CHAPTER 5

Renal Allograft Biopsy

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5.1 Introduction

- A total of 25 centres reported performing allograft biopsies during the period of 2005 till 2017.
- Majority of these centres were state hospitals and major hospitals under the Ministry of Health.

5.2 Number of renal allograft biopsy

- During the span of 13 years (from 2005 till 2017), a total of 2577 renal allograft biopsies were reported to the registry. *(Figure 5.2.1)*
- The number of renal allograft biopsy reported showed an increasing trend despite a decreasing trend in the number of new renal transplant patients (172 new transplant patients in 2005 compared to 82 in 2016) and a relatively unchanged number of prevalent renal transplant recipients during the same period[1].
- This is likely due to the changing pattern in the indications and threshold for renal biopsy rather than a change in the clinical manifestation of renal transplant recipients during this period.
- In the last 13 years, the four main transplant centres (Hospital Kuala Lumpur, Hospital Selayang, University Malaya Medical Centre and Prince Court Medical Centre) reported 2113 allograft biopsies and this accounted for 82% of the total number of renal allograft biopsies reported. *(Table 5.2.2)*
- Of the 4 transplant centres, UMMC reported the largest number of allograft biopsies as this centre performed protocol biopsies for its newly transplanted recipients. *(Table 5.2.2)*
- Majority of the renal allograft biopsies reported were performed for patients aged 25 to 54 years and this accounted for 74% of all renal allograft biopsies performed over the last 13 years. *(Table & Figure 5.2.3).* This pattern remained relative unchanged and probably a reflection of the age demography of renal transplant recipients in this country.
- Consistently, more male transplant recipients underwent allograft biopsies, and this reflects the gender distribution of renal patients undergoing renal transplantation in this country. *(Table 5.2.4)*
- About half of the all the allograft biopsies performed during this period were on the Chinese Malaysian population. *(Table 5.2.5).* This is different from the racial demography of this country where the Chinese accounts for a third of the population. The reason remains unclear, but one possibility is that there may be more Chinese who underwent renal transplants compared to the other races.

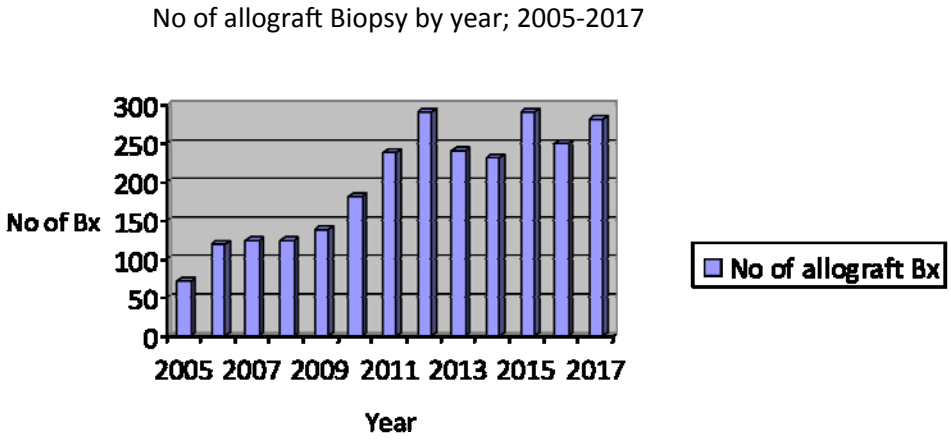

Figure 5.2.1: Number of renal allograft biopsy, 2005-2017

Table 5.2.2 Number of renal allograft biopsy by centre, 2005-2017

Centre	2005		2006		2007		2008		2009		2010		2011	
	n	%	n	%	n	%	n	n	%	n	n	n	n	%
UMMC	0	0	0	0	30	24	27	22	7	5	0	0	36	15
Kuala Lumpur (Adult)	28	39	50	42	43	35	37	30	45	33	42	23	41	17
Prince Court Medical Centre	0	0	0	0	0	0	0	0	7	5	47	26	54	23
Selayang Hospital (Adult)	18	25	19	16	22	18	15	12	41	30	37	21	53	22
Pulau Pinang (Adult)	12	17	11	9	2	2	4	3	2	1	13	7	7	3
Kuala Lumpur (Paed)	1	1	13	11	9	7	17	14	12	9	10	6	9	4
Tengku Ampuan Rahimah	5	7	11	9	12	10	10	8	9	7	3	2	10	4
PPUKM	0	0	0	0	0	0	0	0	0	0	0	0	10	4
Sultanah Bahiyah	0	0	0	0	0	0	3	2	3	2	9	5	3	1
Sarawak General	2	3	2	2	2	2	5	4	3	2	8	4	1	0
Melaka Hospital	0	0	2	2	1	1	1	1	0	0	0	0	3	1
Queen Elizabeth	4	6	3	3	0	0	0	0	0	0	0	0	0	0
Serdang Hospital	0	0	0	0	0	0	0	0	3	2	1	1	0	0
Sultan Ismail (Paed)	0	0	0	0	0	0	2	2	1	1	4	2	4	2
Tengku Ampuan Afzan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tuanku Ja'afar (Adult)	0	0	1	1	1	1	1	1	2	1	0	0	1	0
Sultanah Aminah	0	0	2	2	0	0	1	1	1	1	2	1	1	0
Raja Permaisuri Bainun	1	1	2	2	2	2	0	0	0	0	0	0	0	0
Selayang (Paed)	0	0	1	1	0	0	0	0	0	0	1	1	0	0
Pakar Sultanah Fatimah (Muar)	0	0	0	0	0	0	0	0	0	0	1	1	2	1
KPJ Ampang Puteri	0	0	0	0	0	0	1	1	0	0	1	1	1	0
Pulau Pinang (Paed)	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Sultanah Nur Zahirah	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Miri Hospital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sultanah Nora Ismail	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Normah Medical Specialist	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Fan Medical Renal Clinic	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Loh Guan Lye Specialist	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tuanku Ja'afar (Paed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raja Perempuan Zainab II	0	0	0	0	0	0	0	0	1	1	0	0	0	0

