CHAPTER 5

RENAL ALLOGRAFT BIOPSY

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5.1 Introduction

- Renal allograft biopsy remained an important diagnostic tool for allograft dysfunction.
- A total of 34 centres performed renal allograft biopsies.
- There were 4 major transplant centres in the country namely University Malaya Medical Centre (UMMC), Hospital Kuala Lumpur (HKL), Prince Court Medical Centre and Selayang Hospital.

5.2 Allograft renal biopsy

- UMMC contributed to more than a quarter (26.9%) of all allograft biopsies between 2005 to 2022, followed by HKL (Adult) 21.4%, Prince Court Medical Centre 17.8% and Selayang Hospital (Adult) 13.4% (Table 5.2.1).
- The majority of patients had one allograft biopsy and 24.3% underwent 2 biopsies (Table 5.2.2).
- There were more male (65.2%) had allograft biopsies (Table 5.2.3). This is consistent with the proportion of male who had a kidney transplant in the country.
- Most of the patients who underwent renal allograft biopsies were Chinese, 34.8% were Malay, 9.3% were Indian and others (5.1%) (Table 5.2.4).
- Almost all of the centres obtained >10 glomeruli in biopsies (which is considered as adequate specimen), except for a few centres that performed very few biopsies over the years (Table 5.2.5).
- Majority of patients were young as most patients who had a kidney transplant were in these age groups (Table 5.2.6 and Figure 5.2.1).

Table 5.2.1: Distribution of reported graft renal biopsies by centre, 2005-2022

Centre	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
UMMC	64	11.1	280	23.7	502	34.8	106	36.2	38	22.0	63	24.9	1053	26.9
Kuala Lumpur (Adult)	203	35.2	186	15.7	339	23.5	63	21.5	24	13.9	23	9.1	838	21.4
Prince Court Medical Centre	7	1.2	277	23.4	287	19.9	45	15.4	34	19.7	48	19.0	698	17.8
Selayang Hospital (Adult)	115	20	182	15.4	119	8.3	28	9.6	26	15.0	55	21.7	525	13.4
Pulau Pinang (Adult)	31	5.4	40	3.4	40	2.8	12	4.1	6	3.5	3	1.2	132	3.4
Kuala Lumpur (Paed)	52	9.0	35	3.0	13	0.9	0	0	0	0	0	0	100	2.6
Tengku Ampuan Rahimah	47	8.2	27	2.3	6	0.4	3	1.0	0	0	0	0	83	2.1
PPUKM	0	0	33	2.8	18	1.2	0	0	2	1.2	3	1.2	56	1.4
Sultanah Bahiyah	6	1.0	26	2.2	13	0.9	0	0	2	1.2	3	1.2	50	1.3
Sarawak General	14	2.4	15	1.3	13	0.9	4	1.4	4	2.3	3	1.2	53	1.4
Melaka Hospital	4	0.7	13	1.1	9	0.6	1	0.3	4	2.3	7	2.8	38	1.0
Queen Elizabeth	9	1.6	3	0.3	13	0.9	5	1.7	7	4.0	8	3.2	45	1.1
Serdang Hospital	3	0.5	11	0.9	5	0.3	2	0.7	4	2.3	2	0.8	27	0.7
Sultan Ismail (Paed)	3	0.5	12	1.0	2	0.1	0	0	0	0	0	0	17	0.4
Tengku Ampuan Afzan	0	0	4	0.3	12	0.8	3	1.0	1	0.6	2	0.8	22	0.6
Tuanku Ja'afar (Adult)	5	0.9	5	0.4	8	0.6	4	1.4	1	0.6	3	1.2	26	0.7
Sultanah Aminah	4	0.7	9	0.8	5	0.3	5	1.7	5	2.9	9	3.6	37	0.9
Raja Permaisuri Bainun	5	0.9	4	0.3	2	0.1	1	0.3	6	3.5	3	1.2	21	0.5
Selayang (Paed)	1	0.2	2	0.2	5	0.3	0	0	0	0	0	0	8	0.2
Pakar Sultanah Fatimah (Muar)	0	0	5	0.4	3	0.2	5	1.7	3	1.7	4	1.6	20	0.5
KPJ Ampang Puteri	1	0.2	3	0.3	2	0.1	0	0	0	0	0	0	6	0.2
Pulau Pinang (Paed)	1	0.2	2	0.2	1	0.1	0	0	1	0.6	1	0.4	6	0.2
Sultanah Nur Zahirah	0	0	1	0.1	2	0.1	0	0	0	0	0	0	3	0.1
Miri Hospital	0	0	1	0.1	2	0.1	1	0.3	0	0	0	0	4	0.1
Sultanah Nora Ismail	0	0	0	0	2	0.1	0	0	1	0.6	2	0.8	5	0.1
Normah Medical Specialist	0	0	2	0.2	0	0	0	0	0	0	0	0	2	0.1
Fan Medical Renal Clinic	0	0	2	0.2	2	0.1	0	0	0	0	0	0	4	0.1
Loh Guan Lye Specialist	0	0	2	0.2	0	0	0	0	0	0	0	0	2	0.1
Tuanku Ja'afar (Paed)	0	0	1	0.1	0	0	0	0	0	0	0	0	1	0
Raja Perempuan Zainab II	1	0.2	0	0	2	0.1	1	0.3	0	0	0	0	4	0.1
Hospital Tunku Azizah (Paed)	0	0	0	0	9	0.6	4	1.4	4	2.3	9	3.6	26	0.7
Hospital Wanita Dan Kanak-kanak Sabah	0	0	0	0	3	0.2	0	0	0	0	0	0	3	0.1
Kulim Hospital	0	0	0	0	2	0.1	0	0	0	0	0	0	2	0.1
'Pusat Perubatan Sunway Velocity	0	0	0	0	0	0	0	0	0	0	2	0.8	2	0.1

