

Original Article

Associations between androgen receptor and tyrosine phosphorylated protein expressions in rat prostate gland

Associações entre a expressão do receptor de andrógeno e proteínas fosforiladas de tirosina na próstata de ratos

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Abstract

Mammalian prostate gland plays a role in alkaline substance synthesis including proteins. These functions are depending on glandular maturation and testosterone-androgen receptor (AR) dependent actions. Since tyrosine phosphorylated (TyrPho) proteins, also important for secreting pathways, have been localized in the androgen dependent organs, association between AR and TyrPho protein expressions in prostate is still unknown. This study aimed to investigate the changes of such proteins in prostate gland of male castrated rats. Nine prepubertal and adult twenty-two adult male rats were divided into the prepubertal (Pre, n=9), Sham (n=6), castrate for 3 (Cas-3, n=8) and for 7 (Cas-7, n=8) days groups, respectively. Serum testosterone level was determined. Histology and AR localization in each prostatic lobe were observed. TyrPho and AR protein expressions were also examined. The results showed undetectable testosterone level and low AR expression in Pre and Cas prostates with the decreased size. Few histopathologies were found in Cas groups. In ventral lobe, a Tyrpho protein was increased at the 48 kDa but the 52, 33, and 26 kDas were decreased in the Pre and Cas groups. For dorsolateral lobe, they were decreased at 33 and 30 kDas in Pre group and only 30 kDa was decreased in Cas-3 group. In the anterior lobe, the TyrPho proteins 57, 49, 39, 30, and 26 kDas were decreased in Pre group while 57, 30, and 26 kDas were decreased in Cas-3 group. In conclusion, the alterations of testosterone level and AR expressions associate with TyrPho protein expressions in prostate gland during development.

Keywords: prepuberty, puberty, castration, histopathology, immunofluorescence.

Resumo

A próstata de mamíferos desempenha um papel na síntese de substâncias alcalinas, incluindo proteínas. Essas funções dependem da maturação glandular e das ações dependentes do receptor de testosterona-andrógeno (AR). Como as proteínas fosforiladas de tirosina (TyrPho), também importantes para as vias de secreção, foram localizadas nos órgãos dependentes de andrógeno, a associação entre as expressões de proteínas AR e TyrPho na próstata ainda é desconhecida. Este estudo teve como objetivo investigar as alterações dessas proteínas na próstata de ratos machos castrados. Nove ratos machos pré-púberes e adultos, vinte e dois adultos, foram divididos nos grupos pré-púberes (Pré, n=9), Sham (n=6), castrados por 3 (Cas-3, n=8) e por 7 (Cas-7, n=8) dias, respectivamente. O nível sérico de testosterona foi determinado. Histologia e localização de AR em cada lobo prostático foram observadas. As expressões de proteína TyrPho e AR também foram examinadas. Os resultados mostraram nível indetectável de testosterona e baixa expressão de AR em próstatas Pre e Cas com tamanho reduzido. Poucas histopatologias foram encontradas em grupos Cas. No lobo ventral, uma proteína TyrPho foi aumentada em 48 kDa, mas 52, 33 e 26 kDas foram diminuídos nos grupos Pre e Cas. Para o lobo dorsolateral, eles foram diminuídos em 33 e 30 kDas no grupo Pre e apenas 30 kDa foram diminuídos no grupo Cas-3. No lobo anterior, as proteínas TyrPho 57, 49, 39, 30 e 26 kDas foram diminuídas no grupo Pre, enquanto 57, 30 e 26 kDas foram diminuídas no grupo Cas-3. Em conclusão, as alterações do nível de testosterona e expressões de AR se associam às expressões da proteína TyrPho na próstata durante o desenvolvimento.

Palavras-chave: pré-puberdade, puberdade, castração, histopatologia, imunofluorescência.

1. Introduction

Prostate gland is the largest accessory gland of male reproductive system and plays an important role in the synthesis and secretion of alkaline substances that are

essential to protect ejaculated sperm from acidic vaginal environment (Singh and Bolla, 2022). Among vertebral animals, the rodent prostate glands are composed of

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four pair lobes including ventral, dorsal, lateral, and anterior (also called coagulating) lobes (Ginja et al., 2019). The development and homeostasis of prostate gland are depending on action of androgens particularly testosterone via androgen receptor (AR) binding in both human and rodents (Fujita and Nonomura, 2019; Vickman et al., 2020; Welén and Damber, 2022). Previously, the AR has been localized in the nuclei of columnar epithelial and stromal cells of the ventral, dorsal, and lateral lobes of rat prostate (Banerjee et al., 2001; Gur and Timurkaan, 2016). Indeed, the AR has been previously described to have the important roles in prostate development and benign prostatic hyperplasia (Vickman et al., 2020). It is known that the AR stimulation activates various protein expressions before translational modifications to response in many biological systems. Therefore, the functional proteins important during prostate development and involved in its secreting still needs to be elucidated.