Table 5.2.2 Number of renal allograft biopsy by centre, 2005-2017 (*'cont.*)

Centre	2012		2013		2014		2015		2016		2017		TOTAL	
	n	%	n	%	n	%	n	n	%	n	n	n	n	%
UMMC	87	30	60	25	97	42	79	27	103	41	115	41	641	25
Kuala Lumpur (Adult)	33	11	37	15	33	14	107	37	48	19	63	22	607	24
Prince Court Medical Centre	71	24	72	30	31	13	25	9	42	17	62	22	411	16
Selayang Hospital (Adult)	43	15	25	10	24	10	26	9	19	8	18	6	360	14
Pulau Pinang (Adult)	9	3	9	4	2	1	11	4	10	4	6	2	98	4
Kuala Lumpur (Paed)	8	3	1	0	7	3	3	1	3	1	1	0	94	4
Tengku Ampuan Rahimah	9	3	4	2	1	0	1	0	1	0	0	0	76	3
PPUKM	9	3	9	4	5	2	7	2	6	2	2	1	48	2
Sultanah Bahiyah	1	0	4	2	9	4	5	2	5	2	2	1	44	2
Sarawak General	4	1	2	1	0	0	3	1	3	1	1	0	36	1
Melaka Hospital	2	1	6	2	2	1	3	1	0	0	0	0	20	1
Queen Elizabeth	0	0	1	0	1	0	7	2	2	1	0	0	18	1
Serdang Hospital	3	1	4	2	3	1	0	0	1	0	3	1	18	1
Sultan Ismail (Paed)	1	0	3	1	0	0	0	0	1	0	0	0	16	1
Tengku Ampuan Afzan	1	0	1	0	2	1	5	2	3	1	3	1	15	1
Tuanku Ja'afar (Adult)	2	1	1	0	1	0	2	1	1	0	0	0	13	1
Sultanah Aminah	2	1	1	0	3	1	0	0	0	0	0	0	13	1
Raja Permaisuri Bainun	1	0	0	0	3	1	2	1	0	0	0	0	11	0
Selayang (Paed)	0	0	0	0	1	0	3	1	2	1	0	0	8	0
Pakar Sultanah Fatimah (Muar)	1	0	0	0	1	0	0	0	0	0	1	0	6	0
KPJ Ampang Puteri	0	0	0	0	1	0	0	0	1	0	0	0	5	0
Pulau Pinang (Paed)	1	0	0	0	1	0	0	0	0	0	1	0	4	0
Sultanah Nur Zahirah	0	0	0	0	0	0	1	0	0	0	1	0	3	0
Miri Hospital	0	0	0	0	1	0	1	0	0	0	0	0	2	0
Sultanah Nora Ismail	0	0	0	0	0	0	0	0	0	0	2	1	2	0
Normah Medical Specialist	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Fan Medical Renal Clinic	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Loh Guan Lye Specialist	1	0	0	0	1	0	0	0	0	0	0	0	2	0
Tuanku Ja'afar (Paed)	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Raja Perempuan Zainab II	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Table 5.2.3: Renal allograft biopsy by year and age group, rate per million populations, 2005-2017

Age	2005 (n=71)			2006 (n=118)			2007 (n=124)			2008 (n=124)			2009 (n=137)		
	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate
<15	0	0	0.0	5	4	0.2	7	6	0.3	9	7	0.3	9	7	0.3
15<25	15	21	0.6	26	22	1.0	19	15	0.7	22	18	0.8	15	11	0.5
25<35	11	15	0.4	26	22	1.0	15	12	0.6	20	16	0.7	31	23	1.1
35<45	23	32	0.9	25	21	0.9	50	40	1.9	25	20	0.9	26	19	0.9
45<55	12	17	0.5	25	21	0.9	23	19	0.9	35	28	1.3	37	27	1.3
55<65	8	11	0.3	7	6	0.3	10	8	0.4	9	7	0.3	18	13	0.6
≥65	2	3	0.1	4	3	0.2	0	0	0.0	4	3	0.1	1	1	0.0