Table 5.2.2: Distribution of graft renal biopsy in patients by number of episodes, 2005-2022

Year	2005-2009 (n=470)		2010-2014 (n=800)		2015-2019 (n=992)		2020 (n=215)		2021 (n=132)		2022 (n=187)		Total (n=2796)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1st episode	284	60.4	362	45.3	315	31.8	75	34.9	51	38.6	86	46.0	1173	42.0
2nd episode	121	25.7	214	26.8	224	22.6	51	23.7	31	23.5	38	20.3	679	24.3
3rd episode	39	8.3	102	12.8	156	15.7	40	18.6	22	16.7	26	13.9	385	13.8
4th episode	26	5.5	122	15.3	297	29.9	49	22.8	28	21.2	37	19.8	559	20

Table 5.2.3: Gender distribution of renal allograft biopsy, 2005-2022

Gender	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Male	373	64.8	785	66.4	950	65.9	183	62.5	111	64.2	155	61.3	2557	65.2
Female	203	35.2	398	33.6	491	34.1	110	37.5	62	35.8	98	38.7	1362	34.8

Table 5.2.4: Racial distribution of renal allograft biopsy, 2005-2022

Race	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Malay	199	34.5	333	28.1	510	35.4	121	41.3	87	50.3	113	44.7	1363	34.8
Chinese	294	51.0	648	54.8	755	52.4	125	42.7	62	35.8	109	43.1	1993	50.9
Indian	56	9.7	113	9.6	122	8.5	32	10.9	17	9.8	25	9.9	365	9.3
Others	27	4.7	89	7.5	54	3.7	15	5.1	7	4.0	6	2.4	198	5.1

Table 5.2.5: Number of glomeruli obtained at each renal allograft biopsy by centres, 2005-2022

Total number of glomeruli	**<10 (n=1101)**		**≥10 (n=2680)**		**Missing (n=138)**		**Total (n=3919)**	
Centre	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
UMMC	364	34.6	653	62.0	36	3.4	1,053	100
Kuala Lumpur (Adult)	186	22.2	641	76.5	11	1.3	838	100
Prince Court Medical Centre	106	15.2	574	82.2	18	2.6	698	100
Selayang Hospital (Adult)	163	31.0	339	64.6	23	4.4	525	100
Pulau Pinang (Adult)	56	42.4	75	56.8	1	0.8	132	100
Kuala Lumpur (Paed)	23	23.0	77	77.0	0	0	100	100
Tengku Ampuan Rahimah	29	34.9	54	65.1	0	0	83	100
PPUKM	30	53.6	23	41.1	3	5.4	56	100
Sultanah Bahiyah	21	42.0	29	58.0	0	0	50	100
Sarawak General	20	37.7	33	62.3	0	0	53	100
Melaka Hospital	13	34.2	24	63.2	1	2.6	38	100
Queen Elizabeth	6	13.3	16	35.6	23	51.1	45	100
Serdang Hospital	3	11.1	24	88.9	0	0	27	100
Sultan Ismail (Paed)	11	64.7	6	35.3	0	0	17	100
Tengku Ampuan Afzan	3	13.6	13	59.1	6	27.3	22	100
Tuanku Ja'afar (Adult)	8	30.8	14	53.8	4	15.4	26	100
Sultanah Aminah	22	59.5	15	40.5	0	0	37	100
Raja Permaisuri Bainun	3	14.3	10	47.6	8	38.1	21	100
Selayang Hospital (Paed)	7	87.5	1	12.5	0	0	8	100
Hospital Pakar Sultanah Fatimah (Muar)	11	55.0	9	45.0	0	0	20	100
KPJ Ampang Puteri	2	33.3	4	66.7	0	0	6	100
Pulau Pinang (Paed)	2	33.3	4	66.7	0	0	6	100
Sultanah Nur Zahirah	1	33.3	2	66.7	0	0	3	100
Miri Hospital	2	50	1	25.0	1	25.0	4	100
Sultanah Nora Ismail	2	40	3	60	0	0	5	100
Normah Medical Specialist	0	0	2	100	0	0	2	100
Fan Medical Renal Clinic	2	50	2	50	0	0	4	100
Loh Guan Lye Specialist	0	0	2	100	0	0	2	100
Tuanku Ja'afar (Paed)	0	0	1	100	0	0	1	100
Raja Perempuan Zainab II	2	50	1	25.0	1	25.0	4	100
Hospital Tunku Azizah (Paed)	2	7.7	24	92.3	0	0	26	100
Hospital Wanita Dan Kanak-kanak Sabah	1	33.3	2	66.7	0	0	3	100
Kulim Hospital	0	0	2	100	0	0	2	100