Tyrosine phosphorylation is a post-translational modification of eukaryotic cell that play a vital role in cell proliferation, cell cycle progression, transcriptional activation, metabolic homeostasis, and organogenesis (Hunter, 2009). In adult rats, the tyrosine phosphorylated (TyrPho) proteins have been localized in structures related to testosterone and AR functions of Leydig cells, Sertoli cells, spermatogonia, and spermatids (Chaichun et al., 2017), epididymal epithelial cell, sperm cells, epididymal fluid (Sawatpanich et al., 2018), seminal epithelial cell and fluid (Tongpan et al., 2019). Moreover, the alterations of AR expression in those structures by toxic agents (alcohol and anti-cancer drug) and infertile conditions (type I and II diabetes and chronic stress) were demonstrated to associate with changes of TyrPho protein expressions (Tongpan et al., 2019; Tangsriskakda and Iamsaard, 2020; Tangsriskakda et al., 2022; Lapyuneyong et al., 2022; Choowong-In et al., 2021a, b). Therefore, these alterations indicate that TyrPho proteins are also involved in decreases of sperm quality, testosterone level, and seminal plasma quality. However, the TyrPho proteins that related to AR expressions in prostate gland development have never been reported and their roles in the potential fertility and tumor biomarkers need to be elucidated. The aim of this study; therefore, was to investigate the association between expressions of TyrPho proteins and AR in different prostatic lobes of prepubertal and adult rats with or without castration.

2. Materials and Methods

2.1. Animal ethic and experimental design

The animal ethic of this study has been approved by the Institutional Animal Care and Use Committee of Khon Kaen University based on the Ethic of Animal Experimentation of National Research Council of Thailand (Record No: IACUC-KKU-145/64). For experimental animal design, the prepubertal (4 weeks old, $n = 9$) and sexually adult (12 weeks old, $n = 22$) male Wistar rats were purchased from the Nomura Siam International (Bangkok, Thailand) before acclimatization at the Northeast Laboratory Animal

Center (Khon Kaen University, Thailand) for 7 days. Then, animals were divided into four groups. The prepuberty (Pre, $n = 9$) group is the juvenile rat and adult sham (Sham-7, $n = 6$) group is the control group. For groups of castration for 3 days (Cas-3, $n = 8$), and for 7 days (Cas-7, $n = 8$) rats were castrated via scrotal wall approach under anesthesia to remove testis, epididymis, and proximal portion of vas deferens (Pérez-Pedraza et al., 2018).

All rats were anesthetized by thiopental sodium injection (60 mg/kgBW, i.p.) before collecting the blood by cardiac puncture. The blood sample was further centrifuged (13,000 rpm, 10 min, 4 °C) to collect the serum for testosterone level determination by radioimmunoassay.

2.2. Measurement of prostatic epithelial height

The ventral, dorsolateral, and anterior lobes of prostate gland were gently removed, weighted, and fixed in the 10% formalin solution before processing paraffin-embedded tissue blocks. Then, prostate tissue blocks were sectioned (5 μ m thickness) by using semi-automatic microtome (ERM 3,100, Heston, Australia). The sections were stained with Mayer's hematoxylin followed by 1% eosin Y aqueous solution (Merck KGaA, Germany) before observed under light microscope (Nikon ECLIPSE E200). The prostatic epithelial height was randomly measured from the basement membrane to the apical surface of the epithelial cells by using the ZEN 2 lite program (ZEISS, Germany) as described in Babinski et al. (2003). The histology of each prostate gland lobe was captured by using AxioCam ICC 5 digital camera (ZEISS, Germany).

2.3. Immunofluorescence staining

The antigens on deparaffinized prostatic sections were retrieved by incubation with citrate buffer (10 mM citric acid, 0.05% Tween-20, pH 6.0) in the microwave (300 watt). After cooling down, the endogenous peroxidase activity was blocked with 30% hydrogen peroxide (H_2O_2 , Merck, Germany) for 20 minutes before blocking the non-specific binding proteins with 3% bovine serum albumin (BSA, Merck, Germany) for 30 minutes at room temperature (Choowong-In et al., 2021b). To localize the androgen receptor (AR), prostate sections were probed with rabbit anti androgen receptor (Merck Millipore Co., USA) diluted in PBS (1:100) at 4 °C for overnight in moist chamber. After washing, the sections were incubated with goat anti-rabbit IgG secondary antibody Alexa Fluor® 488 conjugate (Invitrogen, CA, USA) diluted in PBS, pH 7.4 (1:300) for 30 minutes in the dark moist chamber. The nuclei on tissue sections were stained with Hoechst 33342 (Abcam, UK) diluted in PBS (1:10,000) for 5 minutes. The negative control section was omitted for primary antibody and the fluorescent micrographs were captured under Nikon ECLIPSE 80i fluorescence microscope equipped with Nikon DS Fi1c Camera (Nikon, Japan).