Age	2010 (n=180)			2011 (n=239)			2012 (n=290)			2013 (n=241)			2014 (n=230)		
	n	%	rate	n	%	rate	n	%	rate	n	%	rate	n	%	rate
<15	8	4	0.3	9	4	0.3	8	3	0.3	5	2	0.2	5	2	0.2
15<25	21	12	0.7	34	14	1.2	21	7	0.7	21	9	0.7	27	12	0.9
25<35	29	16	1.0	36	15	1.2	78	27	2.6	45	19	1.5	54	23	1.8
35<45	66	37	2.3	86	36	3.0	76	26	2.6	72	30	2.4	62	27	2.0
45<55	40	22	1.4	44	18	1.5	69	24	2.3	75	31	2.5	48	21	1.6
55<65	12	7	0.4	29	12	1.0	33	11	1.1	19	8	0.6	30	13	1.0
≥65	4	2	0.1	1	0	0.0	5	2	0.2	4	2	0.1	4	2	0.1

Age	2015 (n=291)			2016 (n=251)			2017 (n=281)		
	n	%	rate	n	%	rate	n	%	rate
<15	1	0	0.0	2	1	0.1	0	0	0.0
15<25	25	9	0.8	15	6	0.5	26	9	0.8
25<35	45	15	1.4	57	23	1.8	70	25	2.2
35<45	86	30	2.8	62	25	2.0	68	24	2.1
45<55	89	31	2.9	58	23	1.8	70	25	2.2
55<65	39	13	1.3	44	18	1.4	43	15	1.3
≥65	6	2	0.2	13	5	0.4	4	1	0.1

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

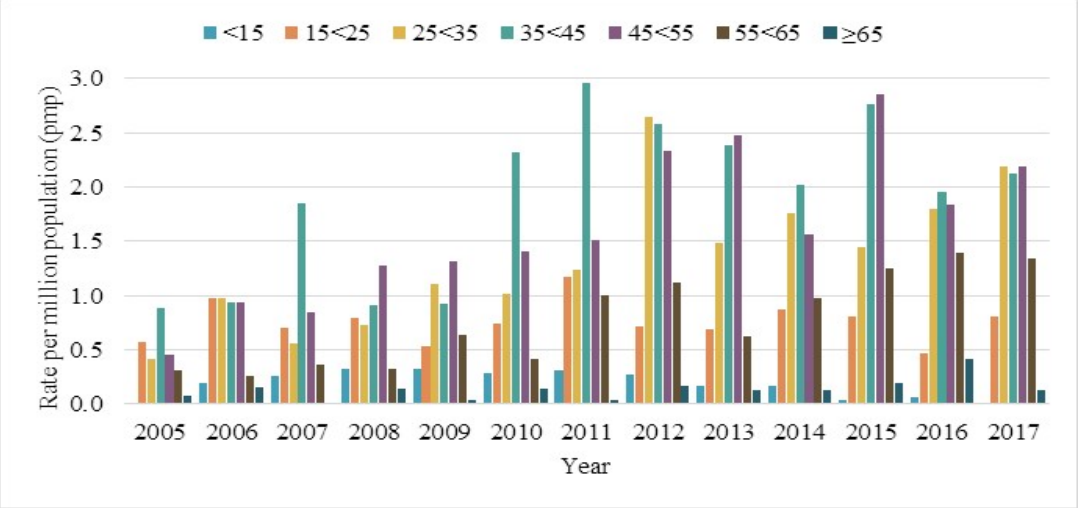

Figure 5.2.3: Renal allograft biopsy by year and age group, rate per million populations, 2005-2017

Table 5.2.4: Gender distribution of renal allograft biopsy, 2005-2017

Gender	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Male	46	65	81	69	80	65	76	61	88	64	122	68	160	67
Female	25	35	37	31	44	35	48	39	49	36	58	32	79	33
Gender	**2012 (n=290)**		**2013 (n=241)**		**2014 (n=230)**		**2015 (n=291)**		**2016 (n=251)**		**2017 (n=281)**		**Total (n=2577)**	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Male	198	68	155	64	148	64	159	55	173	69	208	74	1694	66
Female	92	32	86	36	82	36	132	45	78	31	73	26	883	34