Table 5.2.6: Renal allograft biopsy by year and age group, rate per million populations, 2005-2022

Age	2005 (n=71)			2006 (n=118)			2007 (n=124)			2008 (n=124)			2009 (n=139)			2010 (n=180)		
	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate
<15	0	0	0	5	4.2	0.2	7	5.6	0.3	9	7.3	0.3	8	4.4	0.3	8	4.4	0.3
15-<25	15	21.1	0.6	26	22.0	1.0	19	15.3	0.7	22	17.7	0.8	21	11.7	0.5	21	11.7	0.7
25-<35	11	15.5	0.4	25	21.2	1.0	15	12.1	0.6	20	16.1	0.7	29	16.1	1.1	29	16.1	1.0
35-<45	23	32.4	0.9	26	22.0	0.9	49	39.5	1.9	25	20.2	0.9	66	36.7	0.9	66	36.7	2.3
45-<55	12	16.9	0.5	24	20.3	0.9	24	19.4	0.9	35	28.2	1.3	40	22.2	1.3	40	22.2	1.4
55-<65	8	11.3	0.3	8	6.8	0.3	10	8.1	0.4	9	7.3	0.3	12	6.7	0.6	12	6.7	0.4
≥65	2	2.8	0.1	4	3.4	0.2	0	0	0	4	3.2	0.1	4	2.2	0	4	2.2	0.1

Age	2011 (n=239)			2012 (=290)			2013 (n=244)			2014 (n=230)			2015 (n=291)			2016 (n=251)		
	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate
<15	9	3.8	0.3	8	2.8	0.3	6	2.5	0.2	5	2.2	0.2	1	0.3	0	2	0.8	0.1
15-<25	34	14.2	1.2	21	7.2	0.7	22	9.0	0.7	27	11.7	0.9	25	8.6	0.8	15	6.0	0.5
25-<35	36	15.1	1.2	78	26.9	2.6	45	18.4	1.5	54	23.5	1.8	45	15.5	1.4	57	22.7	1.8
35-<45	86	36.0	3.0	76	26.2	2.6	73	29.9	2.4	62	27.0	2.0	86	29.6	2.8	62	24.7	2.0
45-<55	44	18.4	1.5	69	23.8	2.3	75	30.7	2.5	48	20.9	1.6	89	30.6	2.9	58	23.1	1.8
55-<65	29	12.1	1.0	33	11.4	1.1	19	7.8	0.6	30	13.0	1.0	39	13.4	1.3	44	17.5	1.4
≥65	1	0.4	0	5	1.7	0.2	4	1.6	0.1	4	1.7	0.1	6	2.1	0.2	13	5.2	0.4

Age	2017 (n=281)			2018 (n=260)			2019 (n=358)			2020 (n=293)			2021 (n=173)			2022 (n=253)		
	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate
<15	0	0	0	4	1.5	0.1	9	2.5	0.3	2	0.7	0	3	1.7	0	6	2.4	0.1
15-<25	26	9.3	0.8	19	7.3	0.6	28	7.8	0.8	16	5.5	0.3	27	15.6	0.5	20	7.9	0.3
25-<35	70	24.9	2.2	58	22.3	1.5	81	22.6	2.1	75	25.6	1.3	40	23.1	0.7	77	30.4	1.4
35-<45	68	24.2	2.1	75	28.8	1.8	84	23.5	1.8	92	31.4	1.9	48	27.7	1.0	62	24.5	1.2
45-<55	70	24.9	2.2	57	21.9	1.0	78	21.8	1.5	51	17.4	1.5	27	15.6	0.8	50	19.8	1.4
55-<65	43	15.3	1.3	37	14.2	0.3	60	16.8	0.5	46	15.7	1.8	21	12.1	0.8	23	9.1	0.8
≥65	4	1.4	0.1	10	3.8	0.1	18	5.0	0.3	11	3.8	0.5	7	4.0	0.3	15	5.9	0.6