2.4. Western blotting

The total proteins in ventral, dorsolateral, and anterior lobes of prostate gland were extracted in 1x radioimmunoprecipitation assay (RIPA) buffer (Cell Signaling Technology Inc.) with cocktails of protease

inhibitors (Sigma-Aldrich, Inc.) as described in Tangsriskda and Iamsaard (2020). The protein samples (150 µg) were loaded before separating on sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). Then, all proteins were transferred onto the nitrocellulose membrane (Bio-Rad Laboratories, Inc., Germany). The non-specific proteins were blocked with 5% BSA dissolved in 0.1% TBST (TBS and Tween 20). Subsequently, the proteins membranes were incubated with rabbit androgen receptor (AR) antibody (1:2,500; Abcam) and mouse anti-phosphotyrosine (1:2,000; Merck Millipore Co.) at 4 °C for overnight (Tangsriskda et al., 2022). After washing, the membranes were incubated with the rabbit secondary antibody conjugated with horseradish peroxidase (HRP; Merck) for anti-AR and anti-mouse secondary antibody conjugated with HRP (Merck Millipore Co.) for anti-phosphotyrosine for 1 hour. The epidermal growth factor (EGF) was used as positive control, whereas the BSA was used as negative control. Then, all membranes were washed with 0.05% PBST before visualizing the immunoreactivities by using the Enhanced Chemiluminescence (ECL) Substrate Reagent Kit (GE Healthcare Life Sciences) and detected by using Gel Documentation 4 (ImageQuant 400, GH Healthcare).

2.5. Statistical analysis

The data were expressed as mean ± standard deviation (SD). The data were analyzed with one-way ANOVA and followed by post hoc LSD test. Statistical analyses were performed by using the IBM SPSS 19.0 software (Statistical

Package for the Social Sciences, version 19.0, SPSS Inc, downloaded and installed from KKKU Software Center, Khon Kaen University). The *p*-value < .05 was considered as significant difference among groups.

3. Results

3.1. Deceased body and prostate glands weight in castrated-rat groups

Table 1 showed that the body and adrenal gland weights of Pre group were significantly decreased as compared to the Sham-7 group. The prostate gland (ventral, dorsolateral, and anterior lobes) weights of Pre, Cas-3, and Cas-7 groups were significantly decreased as compared to the Sham-7 group (Table 1, Figure 1). However, the serum testosterone levels were undetectable in the Pre, Cas-3, and Cas-7 groups (Table 1).

3.2. Decrease of prostatic epithelial height in Pre and castrated rats

The epithelial heights of ventral, dorsolateral, and anterior prostate glands were significantly decreased in the Pre, Cas-3, and Cas-7 groups as compared to the Sham-7 group (Figure 2).

3.3. Histopathology in the prostatic tissue of castrated rats

As compared to the Sham-7 group, the histopathologies of prostatic tissue in both castrated groups (days 3 and 7,

Table 1. The comparisons of weights of rat body, prostate glands, and adrenal glands weights, and serum testosterone levels among Pre, Sham-7, Cas-3, and Cas-7 groups.

Parameters	Groups			
	Prepuberty (Pre)	Puberty		
		Sham-7	Cas-3	Cas-7
Body weight (g)	108.67 ± 3.30**	365.53 ± 12.53	361.26 ± 10.86	363.65 ± 11.22
Prostate gland weight				
Ventral lobe				
Absolute weight (g)	0.061 ± 0.023**	0.425 ± 0.062	0.186 ± 0.040**	0.067 ± 0.019**
Relative weight (g/100g)	0.056 ± 0.020**	0.107 ± 0.013	0.053 ± 0.010**	0.018 ± 0.005**
Dorsolateral lobe				
Absolute weight (g)	0.015 ± 0.009**	0.232 ± 0.095	0.126 ± 0.026**	0.091 ± 0.020**
Relative weight (g/100g)	0.013 ± 0.008**	0.058 ± 0.023	0.036 ± 0.008*	0.025 ± 0.006**
Anterior lobe				
Absolute weight (g)	0.005 ± 0.002**	0.087 ± 0.015	0.061 ± 0.012**	0.043 ± 0.005**
Relative weight (g/100g)	0.004 ± 0.002**	0.022 ± 0.003	0.017 ± 0.003*	0.012 ± 0.002**
Adrenal gland				
Absolute weight (g)	0.015 ± 0.002**	0.036 ± 0.011	0.031 ± 0.009	0.032 ± 0.004
Relative weight (g/100g)	0.014 ± 0.002**	0.009 ± 0.003	0.009 ± 0.003	0.009 ± 0.001
Testosterone levels (ng/ml)	Undetectable	4.908 ± 1.100	Undetectable	Undetectable

p* < 0.01; *p* < 0.001 compared to the sham group.