Table 5.2.5: Racial distribution of renal allograft biopsy, 2005-2017

Race	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Malay	23	32	33	28	47	38	49	40	46	34	58	32	71	30
Chinese	38	54	65	55	61	49	55	44	75	55	83	46	132	55
Indian	6	8	17	14	10	8	11	9	11	8	22	12	17	7
Others	4	6	3	3	6	5	9	7	5	4	17	9	19	8
Race	**2012 (n=290)**		**2013 (n=241)**		**2014 (n=230)**		**2015 (n=291)**		**2016 (n=251)**		**2017 (n=281)**		**Total (n=2577)**	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Malay	79	27	58	24	66	29	128	44	72	29	85	30	815	32
Chinese	148	51	145	60	139	60	130	45	146	58	149	53	1366	53
Indian	33	11	26	11	15	7	21	7	26	10	36	13	251	10
Others	30	10	12	5	10	4	12	4	7	3	11	4	145	6

5.3: Clinical presentation at biopsy

- More than three quarter of the renal allograft biopsies performed during this period were for allograft dysfunction with acute graft dysfunction and gradual allograft dysfunction (creeping serum creatinine) accounting for 21% and 46% respectively.
- Allograft biopsy for urinary abnormalities only accounted for 7% of all reported biopsies. *(Table 5.3)*
- From 2005 till 2017, there is a reverse in the pattern of the 2 main presentations of graft dysfunction. Acute deterioration of graft function accounted for 55% in 2005 and declined to 14% in 2017 while gradual allograft dysfunction increased during the same period. The change in the indications for allograft biopsy during this period is probably a reflection of the increasing awareness of the IFTA and the decreasing trend in the acute rejection rates among the transplant recipients.

Table 5.3: Indications for renal allograft biopsy, 2005-2017

Current clinical presentation	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	n	%	n	n	n	n	%
Urine abnormalities	1	1	6	5	9	7	10	8	16	12	8	4	18	8
Asymptomatic hematuria	0	0	2	2	0	0	0	0	0	0	0	0	1	0
Asymptomatic hematuria & proteinuria	0	0	0	0	0	0	5	4	3	2	2	1	4	2
Asymptomatic proteinuria	1	0	1	0	2	0	4	4	10	2	3	1	11	2
Gross Hematuria	0	1	0	1	1	2	1	3	1	7	0	2	0	5
Nephrotic range proteinuria	0	0	3	0	3	1	0	1	2	1	1	0	2	0
*Not Available***	0	0	3	3	4	3	1	1	3	2	1	1	2	1
Graft dysfunction	69	97	115	97	115	93	111	90	120	88	164	91	192	80
Acute deterioration	39	55	55	47	55	44	42	34	40	29	47	26	49	21
Gradual deterioration (Creeping se Cr)	24	34	50	42	41	33	55	44	58	42	104	58	113	47
Poor delayed graft function	6	8	10	8	18	15	14	11	21	15	13	7	27	11
*Not available***	0	0	0	0	1	1	0	0	1	1	0	0	3	1
No information***	1	1	1	1	5	4	9	7	12	9	15	8	40	17

Current clinical presentation	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	n	%	n	n	n	n	%
Urine abnormalities	25	9	20	8	10	4	18	6	15	6	24	9	180	7
Asymptomatic hematuria	2	1	1	0	2	1	2	1	1	0	1	0	12	0
Asymptomatic hematuria & proteinuria	4	1	10	4	2	1	5	2	2	1	4	1	41	2
Asymptomatic proteinuria	15	1	7	4	3	1	8	2	9	1	9	1	83	2
Gross Hematuria	1	5	0	3	0	1	0	3	0	4	1	3	5	3
Nephrotic range proteinuria	1	0	1	0	1	0	1	0	2	0	6	0	23	0
*Not Available***	2	1	1	0	1	0	1	0	2	1	7	2	28	1
Graft dysfunction	219	76	177	73	153	67	194	67	189	75	159	57	1977	77
Acute deterioration	43	15	28	12	21	9	63	22	30	12	40	14	552	21
Gradual deterioration (Creeping se Cr)	160	55	140	58	121	53	94	32	144	57	90	32	1194	46
Poor delayed graft function	15	5	8	3	10	4	29	10	15	6	25	9	211	8
*Not available***	1	0	1	0	1	0	8	3	0	0	4	1	20	1
No information***	63	22	62	26	77	33	93	32	58	23	116	41	552	21

** Patients may have one or more clinical presentation*
*** Not available: Main clinical presentation available but detail clinical presentation missing or not available*
****No information: No information on the clinical presentation / indication*

5.4 Timing of renal allograft biopsy

- Over the last 13 years, there has not been much change in timing of performing allograft biopsies.
- Allograft biopsies performed after 1-year post transplant accounted for 40-50% of all allograft biopsies reported. (Figure 5.4)