*Rate based on the total population of the year of biopsy

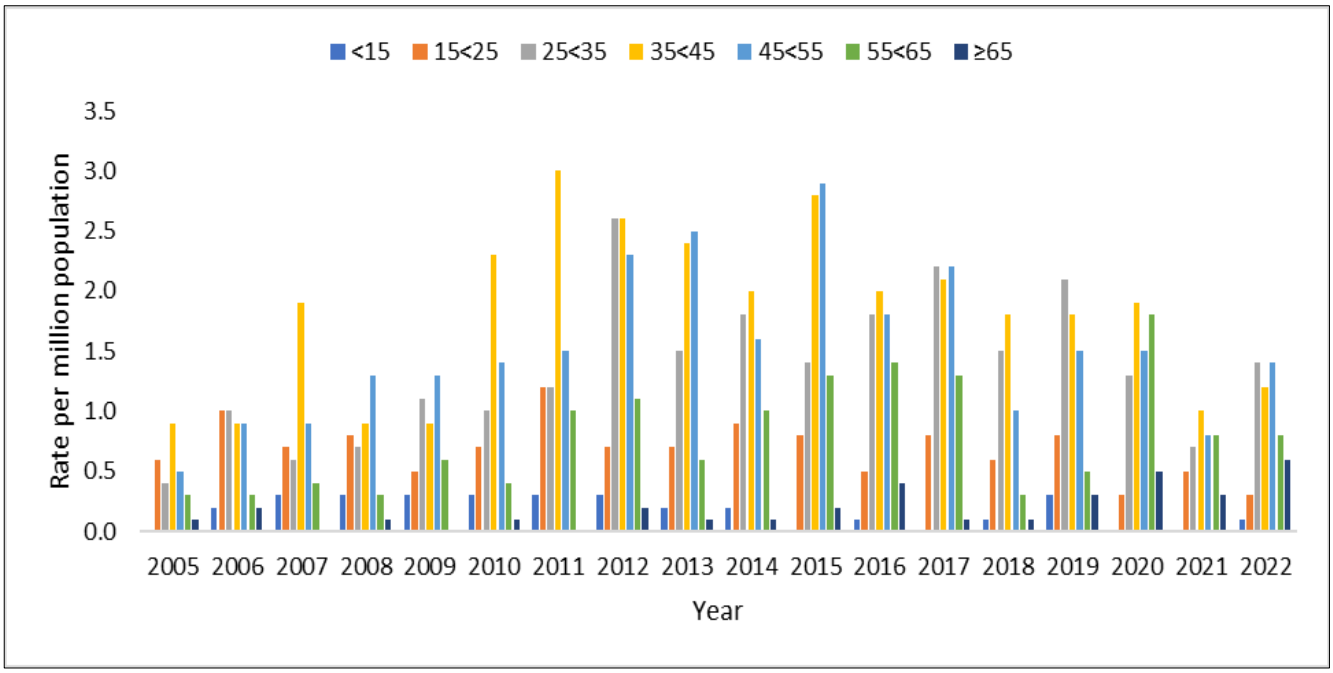

Figure 5.2.1: Allograft biopsy by year and age group, rate per million populations, 2005-2022

5.3 Clinical presentation at biopsy

- Almost two-third (65.4%) of all allograft biopsies were performed for abnormal allograft function, of which 46% were "Creeping creatinine" and 19.4% were "Acute deterioration" (Table 5.3.1).
- There was a doubling of allograft biopsies done for asymptomatic proteinuria, from 3.1% in 2005-2009 to 7.5% in 2022.
- Roughly 4% of the biopsies were performed to delineate the cause of poor or delayed graft function.
- About 20 – 30% of cases did not report clinical presentation of graft function.

Table 5.3.1.: Indications for renal allograft biopsy, 2005-2022

Current clinical presentation	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Urine abnormality	**42**	**-**	**81**	**-**	**115**	**-**	**22**	**-**	**19**	**-**	**23**	**-**	**302**	**-**
Asymptomatic hematuria	2	0.3	6	0.5	10	0.7	1	0.3	1	0.6	0	0	20	0.5
Asymptomatic hematuria and proteinuria	8	1.4	22	1.9	31	2.2	4	1.4	1	0.6	0	0	66	1.7
Asymptomatic proteinuria	18	3.1	39	3.3	47	3.3	9	3.1	11	6.4	19	7.5	143	3.6
Gross Hematuria	3	0.5	1	0.1	2	0.1	0	0	0	0	0	0	6	0.2
Nephrotic range proteinuria	8	1.4	6	0.5	14	1.0	8	2.7	6	3.5	4	1.6	46	1.2
Not Available**	11	1.9	6	0.5	11	0.8	0	0	0	0	0	0	21	0.5
Graft function	**530**	**-**	**907**	**-**	**925**	**-**	**190**	**-**	**122**	**-**	**182**	**-**	**2856**	**-**
Acute deterioration	231	40.1	188	15.9	208	14.4	57	19.5	29	16.8	46	18.2	759	19.4
Creeping creatinine	228	39.6	640	54.1	609	42.3	117	39.9	85	49.1	124	49.0	1803	46.0
Poor delayed graft function	69	12.0	73	6.2	92	6.4	14	4.8	7	4.0	11	4.3	266	6.8
Not available**	2	0.3	6	0.5	16	1.1	2	0.7	1	0.6	1	0.4	28	0.7
No information***	28	4.9	258	21.8	450	31.2	99	33.8	47	27.2	59	23.3	973	24.8

* Patients may have one or more clinical presentation
**Not available-missing type of clinical presentation
***No information of clinical presentation

5.4 Timing of renal allograft biopsy

- Over the last 18 years, there had not been much change in the timing of renal allograft biopsies.
- Allograft biopsies performed within 1-month post-transplantation in 2020, 2021 and 2022 were 17%, 13% and 16% respectively.
- Allograft biopsies performed after 1-year post-transplantation were 42%, 55% and 44% respectively, for 2020, 2021 and 2022.