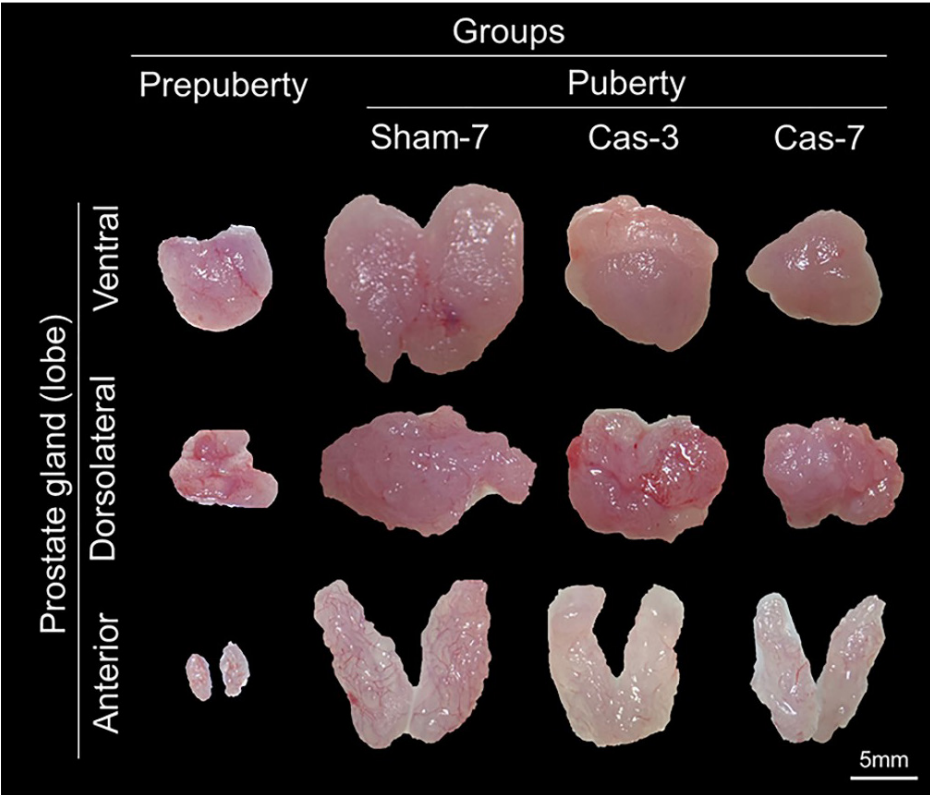


Figure 1. Showing the sizes of ventral, dorsolateral, and anterior lobes of rat prostate gland compared among the prepuberty, Sham-7, Cas-3, and Cas-7 groups.

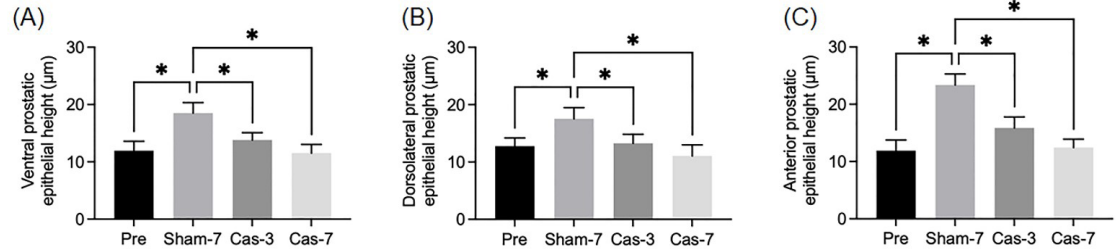


Figure 2. Comparison of epithelial height of ventral (A), dorsolateral (B), and anterior (C) prostate glands among groups. * $p < 0.01$ compared to the Sham-7 group.

shown in the Figure 3) revealed the vacuolization on its epithelium (Figure 3C, H and L) and the sloughing cells within the prostatic lumen (Figure 3D and K). Moreover, the prostatic intraepithelial neoplasia (PIN) was found in all prostate lobes of both castrated groups (Figure 3C, H and L). However, these histopathologies observed in the castrated rats were not investigated in the Pre group (Figure 3A, E and I).

3.4. Androgen receptor expression in prostate lobes of castrated rats

The immunofluorescent results showed AR expressions in the cytoplasm of some columnar epithelial cells and

stromal tissue of ventral prostate gland in all groups (Figure 4). However, the stroma of Cas-7 group obviously presented the AR expression as compared to the Cas-3 group (Figure 4K, L). Similar to the ventral lobe, other prostate lobes also revealed the same patterns of such the AR expression.

As shown in the Figure 5A-C, the AR expressions in the ventral, dorsolateral, and anterior groups were obviously decreased in the both Pre and Cas-3 groups when compared to that of Sham-7 group. These results are significantly associated to their relative intensity of AR expression. In the dorsolateral and anterior glands, its expression in

