theta+1+\theta x/\theta+1e-\theta x]^{\alpha},x>0,$$

Hence the pdf of new transmuted Lindley distribution is $f(x)=\theta^2/\theta+1\ (1+x)e\theta x(1+\lambda)\delta$ $^{[1-\theta+1+\theta x/\theta+1]\delta-1-\lambda\alpha[1-\theta+1+\theta x/\theta+1\ e-\theta x]\delta-1)}$

where $\theta,\alpha\ ,\delta>0$, for $0>\lambda>-1$ and θ, >0, $(\alpha+\alpha/4)\geq\delta\geq(\alpha/2)$ for $0<\lambda<1$.

CONCLUSION

In this paper we discussed gherlin pulsatility and relatedness to GH during fasting. Relatedness of GH and ghrelin may result from direct stimulation of GH by ghrelin and/or co-regulation by other neuroendocrine factors. Stimulation of ghrelin by combined GHRH- arginine, more than GHRH alone, suggests potential regulation of ghrelin by somatostatin. Coordinated regulation of ghrelin and GH may be an important component in nutrient signaling to the brain, and ghrelin may be an important physiological regulator of GH. By using new transmuted Lindley distribution also found pdf and cdf of gherlin.

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