Table 5.4: Timing of renal allograft biopsy, 2005-2022 (dates: date of biopsy & date of transplant)

Timing of renal transplant biopsy	Within 1 week		>1 week to 1 month		> 1 month to 3 months		> 3 months to 6 months		> 6months to 1 year		>1-year post-transplant		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2005-2009	21	3.7	65	11.3	75	13.0	42	7.3	50	8.7	322	56.0	575	100
2010-2014	41	3.5	184	15.6	189	16.0	136	11.5	128	10.8	505	42.7	1183	100
2015-2019	45	3.1	165	11.5	206	14.3	169	11.7	176	12.2	680	47.2	1441	100
2020	15	5.1	35	11.9	36	12.3	46	15.7	38	13.0	123	42.0	293	100
2021	7	4.3	14	8.6	20	12.3	14	8.6	19	11.7	89	54.6	163	100
2022	7	2.8	32	12.9	35	14.1	41	16.5	25	10.0	109	43.8	249	100

*15 notifications with the missing date of transplant

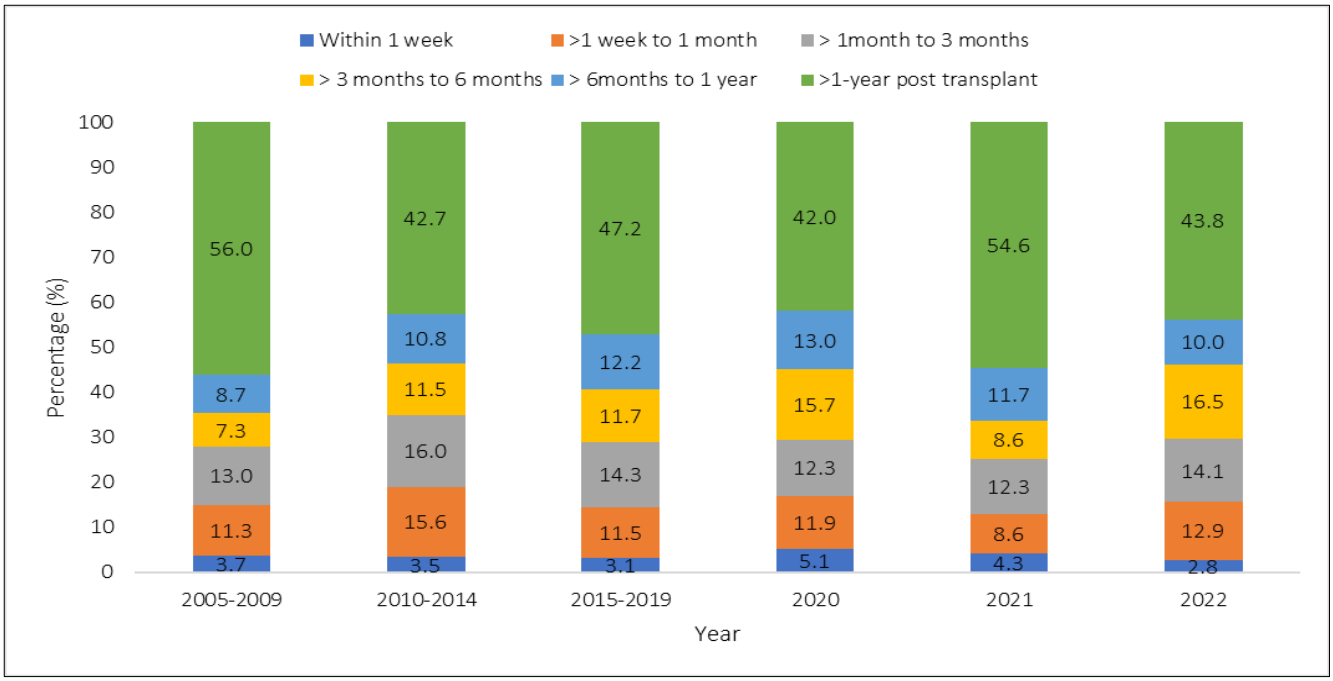

Figure 5.4: Timing of renal allograft biopsy, 2005-2022

5.5 Renal allograft biopsy procedure

5.5.1 Renal allograft biopsy method

- All the renal allograft biopsies were performed under ultrasonographic guidance primarily for the last 3 years.
- The number of allograft biopsies performed without real-time ultrasonographic guidance continued to decline, with only 0%, 2.9% and 0.4% in the recent 3 years.
- However, up to 30% of the biopsies methods were not reported (Table 5.5.1).

Table 5.5.1: Biopsy method, 2005-2022

Method	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Blind (not US-guided)	2	0.3	2	0.2	1	0.1	0	0	0	0	0	0	5	0.1
US-guided: real-time	339	58.9	657	55.5	806	55.9	155	52.9	111	64.2	165	65.2	2233	57.0
US-guided: not real-time	81	14.1	116	9.8	5	0.3	0	0	5	2.9	1	0.4	208	5.3
Not available	154	26.7	408	34.5	629	43.7	138	47.1	57	32.9	87	34.4	1473	37.6

5.5.2 Number of passes

- The number of passes made during renal allograft biopsy showed a similar trend since 2005, with the majority being either one or 2 passes.
- In the last 3 years (2020, 2021, 2022), 1 or 2 passes comprised 49%, 57% and 59% respectively. In comparison, the percentage of 3 or more attempts made was 6.8%, 10.4% and 7.5%, respectively, over these 3 years.
- The remaining data on the number of passes were not reported (Table 5.5.2 & Figure 5.5.2).