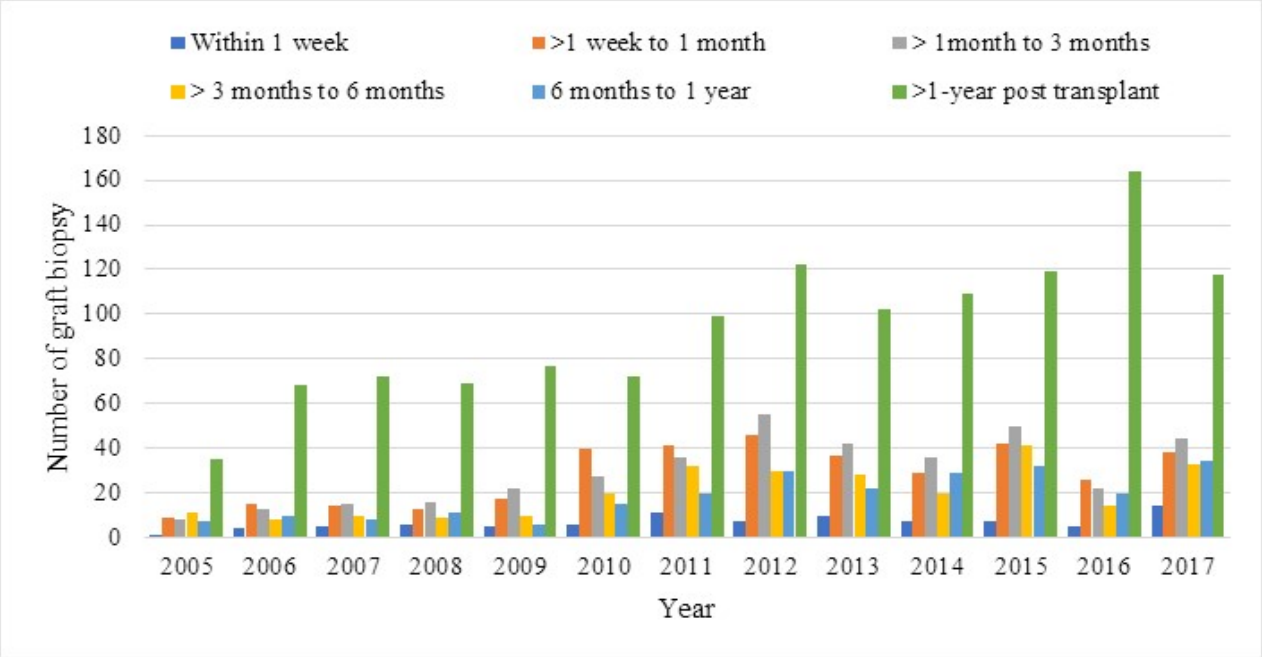

Figure 5.4: Timing of renal allograft biopsy, 2005-2017

5.5 Renal allograft biopsy procedure

- Sixty-five percent of allograft renal biopsies were performed under ultrasonographic guidance. *(Table 5.5.1)*
- From 2005 till 2017, the allograft biopsy without real-time ultrasonographic guidance continued to decline.
- The number of passes made during renal allograft biopsy remained unchanged over the last 13 years with majority of allograft biopsies having less than 3 passes. Renal allograft biopsies requiring more than 3 passes were uncommon and only account for 2% of cases. *(Table & Figure 5.5.2)*
- Despite increasing use of real-time ultrasonographic guided allograft biopsy, the success of renal allograft biopsy (as defined by the presence of at least 10 glomeruli in the biopsied renal tissues) has remained relatively unchanged over the last 13years with an overall success rate of 66%. *(Table & Figure 5.5.3)* Failure to obtain any glomerulus is uncommon and only accounted for 4.4% of all reported allograft biopsies.
- Complications associated with allograft biopsy that required intervention were extremely uncommon and none was reported in 2017. There were only 2 reported cases of complication occurring after allograft biopsy and both were mild. *(Table 5.5.4)*

Table 5.5.1: Biopsy method, 2005-2017

Methods	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Blind (not US guided)	0	0	0	0	0	0	0	0	0	0	0	0	2	1
US guided: eal-time	27	38	62	53	65	52	82	66	103	75	109	61	160	67
US guided: not real-time	33	46	35	30	6	5	5	4	9	7	33	18	26	11
Not available*	11	15	21	18	53	43	37	30	25	18	38	21	51	21

Methods	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Blind (not US guided)	0	0	0	0	0	0	0	0	0	0	1	0	3	0
US guided: eal-time	154	53	125	52	105	46	177	61	122	49	144	51	1435	56
US guided: not real-time	28	10	28	12	14	6	8	3	2	1	3	1	230	9
Not available*	108	37	88	37	111	48	106	36	127	51	133	47	909	35

**No data on biopsy technique*

Table 5.5.2: Number of passes, 2005-2017

Number of passes	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	21	30	39	33	22	18	29	23	22	16	25	14	62	26
2	31	44	46	39	36	29	45	36	69	50	91	51	104	44
3	6	8	8	7	10	8	10	8	19	14	19	11	17	7
4	0	0	0	0	1	1	1	1	2	1	4	2	5	2
5	0	0	0	0	0	0	0	0	0	0	2	1	1	0
6	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Not available	13	18	25	21	55	44	39	31	25	18	38	21	50	21

