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Molecular Detection of Human Cytomegalovirus in Renal Failure Patients Using RT-Qpcr

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Abstract. This study aimed to detect Human Cytomegalovirus (CMV) in patients with renal failure using RT-qPCR. A total of 100 blood and serum samples were collected from July to September 2023 from individuals aged 1 to 80 years. The RT-qPCR technique revealed 79 positive cases of CMV infection. The study population was divided into five age groups, with the 51–67 age group showing the highest infection rate (29.11%). Infections were more common in females (41 cases) than in males (38 cases). The use of real-time PCR demonstrated a rapid, sensitive, and specific diagnostic tool for CMV, especially among immunocompromised patients. These findings suggest a significant association between CMV infection and renal failure, emphasizing the need for molecular testing in clinical diagnostics. The study provides valuable epidemiological insight and supports the implementation of RT-qPCR for detecting CMV in Iraqi healthcare settings.

Highlights:

1. RT-qPCR detected CMV infection in 79% of renal failure patients, confirming its high prevalence.
2. Older adults (51–67 years) showed the highest infection rate, with females slightly more affected than males.
3. RT-qPCR proved to be a rapid, sensitive, and reliable diagnostic tool for CMV detection in immunocompromised patients.

Keywords: Cytomegalovirus, renal failure, RT-qPCR, CMV infection, molecular diagnostics.

Product Description

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This study uses RT-qPCR to detect Human Cytomegalovirus in renal failure patients, revealing a high infection rate, especially among older adults. The results highlight the importance of molecular diagnostics in managing viral infections in immunocompromised populations.

Introduction

Human Cytomegalovirus (HCMV), a member of the Herpesviridae family, is a widespread pathogen with a global seroprevalence ranging between 50% and 85% among adults [1]. Its prevalence varies depending on geographic location, age, and immunological status. While CMV infection is typically asymptomatic in immunocompetent individuals, it poses serious risks for immunocompromised patients, particularly those with renal failure [2,3],

CMV can establish lifelong latency and is capable of reactivation, especially under conditions of immune suppression such as organ transplantation, malignancy, or chronic diseases like kidney failure [4,5]. In renal failure patients, CMV contributes not only to direct viral pathology but also to secondary complications such as anemia, inflammation, and reduced immune competence [6]. Studies have shown that early and accurate detection of CMV in such patients can significantly improve clinical outcomes [7].

Real-time quantitative PCR (RT-qPCR) has emerged as a gold standard for detecting CMV due to its high sensitivity, specificity, and ability to quantify viral load [8]. This method enables early diagnosis and monitoring of CMV infections, particularly crucial in patients undergoing dialysis or immunosuppressive therapy[9].

This study aims to investigate the prevalence of CMV among renal failure patients using RT-qPCR, providing insights into age and gender-related infection patterns and highlighting the importance of molecular diagnostics in clinical nephrology.

Materials and Methods

A case-control study was conducted on 100 blood and serum samples collected from patients diagnosed with chronic renal failure between July and September 2023. The study population included 52 females and 48 males, aged between 1 and 80 years. Verbal consent was obtained from all participants prior to sample.

Real-Time qPCR Technique

Human Cytomegalovirus (HCMV) was detected using the Real-Time Quantitative Polymerase Chain Reaction (RT-qPCR) method. Primers were designed based on NCBI reference sequences[10,11,]. DNA was extracted using the gSYNC DNA Extraction Kit (Geneaid, USA), and amplification was

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performed using the GoTaq qPCR Master Mix (abm, Canada). PCR reactions were carried out using two platforms: The Analytik Jena qTOWER³ G device at Al-Hakim Hospital for Advanced Research and Biotechnology, and the BIO-RAD CFX96 system at the Public Health Laboratory[12,13,14].

The primer sequences used were:
- Forward: TCAAAACCACCGTGACAAGC
- Reverse: ACAACGTGCTACGAAAGTGC
The amplified product size was 113 bp, specific for HCMV DNA.

Table 1: Primer Information for Human Cytomegalovirus Detection.

Primer		Sequence	PCR Product size
Human ytomegalovirus prime	Reverse	ACAACGTGCTACGAAAGTGC	113 bp
	Forward	TCAAAACCACCGTGACAAGC	

Results

Out of 100 patient samples analyzed using RT-qPCR, 79 samples tested positive for Human Cytomegalovirus, while 21 were negative. The results revealed a higher prevalence of infection in females (41 cases) compared to males (38 cases). When stratified by age, the 51–67-year age group exhibited the highest infection rate (29.11%), followed by the 34–50-year group at 27.84%. The youngest age group (1–16 years) had the lowest infection rate at 12.65%.

These findings indicate a notable correlation between age and CMV positivity, with older individuals being more susceptible. The study confirms the utility of RT-qPCR as a sensitive and reliable diagnostic tool for detecting HCMV in immunocompromised populations, particularly those suffering from chronic renal failure [15] [16].