Table 5.5.2: Number of passes, 2005-2022

Number of passes	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	133	23.1	251	21.2	337	23.4	72	24.6	51	29.5	81	32.0	925	23.6
2	227	39.4	416	35.2	371	25.7	73	24.9	48	27.7	68	26.9	1203	30.7
3	53	9.2	94	7.9	90	6.2	18	6.1	16	9.2	14	5.5	285	7.3
4	4	0.7	19	1.6	27	1.9	2	0.7	1	0.6	4	1.6	57	1.5
5	0	0	5	0.4	3	0.2	0	0	1	0.6	1	0.4	10	0.3
6	0	0	2	0.2	0	0	0	0	0	0	0	0	2	0.1
Not available	159	27.6	396	33.5	613	42.5	128	43.7	56	32.4	85	33.6	1437	36.7

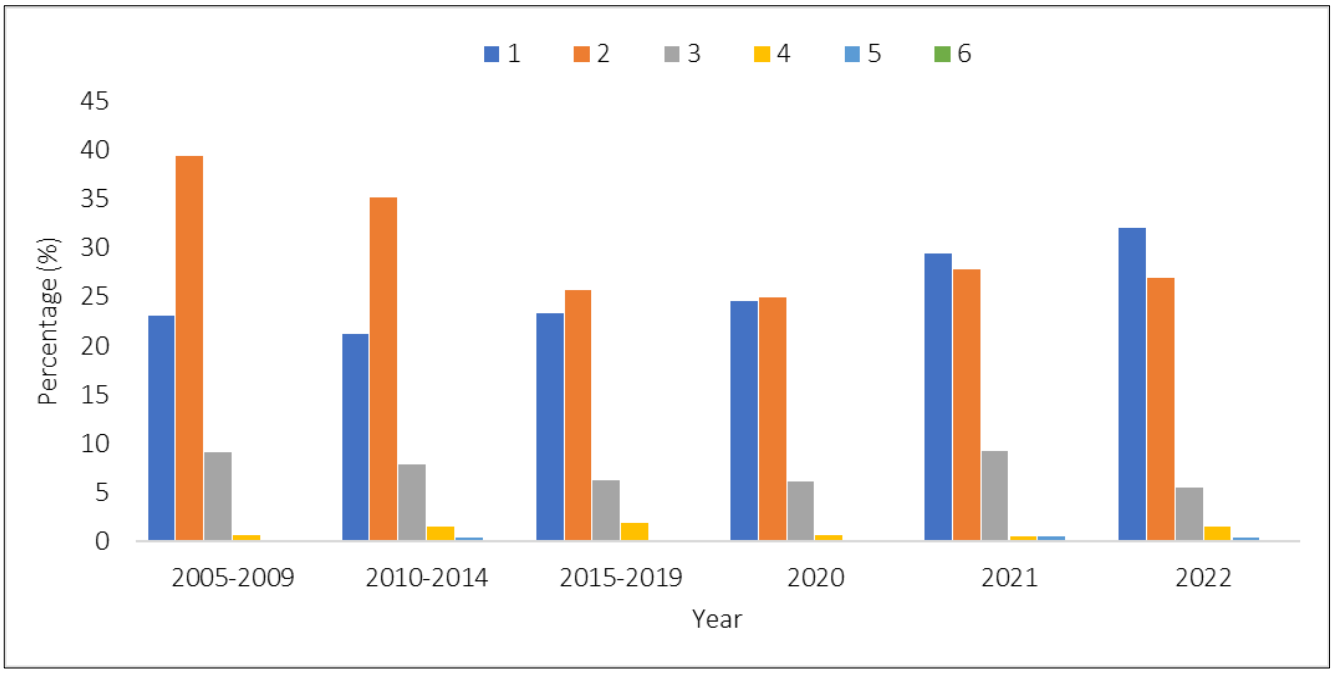

Figure 5.5.2: Number of passes, 2005-2022

5.5.3 Number of glomeruli obtained on biopsy

- A successful allograft biopsy is defined as having at least 10 glomeruli in the specimen.
- Despite increasing utility of using ultrasonographic guidance real-time allograft biopsies, there were 22.5%, 17.3% and 19% biopsy reported to have nine or fewer glomeruli, over the last three years.