Methods	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	65	22	55	23	42	18	52	18	51	20	63	22	548	21
2	97	33	69	29	52	23	94	32	55	22	65	23	854	33
3	16	6	24	10	18	8	28	10	14	6	18	6	207	8
4	3	1	3	1	4	2	9	3	5	2	3	1	40	2
5	0	0	1	0	1	0	2	1	0	0	1	0	8	0
6	0	0	1	0	0	0	0	0	0	0	0	0	2	0
Not available	109	38	88	37	113	49	106	36	126	50	131	47	918	36

**No data information on number of passes*

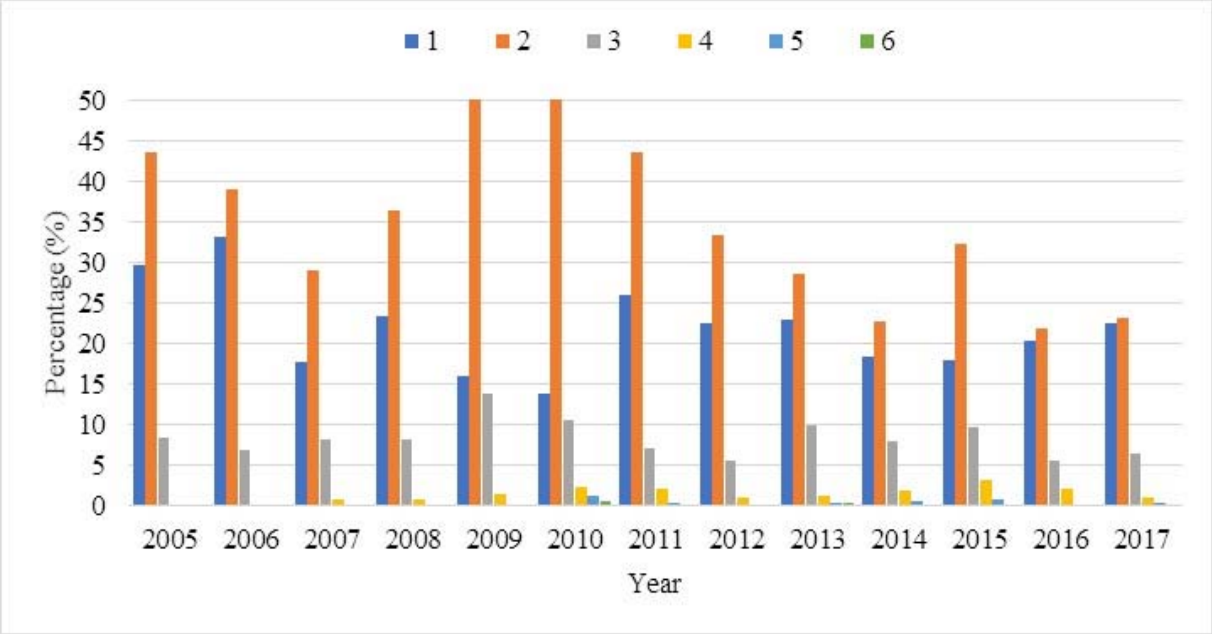

Figure 5.5.2: Number of passes, 2005-2012

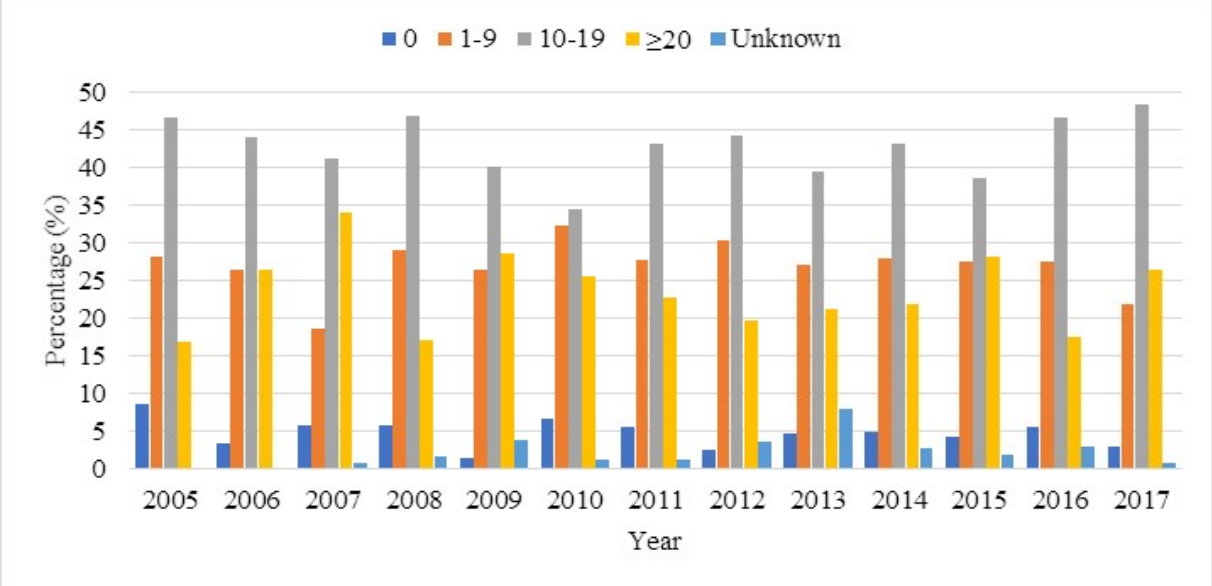

Figure 5.5.3: Number of glomeruli obtained on biopsy, 2005-2012

Table 5.5.3: Number of glomeruli obtained on biopsy, 2005-2012

Number of glomeruli obtained	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0	6	8	4	3	7	6	7	6	2	1	12	7	13	5
1-9	20	28	31	26	23	19	36	29	36	26	58	32	66	28
10-19	33	46	52	44	51	41	58	47	55	40	62	34	103	43
≥20	12	17	31	26	42	34	21	17	39	28	46	26	54	23
Unknown	0	0	0	0	1	1	2	2	5	4	2	1	3	1

Number of glomeruli obtained	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0	7	2	11	5	11	5	12	4	14	6	8	3	114	4
1-9	88	30	65	27	64	28	80	27	69	27	61	22	697	27
10-19	128	44	95	39	99	43	112	38	117	47	136	48	1101	43
≥20	57	20	51	21	50	22	82	28	44	18	74	26	603	23
Unknown	10	3	19	8	6	3	5	2	7	3	2	1	62	2

**No data information on the number of glomeruli*

Table 5.5.4: Type of complications, 2005-2017

Type of complications	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No complication	53	75	95	81	68	55	88	71	105	77	131	73	186	78
Mild complication[a]	1	1	2	2	3	2	2	2	2	1	6	3	2	1
Severe Complication[b]	1	1	0	0	1	1	1	1	1	1	0	0	1	0
Missing / Unknown[c]	16	23	21	18	52	42	33	27	29	21	43	24	50	21

Type of complications	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No complication	179	62	151	63	114	50	183	63	121	48	148	53	1622	63
Mild complication[a]	1	0	2	1	3	1	2	1	2	1	2	1	30	1
Severe Complication	1	0	1	0	0	0	1	0	0	0	0	0	8	0
Missing / Unknown[c]	109	38	87	36	113	49	105	36	128	51	131	47	917	36

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