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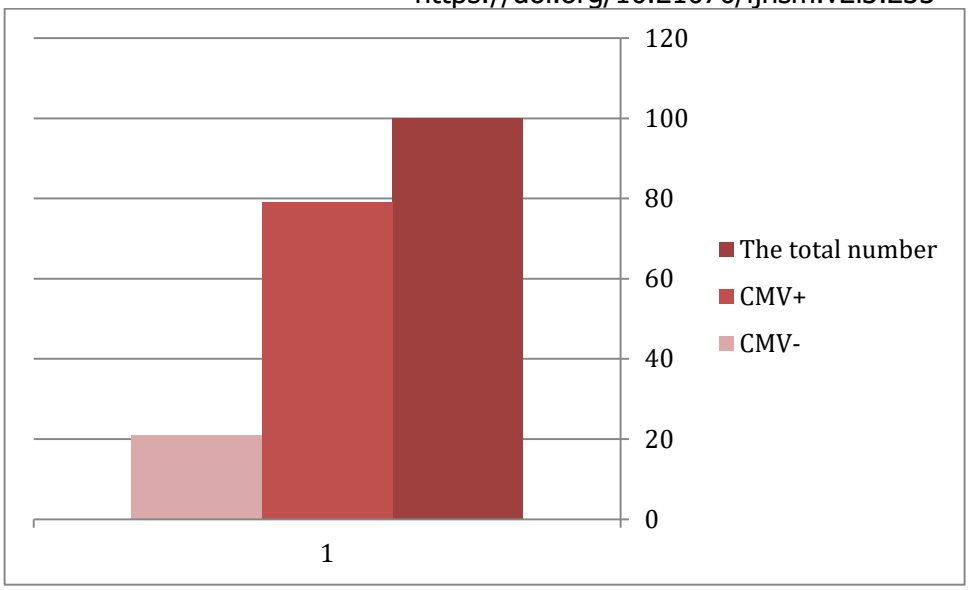

Figure 1: Positive and negative of cases of Human Cytomegalovirus

Table 2: Results of Infected Patients Distributed by Gender

Virus	The results	Percentage
CMV	33	48.1
CMV	41	51.89

Table 3: The distribution of patients according to age groups

Age group	CMV	The results
1-16 years	10	12.65

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17-33 years	12	15.18
34-50 years	22	27.84
51-67 years	23	29.11
68-84 years	12	15.18

Figure 2: Real time PCR technique

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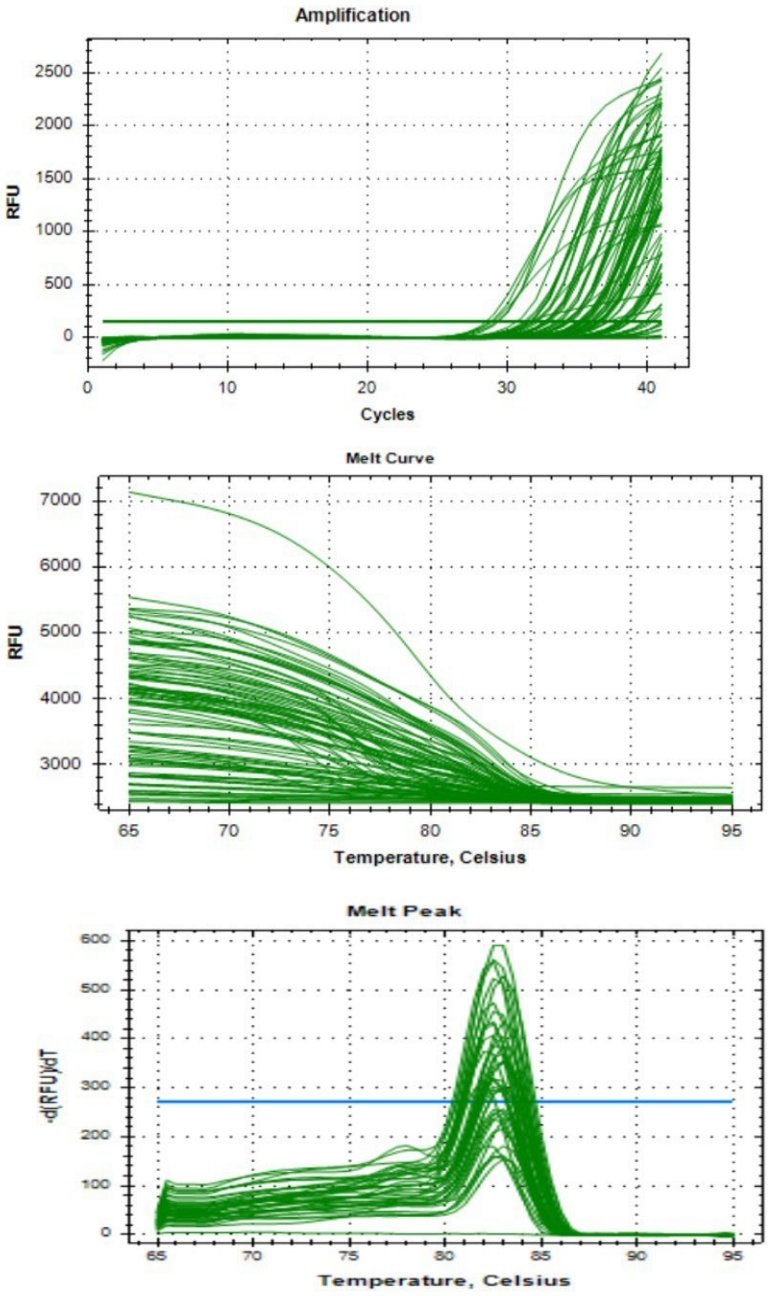

Figure 3: Detection of cytomegalovirus by RT-qPCR qPCR

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Conclusion

The present study highlights the high prevalence of Human Cytomegalovirus (HCMV) infection among patients with chronic renal failure, particularly in older age groups. The application of real-time quantitative PCR (RT-qPCR) proved to be a highly sensitive and specific method for the rapid detection of CMV DNA, offering a reliable diagnostic approach for immunocompromised individuals. The results showed a slightly higher infection rate among females and a clear association between increasing age and CMV positivity. These findings emphasize the importance of implementing molecular diagnostic techniques such as RT-qPCR in clinical settings to enable early detection, proper monitoring, and improved management of CMV infections in renal failure patients.

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