Table 5.5.3: Number of glomeruli obtained on biopsy, 2005-2022

Number of glomeruli obtained	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0	26	4.5	54	4.6	49	3.4	8	2.7	3	1.7	4	1.6	144	3.7
1-9	147	25.5	341	28.8	340	23.6	58	19.8	27	15.6	44	17.4	957	24.4
10-19	249	43.2	489	41.3	615	42.7	124	42.3	69	39.9	92	36.4	1638	41.8
≥20	145	25.2	259	21.9	409	28.4	88	30	54	31.2	87	34.4	1042	26.6
Unknown	9	1.6	40	3.4	28	1.9	15	5.1	20	11.6	26	10.3	138	3.5

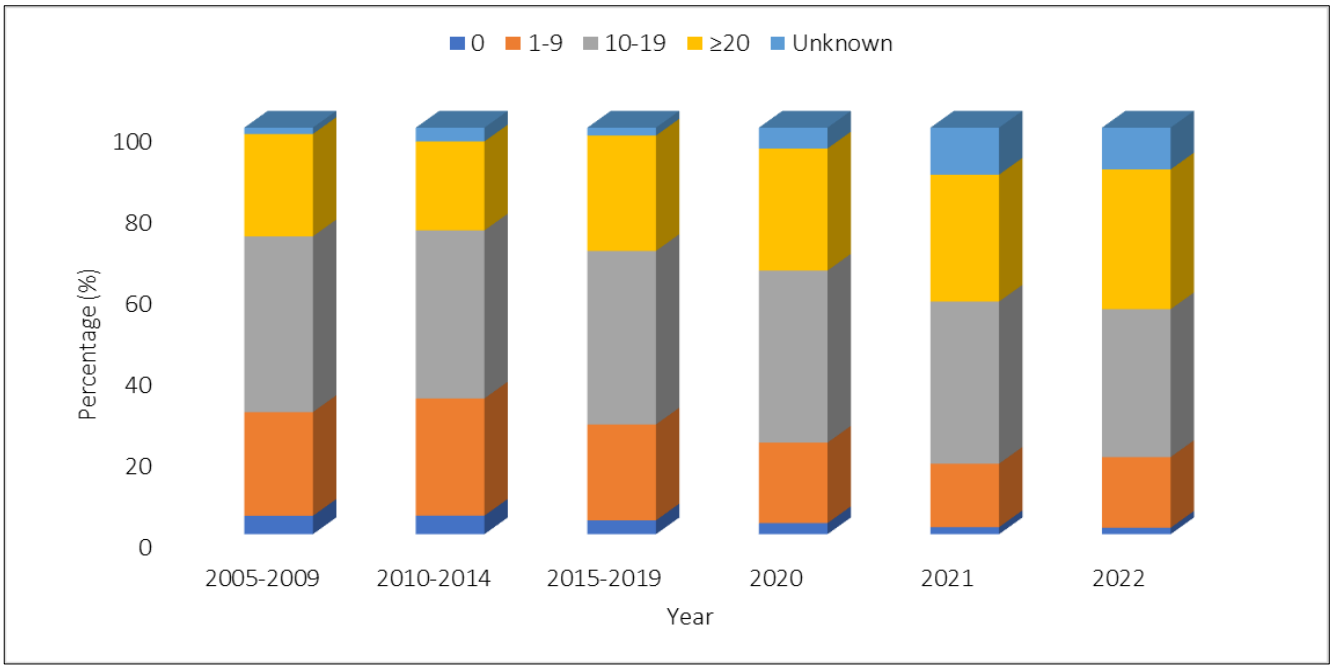

Figure 5.5.3: Number of glomeruli obtained on biopsy, 2005-2022

5.5.4 Type of complications

- Complications associated with allograft biopsy that required intervention were extremely low, with 0 cases reported over the last three years (Table 5.5.4).

Table 5.5.4: Type of complications, 2005-2022

Type of complications	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Mild complication[a]	10	1.7	14	1.2	11	0.8	1	0.3	3	1.7	2	0.8	41	1.0
Severe complication[b]	4	0.7	3	0.3	1	0.1	0	0	0	0	0	0	8	0.2
No complication	562	97.6	1166	98.6	1429	99.2	292	99.7	170	98.3	251	99.2	3870	98.7

[a]Mild complication is defined as the presence of gross hematuria, perirenal collection, hematoma, or AVM that do not require intervention.

[b]Severe complication is defined as the presence of hypotension or complications requiring intervention.

5.6 Histological diagnosis

- Allograft rejection remained the most common histological diagnosis over the years. This can be either acute or borderline rejection.
- Borderline rejections were identified in the setting of protocol biopsy (without biochemical abnormalities).
- Moreover, for the last three years, the reported histological diagnosis of borderline rejection superseded acute rejection histology, with reported cases of 20.8%, 9.8% and 17% in 2020, 2021 and 2022, respectively. This could be due to the lower threshold of performing allograft biopsy and hence detecting borderline rejection early.
- In comparison, reported cases of acute rejection over these three years were 10.9%, 7.5% and 12.3% respectively (Table 5.6 & Figure 5.6). This was consistent with around 19% of the allograft biopsies were performed because of acute deterioration of allograft function (Table 5.3.1).
- Interestingly, the histological diagnosis of acute tubular necrosis demonstrated an increasing pattern over the last three years, contributing 20.1%, 23.7% and 24.5% from the yearly histological diagnosis (Figure 5.6). This was in contrast to the earlier years. The likely reason was probably the increasing trend of deceased donor transplantation.
- The histological diagnosis of calcineurin inhibitor toxicity, chronic allograft nephropathy and recurrent GN had demonstrated a declining trend over the years. The percentage of calcineurin inhibitor toxicity was reported to be about 5.9 % in the year 2022. The low number of this incidence was likely due to lower therapeutic targets over the years post-transplantation as well as improved histopathological interpretation.
- Other histological diagnoses of diabetic nephropathy, de novo disease and PTLD remained uncommon findings.