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

c. No data information for complications

5.6: Histological diagnosis

- Rejection (acute and borderline) has remained the most common histological diagnosis *(Table 5.6)* and accounted for 36% of all allograft biopsies that were reported from 2005 till 2017.
- Allograft biopsies with histological diagnosis of acute rejection appeared to have a reducing trend with only 12% reported in 2017 while the diagnosis of borderline rejection increased during the same period.
- Since only 21% of allograft biopsies were performed for acute deterioration of allograft function *(Table 5.3)*, it would mean that nearly half of all acute rejection did not present with the acute allograft dysfunction. This is likely due to the usage of more potent immunosuppressive agents which have masked the classical feature of acute rejection.
- The diagnosis of calcineurin inhibitors toxicity and chronic allograft nephropathy have decreased over the last 13 years and in 2017 only accounted for 5% and 6% respectively. These trends were probably due to the lower therapeutic targets of calcineurin inhibitors used during this current era.
- Since 46% allograft biopsies performed were for gradual deterioration of allograft function ("creeping creatinine") *(Table 5.3)*, it would suggest that calcineurin inhibitor toxicity and chronic allograft nephropathy were not the main reasons for the slow, gradual deterioration of allograft function. It is likely that substantial number of renal transplant recipients with acute rejection especially borderline rejection had presented with this slow gradual allograft dysfunction.
- Over the last 13 years, the trend of allografts with a diagnosis of acute tubular necrosis remained relatively unchanged while the diagnosis of recurrent or de nova glomerulonephritis, diabetic nephropathy and post transplant lymphoproliferative disease have remained relatively uncommon.