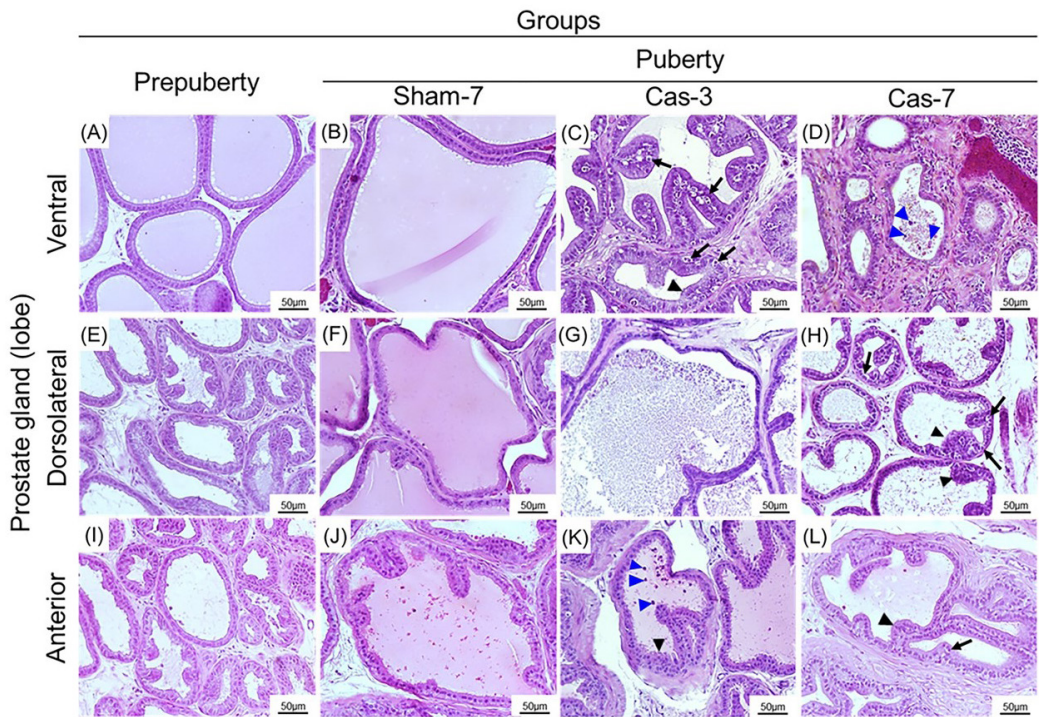


Figure 3. Histopathologies of ventral (A-D), dorsolateral (E-H), and anterior (I-L) prostate glands observed in the both castrated groups compared to the Sham-7 group. Arrow, vacuolization; blue arrowhead, sloughed cells; black arrowhead, prostatic intraepithelial neoplasia (PIN).

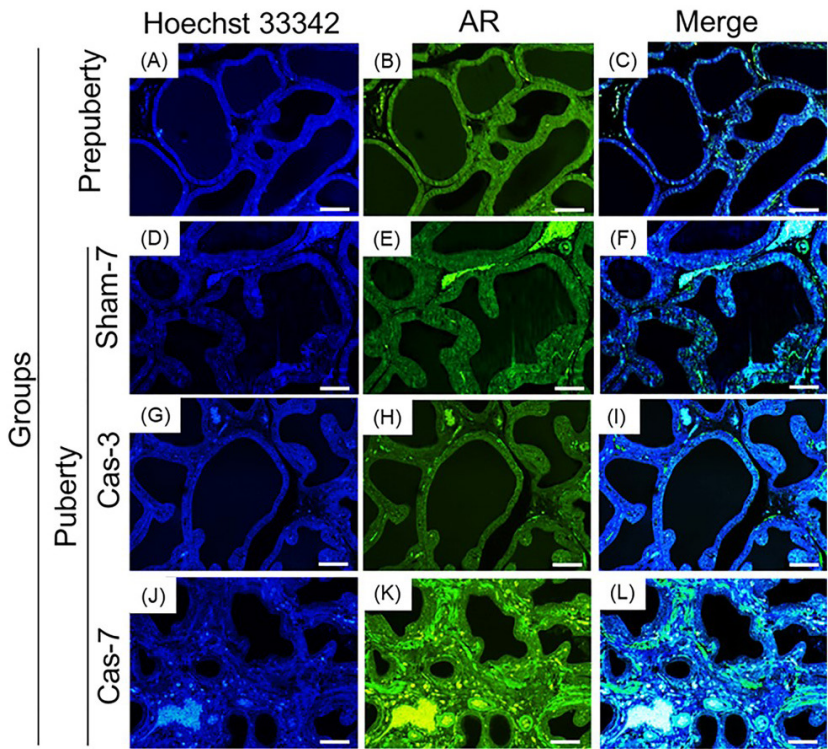


Figure 4. Immunofluorescence localization of androgen receptor (AR, green fluorescence) in the ventral prostatic gland (E-L) compared among Pre, Sham-7, Cas-3, and Cas-7 groups, respectively. Hoechst 33342 (blue fluorescence) used as counterstaining. Scale bar, 50 µm.

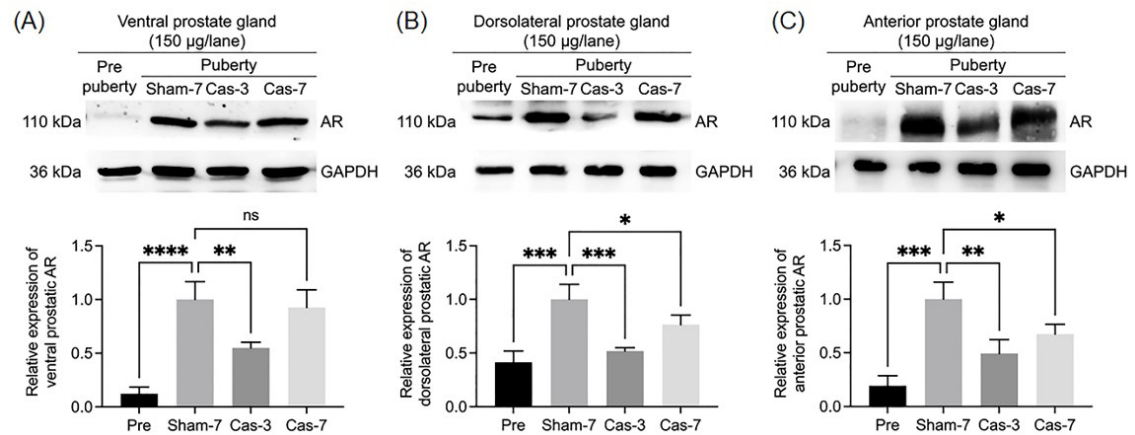


Figure 5. Immuno-Western blotting of AR expressions in the rat ventral (A), dorsolateral (B), and anterior (C) prostate lobes compared among Pre, Sham-7, Cas-3, and Cas-7 groups. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$ compared to the Sham-7 group. GAPDH, glyceraldehyde-3-phosphate dehydrogenase used as internal control; kDa: kilodalton; ns: not significant.

