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Editorial

Localized Drug Delivery in Prostate Cancer Treatment

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Abstract

Drug delivery to prostate through conventional route is associated with pharmacokinetics based and side effects related problems. Alternate localized drug delivery route is a prerequisite which may offers many advantages over oral route of drug delivery to prostate. In male reproductive system, Vas deferens forms a continuous system with prostate, so we discuss possibility of developing novel drug delivery system which may help to overcome with problems associated with the route of drug administration, including poor absorption, metabolic degradation, sub-threshold value of drug reaching the target tissue and non-specific drug distribution related side effects. And particularly, throwing light on an alternative drug delivery route may offer advantages to circumvent some of the above mentioned hurdles of oral drug administration. The current editorial promotes vas deferens as a local drug delivery route to prostate in conjunction with a concept of in-vivo self-assembly of multi component nanodrug carrier generated by a drug delivery system injected in the lumen of vas deferens.

Editorial

Prostate related disease is one of the most pertinent glitches in urology, affecting many males across the globe [1]. Predominantly prostate cancer and benign prostate hyperplasia, former being the terminal disease whiles the latter is not fatal but if left untreated can cause a series of problems that affects the life standards of the patients [1]. The gold standard for pharmacological intervention for the treatment of both diseases includes directing drug molecules, to the target site by systemic circulation, i.e., oral route or systemic injection (iv, ia). This mode of drug delivery tends to come with severe side effects especially in case of chemotherapy for prostate cancer [2] or in the case of long time ingestion of the drug for BPH treatment where the clinically approved drug, which is finasteride, have been shown to have side effect ensuing sexual problem (erectile dysfunction, loss of libido), psychological problem (depression) [3] and cardiovascular problems [3,4].

Problems associated with oral administration may cause various bioavailability problems pertaining to the route of drug administration, including poor absorption, metabolic degradation, sub-threshold value of drug reaching the target tissue and non-specific drug distribution related side effects. In such circumstances, an alternative drug delivery route may offer advantages to circumvent some of the above mentioned hurdles of oral drug administration. The emerging trends of using vas deferens as a local drug delivery route to prostate in conjunction with a novel concept of *in vivo* self-assembly drug carrier generated by a drug delivery system injected in the lumen of vas deferens, might be the real solution of prostate cancer prevention.

Apart from serving as a conduit for sperm transport to urethra, Vas deferens, also contributes to secretion of fluid for sperm transport, reabsorption of fluid secreted from epididymis, maintenance of luminal pH and resorption of spermatozoan remnants from the terminal segment of vas deferens' lumen which is called ampulla in higher male animal [5]. Vas deferens luminal contents (sperm, vas fluid) are propelled anterogradely as a net effect of relaxation of circular muscle and contraction of longitudinal muscle of vas deferens' middle layer muscular coat during emission phase [6]. So, a system exist that drains the luminal contents of vas deferens from the proximal end (epididymis end) to distal end (prostate end).

Anatomical association of the vas deferens with the prostate gland in human male is accomplished by forming ejaculatory duct where the duct of the seminal vesicle joins the terminal segment of vas known as ampulla. This ejaculatory duct is infested into the prostate gland and expels its content through ejaculatory duct opening into the prostatic urethra [7]. In rodents the duct of prostate joins with the vas deferens along with the duct of seminal vesicle. The anatomical differences in prostate with respect to the vas is prominent in terms of the anatomical position and components of the secretion [2] within the animal kingdom (Perriepoint, 1975), but in terms of function, the role of

prostate and vas is almost synonymous in rat and other higher animal including human[8].

Earlier, the role of vas deferens lumen mediated transport of small molecules (steroids) and larger particles have also been studied both in perspective of vas deferens physiology and its influence on other reproductive secondary sex organs (prostate, seminal vesicle, and ampulla). Skinner and Rowson (1968), hypothesized the role of ductus deferens' luminal transport for maintenance of male reproductive tract by testicular fluid containing testosterone having a direct unilateral effect on the ampulla gross morphology and chemical composition of its secretion compared to the contralateral untreated ampulla [9]. This hypothesis was also supported by Ohati and Gannon work in 1982, where the microvasculature of the rat vas deferens were studied by corrosion vascular casting/scanning electron microscope method, suggesting the possibility of the vas deferens luminal transport mechanism in relation to prostate maintenance[10].

Pierriepoint's work on the role of vas deferens for maintenance of prostate showed the involvement of luminal transport but his studies suggested deferential veins to play major role while the luminal aspect had significant contribution in maintaining prostate. All these critical studies have shown the role of vas deferens to have a direct and local influence on the maintenance of secondary sex organs situated upstream of vas deferens, which in this case was prostate gland [11-13].

Since, vas deferens access is a minimally invasive process which is basically an out-patient process for human subjects. So, a system that could be injected once or twice in the vas deferens would be more appropriate for a long term delivery of the drug while acting as a drug depot inside the vas. Keeping all these considerations in mind, a novel drug delivery system is required that mediates the delivery of the prostate disease specific drug being encapsulated by the *in vivo* formed nanoparticles inside the vas deferens, to the prostate while acting as a drug depot at the implantation site [14-18].

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