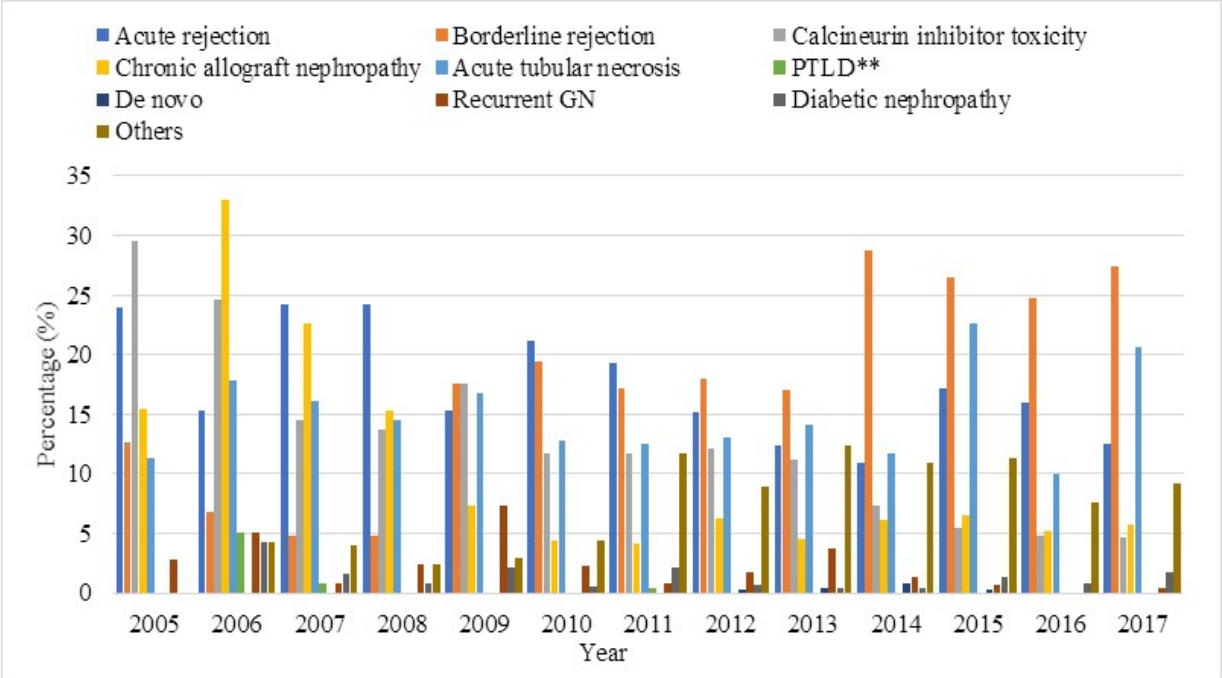

Figure 5.6: Histological diagnosis, 2005-2017

Table 5.6: Histological diagnosis , 2005-2017

Histological Diagnosis	2005 (n=71)		2006 (n=118)		2007 (n=124)		2008 (n=124)		2009 (n=137)		2010 (n=180)		2011 (n=239)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Acute rejection	17	24	18	15	30	24	30	24	21	15	38	21	46	19
Borderline Rejection	9	13	8	7	6	5	6	5	24	18	35	19	41	17
Calcineurin inhibitor toxicity	21	30	29	25	18	15	17	14	24	18	21	12	28	12
Chronic allograft nephropathy	11	15	39	33	28	23	19	15	10	7	8	4	10	4
Acute tubular necrosis	8	11	21	18	20	16	18	15	23	17	23	13	30	13
PTLD**	0	0	6	5	1	1	0	0	0	0	0	0	1	0
De novo	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recurrent GN	2	3	6	5	1	1	3	2	10	7	4	2	2	1
Diabetic nephropathy	0	0	5	4	2	2	1	1	3	2	1	1	5	2
Others	0	0	5	4	5	4	3	2	4	3	8	4	28	12

Histological Diagnosis	2012 (n=290)		2013 (n=241)		2014 (n=230)		2015 (n=291)		2016 (n=251)		2017 (n=281)		Total (n=2577)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Acute rejection	44	15	30	12	25	11	50	17	40	16	35	12	424	16
Borderline Rejection	52	18	41	17	66	29	77	26	62	25	77	27	504	20
Calcineurin inhibitor toxicity	35	12	27	11	17	7	16	5	12	5	13	5	278	11
Chronic allograft nephropathy	18	6	11	5	14	6	19	7	13	5	16	6	216	8
Acute tubular necrosis	38	13	34	14	27	12	66	23	25	10	58	21	391	15
PTLD**	0	0	0	0	0	0	0	0	0	0	0	0	8	0
De novo	1	0	1	0	2	1	1	0	0	0	0	0	5	0
Recurrent GN	5	2	9	4	3	1	2	1	0	0	1	0	48	2
Diabetic nephropathy	2	1	1	0	1	0	4	1	2	1	5	2	32	1
Others	26	9	30	12	25	11	33	11	19	8	26	9	212	8

**Patients may have more than 1 diagnosis classification*
***Post Transplant Lymphoproliferative disease*

Reference

1. *Wong HS and Goh BL (Eds). Twenty Forth Report of the Malaysian Dialysis and Transplant Registry 2016, Kuala Lumpur 2018*