Cas-7 group was significantly decreased as compared to the Sham-7 group (Figure 5B).

3.5. Alterations of TyrPho proteins expression in castrated rats

The intensities of TyrPho proteins of ventral prostate in the Pre and Cas-3 groups were significantly decreased at the 52, 33, and 26 kDas as compared to Sham-7 group. In contrast, a 48 kDa TyrPho protein in the Pre, Cas-3, and Cas-7 groups was significantly increased as compared to the Sham-7 group (Figure 6). In pre group, a 39 kDa had significantly lowered intensity but increased in Cas-3 and Cas-7 groups (Figure 6).

As shown in the Figure 7, the 33 and 30 kDas TyrPho proteins in the Pre group and 30 kDa in Cas-3 group of dorsolateral prostate were significantly decreased as compared to the Sham-7 group.

In Pre and Cas-3 groups, anterior prostate gland had obvious decrease of TyrPho expressions at 57, 30, and 26 kDas as compared to the Sham-7 group. Moreover, those of the 49 and 39 kDas in Pre group and of 57 kDa in Cas-7 group were significantly decreased when compared to Sham-7 group (Figure 8).

4. Discussion

The prostate gland is an androgen dependent organ in male reproductive system, responsible for alkaline and protein productions to be contained in the seminal plasma. Such property of prostatic fluid can neutralize the acidic condition within vagina to protect newly ejaculated sperm (Singh and Bolla, 2022). In difference from human, the rodent prostate gland classified into four lobes including ventral, dorsal, lateral, and anterior lobes (Ginja et al., 2019). It is known that development and functional maturation of all mammalian prostate glands are depending on the levels of androgens and AR expression (Shin et al., 2012; Banerjee et al., 2018). Therefore, the testosterone insufficiency after castration,

in this study, leads to the decrease of prostatic size with increase of histopathologies.

This study demonstrated that the AR localization in the stromal prostatic tissue of ventral, dorsolateral, and anterior lobes which agreed with the previous studies (Shin et al., 2012; Banerjee et al., 2018). AR and testosterone binding is essential for prostatic development from embryonic to adult period. This has been improved when AR gene was deleted, resulting in prostate development failure (Vickman et al., 2020). Moreover, the AR expression in the ventral, dorsolateral, and anterior lobes was downregulated after castration for 3 days which is corroborated with the markedly decrease of testosterone level. In contrast, these expressions in all lobes were tended to be upregulated by 7 days after castration but did not reach to that level of Sham-7 group. These results were similar to a previous study of Banerjee et al. (2001). The increase of AR expression of the Cas-7 prostate gland might to maintain the prostatic functions after dramatical decreasing of testosterone level.

It has been reported that the testosterone reduction by many infertile conditions can change the AR and TyrPho protein expressions (Iamsaard et al., 2023; Sukhorum and Iamsaard, 2017; Burawat et al., 2018; Chaichun et al., 2017; Tongpan et al., 2019; Tangsriskda et al., 2022). Indeed, the TyrPho protein expressions (52, 48, 33, and 26 kDas) in our study were also altered after castration. In the ventral lobe, those TyrPho proteins changes were related to the AR alteration. We assumed that such proteins are involved in the development and function of ventral prostate by AR pathway. All TyrPho proteins detected in this study have been observed to have the frequency of tyrosine (Tyr or Y) on their own amino acid sequences by using protein databases in the NCBI homepage.

It was possible that a 52 kDa protein found in our study was the clusterin, a major glycoprotein present in the testis, epididymis, seminal vesicles, prostate gland, and the mammalian semen (Lam et al., 2008; Han et al., 2012; Rodríguez-Rivera et al., 2021). It was also known as the testosterone-repressed prostate message (TRPM-2) (Léger et al., 1987; Cochrane et al., 2007). This protein