Table 5.6: Histological diagnosis, 2005-2022

Benign/malignant hypertension	2005-2009 (n=576)		2010-2014 (n=1183)		2015-2019 (n=1441)		2020 (n=293)		2021 (n=173)		2022 (n=253)		Total (n=3919)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Acute rejection	116	20.1	183	15.5	220	15.3	32	10.9	13	7.5	31	12.3	592	15.1
Borderline rejection	54	9.4	236	19.9	366	25.4	61	20.8	17	9.8	43	17.0	777	19.8
Calcineurin inhibitor toxicity	110	19.1	128	10.8	75	5.2	14	4.8	15	8.7	15	5.9	354	9.0
Chronic allograft nephropathy	108	18.8	61	5.2	73	5.1	8	2.7	2	1.2	15	5.9	267	6.8
Acute tubular necrosis	90	15.6	154	13.0	283	19.6	59	20.1	41	23.7	62	24.5	689	17.6
'Acute interstitial nephritis	5	0.9	6	0.5	19	1.3	4	1.4	1	0.6	5	2.0	40	1.0
Chronic interstitial nephritis	9	1.6	32	2.7	16	1.1	2	0.7	0	0	6	2.4	65	1.7
PTLD**	7	1.2	1	0.1	12	0.8	1	0.3	1	0.6	1	0.4	23	0.6
De novo	0	0	4	0.3	3	0.2	3	1.0	1	0.6	2	0.8	13	0.3
Recurrent GN	22	3.8	23	1.9	2	0.1	0	0	1	0.6		0	48	1.2
Diabetic nephropathy	11	1.9	10	0.8	16	1.1	5	1.7	3	1.7	3	1.2	48	1.2
Benign/malignant hypertension	3	0.5	32	2.7	43	3.0	3	1.0	6	3.5	8	3.2	95	2.4
Others	17	3.0	117	9.9	105	7.3	17	5.8	5	2.9	16	6.3	277	7.1

** *Post Transplant Lymphoproliferative disease

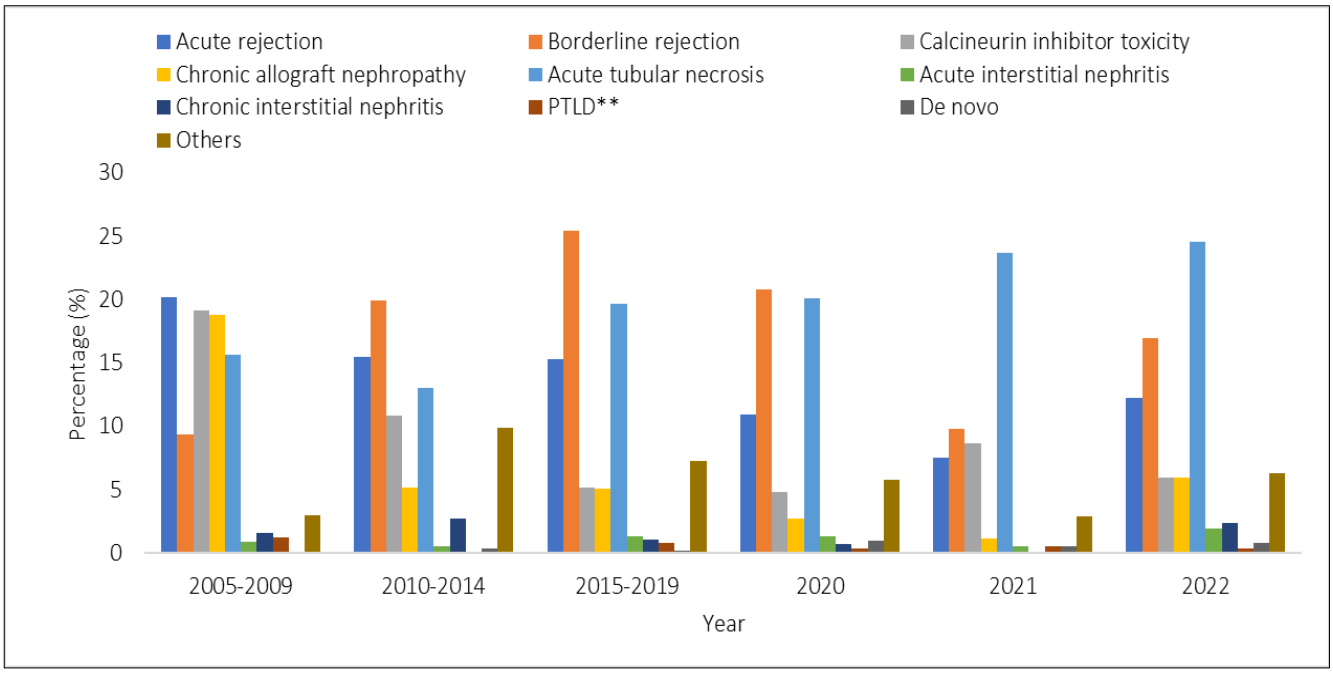

Figure 5.6: Histological diagnosis, 2005-2022