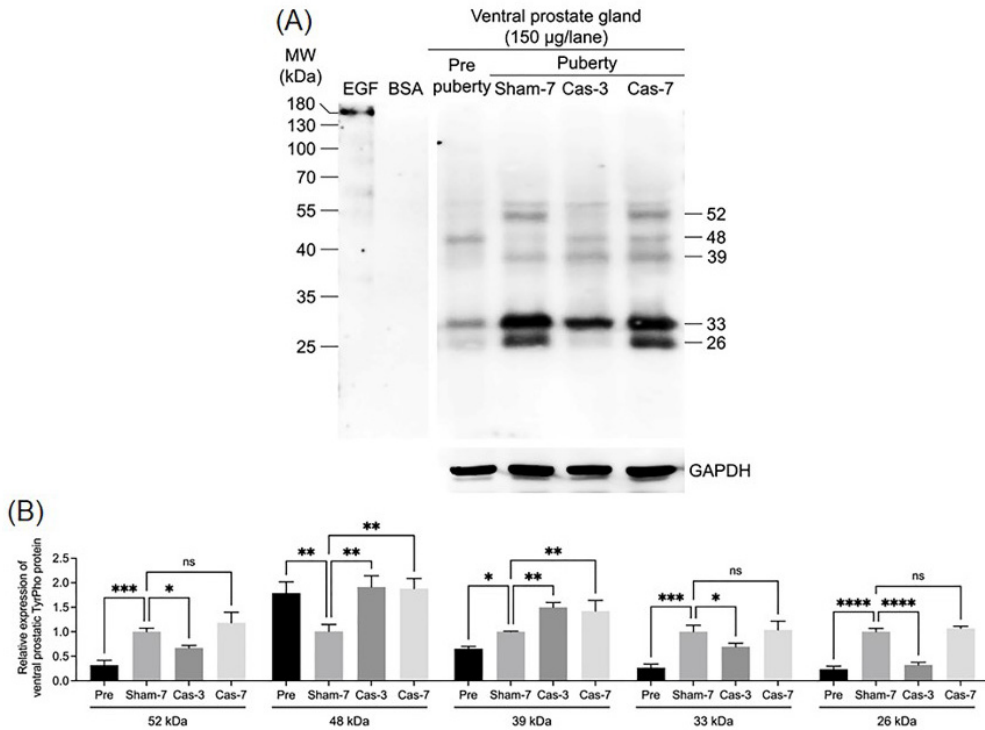


Figure 6. Western blotting of anti-TyrPho proteins compared among groups (A). Intensity of TyrPho proteins of ventral prostate gland (B). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$ compared to Sham-7 group. GAPDH, glyceraldehyde-3-phosphate dehydrogenase used as internal control; kDa: kilodalton; ns: no significance.

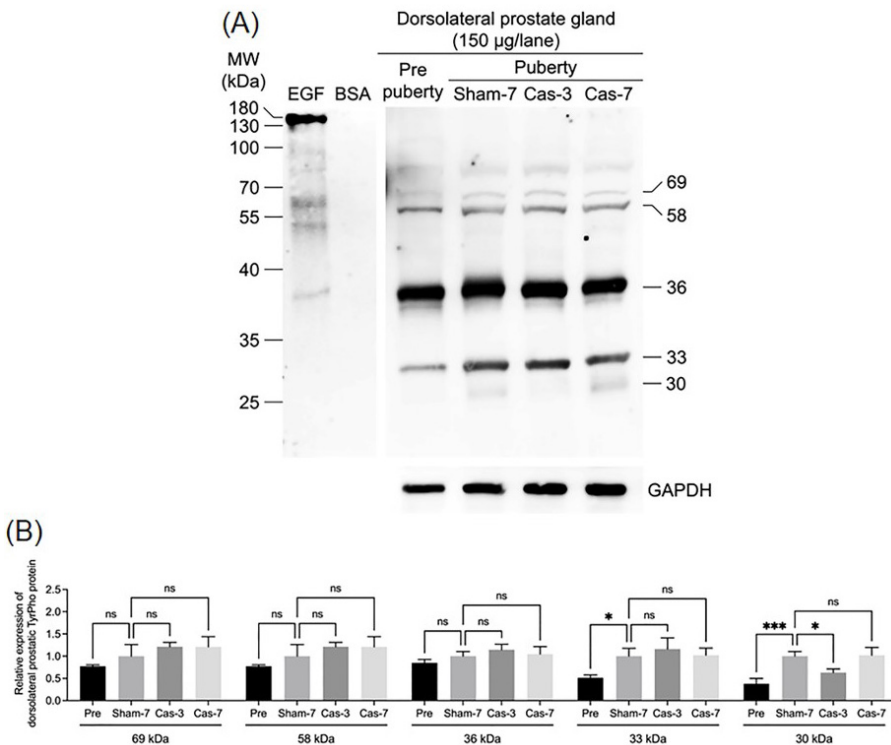


Figure 7. Western blotting of TyrPho proteins compared among groups (A). Intensity of TyrPho proteins of dorsolateral prostate gland (B). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$ compared to Sham-7 group. GAPDH, glyceraldehyde-3-phosphate dehydrogenase used as internal control; kDa: kilodalton; ns: no significance.

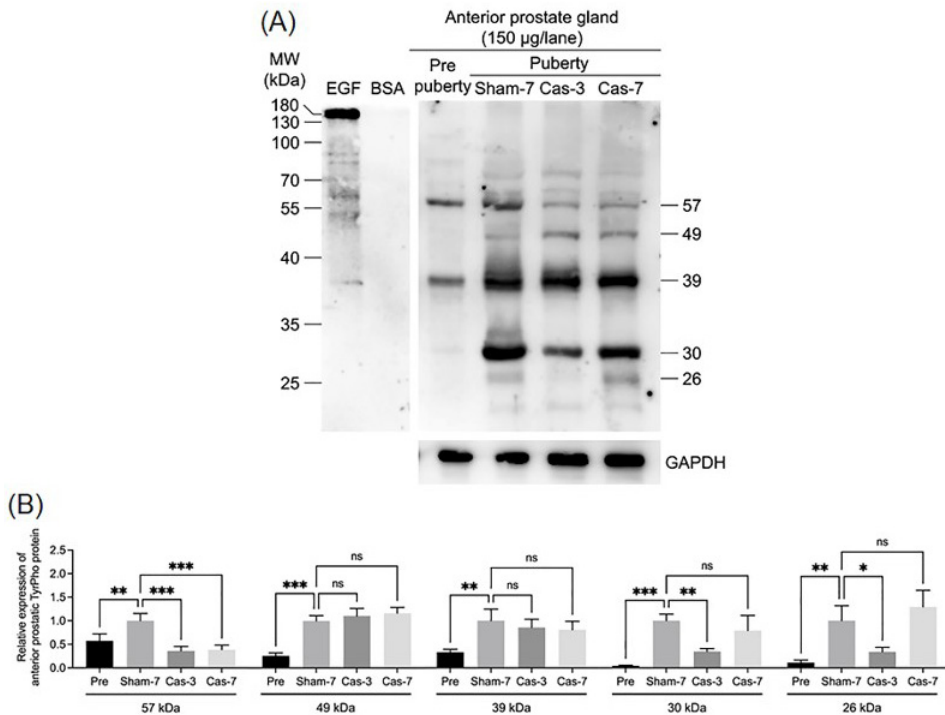


Figure 8. Western blotting of TyrPho proteins compared among groups (A). Intensity of TyrPho protein expressions of anterior prostate gland (B). *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0.0001 compared to the Sham-7 group. GAPDH, glyceraldehyde-3-phosphate dehydrogenase used as internal control; kDa: kilodalton; ns: no significance.

played a role in the semen liquefaction to interact with the epididymal protease inhibitor (called eppin) presented on the sperm surface during capacitation, and in the female reproductive tract (Janiszewska and Kratz, 2020; Janiszewska et al., 2021). In this study, the expression of this relative-clusterin protein was decreased in Cas groups, indicating its expression based on AR action. Léger et al. (1987) showed that the clusterin mRNA levels were markedly increased in the ventral prostate gland after castration to compensate its functions. In addition, androgen ablation therapy in the patients with prostate cancer can upregulate the clusterin level (July et al., 2002; Matsumoto et al., 2013). Increased expression of this protein in our work was also possibly to sustain the prostatic functions.

A 48 kDa protein band is possible to be the T-kininogen, the kinin precursor protein for found in only rats (Rhaleb et al., 2011). It was shown to enhance the sperm motility (Bosler et al., 2014). Insufficiency of this protein in castrated group may imply low sperm motility in men with AR deficiency.

Additionally, a 39 kDa found herein might be arylsulfatase A (ARSA) involved in sperm-oocyte recognition (Nixon et al., 2015; Gómez-Torres et al., 2021). This protein expression was increased after sperm capacitation (Gómez-Torres et al., 2021). Significantly, increased expression of this protein in castrated prostate gland is still unexplained.

It was supposed that the proteins of 33 kDa and 26 kDa TyrPho protein were the spermidine synthase (Cyriac et al., 2002; Ikeguchi et al., 2006) and glutathione

S-transferase (GST) (Llavanera et al., 2020), respectively. Whereas spermidine synthase is known to play roles in the sperm motility and acrosome reaction (Lefèvre et al., 2011; Singh et al., 2017; Wang et al., 2022), the GST is involved in cell detoxification and sperm capacitation (Llavanera et al., 2020). These protein functions are associated with androgen level (Cyriac et al., 2002).

Moreover, the glutathione S-transferase Mu 3 (GSTM3) also has a molecular weight of 26 kDa TyrPho protein band found in ventral lobe and in seminal plasma, playing roles in sperm mitochondrial activity, acrosome reaction, sperm-zona pellucida binding, and reactive oxygen species (ROS) detoxification (Harper and Speicher, 2011; Llavanera et al., 2020). It was shown to be increased in varicocele patients (Agarwal et al., 2015). These TyrPho protein expressions were increased after castration for 7 days, indicating overactivated prostate functions to support ejaculated sperm after castration.

For the dorsolateral lobe, a 30 kDa TyrPho protein has various tyrosine residues with same molecular weight of apolipoprotein A-I (ApoA1), which facilitating of sperm cholesterol stability and motility, survival rate, and fertilization process (Chi et al., 2022). A 33 kDa might be the spermidine synthase also detected in the ventral lobe. However, the expression of this protein was not different in the dorsolateral lobe of all Cas groups. Banerjee et al. (2001) reported that the androgen has more affected on the ventral than the dorsolateral lobe.

The anterior prostate lobe secretes the many proteins and fructose-rich secretions to form semen coagulation and to

stimulate sperm motility (Adebayo et al., 2015; Ginja et al., 2019). In recent study, the alterations of TyrPho protein expressions of castrated groups may lead to the change of various secretion components leading to decrease of sperm physiological functions. Particularly, a protein disulfide isomerase has 57 kDa form found on sperm membrane for sperm-oocyte fusion (Ellerman et al., 2006). The dramatical reduction of AR might lead to decrease the ability of gamete fusion. Moreover, the 30 and 26 kDa TyrPho proteins found to contain many tyrosine residues in these lobes were ApoA1 and GST or GSTM3, respectively. It is possible that the ventral and dorsolateral lobes have roles to produce secreted proteins into ejaculated semen for sperm physiology and detoxification.

5. Conclusion

In conclusion, this study has demonstrated the association of testicular androgen to tyrosine phosphorylation changes of proteins expression secreted from the prostate gland. Possibly, some of TyrPho proteins in the prostate gland found in this recent study can be potential fertility or tumor biomarkers in the urology and andrology clinic.

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