

Supplementary Table 1.

Clinico-pathological characteristics, mutation status and FGA in 160 UC.

Sample ID	Gender	Age at onset	Stage ¹	Grade	Smoking	Tumor sequence	CIS	Metastasis	<i>FGFR3</i> status	<i>TP53</i> status ²	<i>PIK3CA</i> status	<i>RAS</i> status	<i>TSC1</i> status	<i>AKT1</i> status	FGA (%)	FGA group ³	
94	M	84	1	3	Yes	Primary	Unknown	Yes	p.R248C	WT	WT	WT	WT	WT	12.76657061	C	
95	M	53	2	3	Yes	Recurrence	No	Yes	No	WT	WT	WT	WT	WT	14.67303982	C	
113	M	61	a	3	Unknown	Recurrence	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	13.4870317	C	
137	M	81	2	3	Yes	Primary	Unknown	Unknown	Unknown	WT	p.E271K	WT	WT	WT	64.4956723	D	
140	F	84	1	3	Yes	Primary	Unknown	Unknown	Unknown	WT	WT	p.E542K	WT	WT	14.03912543	C	
228	M	87	1	3	Yes	Recurrence	No	Unknown	p.S249C	WT	WT	WT	WT	WT	19.59654179	C	
239	M	59	a	1	Yes	Primary	No	Unknown	Unknown	WT	WT	WT	WT	WT	0	A	
243	M	64	1	3	Yes	Primary	Yes	Unknown	Unknown	WT	WT	WT	WT	p.V24fs	14.61095101	C	
264	M	63	a	2	Yes	Primary	No	Unknown	Unknown	WT	p.E545K	KRAS p.G12V	WT	WT	1.81556196	B	
271	M	57	4	3	Yes	Primary	Yes	At diagnosis	Unknown	p.K132N	WT	WT	WT	WT	20.45454545	C	
287	M	69	a	2	Yes	Recurrence	Unknown	Unknown	p.S249C	WT	WT	WT	WT	WT	17.23342939	C	
291	F	75	2	3	Yes	Primary	Yes	Unknown	Unknown	WT	WT	WT	WT	WT	22.85302594	C	
299	F	85	a	2	No	Recurrence	No	Unknown	p.S249C	WT	WT	WT	WT	WT	8.242074928	B	
312	M	56	a	2	Yes	Recurrence	Unknown	Unknown	p.S249C	WT	WT	WT	WT	WT	10	C	
315	M	73	1	3	Yes	Primary	Unknown	Unknown	Unknown	p.R213* or p.R213W	p.D1017H	WT	WT	WT	16.858458	C	
339	M	70	a	2	Yes	Recurrence	Unknown	Unknown	p.Y375C	WT	WT	WT	p.Q55*	WT	8.386167147	B	
344	F	74	1	3	No	Recurrence	Yes	Unknown	p.S249C	WT	WT	WT	WT	WT	20.33947066	C	
355	F	70	3	3	Yes	Recurrence	No	Unknown	Unknown	p.R280T	WT	WT	WT	WT	51.1527375	D	
358	F	73	a	2	Yes	Primary	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	14.75504323	C	
359	F	75	a	2	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	WT	p.E17K	0.11527375	A	
360	M	69	2	3	Yes	Primary	Yes	Unknown	Unknown	WT	WT	WT	WT	WT	26.91642651	C	
364	F	67	3	3	No	Primary	Yes	Unknown	Unknown	p.E198*	p.E545K	KRAS p.G12S	p.S35C	WT	25.87896254	C	
366	F	89	a	2	Yes	Primary	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	17.03170829	C	
385	F	75	1	2	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	7.377521614	B	
397	M	58	a	2	Yes	Recurrence	Unknown	Unknown	p.S249C	WT	p.E542K, p.E545K	KRAS p.G12D	WT	WT	0	A	
406	F	84	a	2	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	3.688760807	B	
411	M	Unknown	1	3	Yes	Recurrence	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	71.60529344	D	
417	F	88	4	3	Yes	Primary	Unknown	Yes	Unknown	WT	p.E542K	KRAS p.G12V	WT	WT	23.17028282	C	
418	F	73	1	3	Yes	Primary	Unknown	Unknown	Unknown	WT	p.E545K	WT	WT	WT	7.55043227	B	
433	M	78	2	3	Yes	Recurrence	Unknown	Unknown	p.S249C, p.Y375C	WT	WT	WT	WT	WT	19.41887227	C	
438	F	73	2	3	Unknown	Primary	Unknown	Unknown	p.Y375C	p.H214R, p.R280K	WT	WT	WT	WT	24.29394813	C	
454	M	56	a	2	Yes	Primary	No	Unknown	p.G372C	WT	p.E542K	WT	WT	WT	18.06916426	A	
457	M	67	1	3	Yes	Primary	Unknown	Unknown	p.S249C	p.M104G1	WT	WT	WT	WT	12.96829971	C	
461	M	53	1	3	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	9.193083573	B	
468	M	53	1	2	No	Primary	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	5.30259366	B	
482	F	81	a	3	No	Primary	Yes	Unknown	p.S249C	WT	WT	WT	WT	WT	24.49567723	C	
489	F	67	a	3	No	Primary	Yes	Unknown	WT	p.E180K	p.E545K	WT	WT	WT	0	A	
494	F	68	a	2	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	0.3178T	A	
498	F	71	3	3	No	Primary	Unknown	At diagnosis	Unknown	WT	WT	WT	WT	WT	16.08069144	C	
500	F	63	2	3	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	Splicing error (c.509-527del20)	WT	12.37054085	C	
504	F	62	2	3	Yes	Primary	No	Unknown	Unknown	WT	WT	HRAS p.G13R	WT	WT	31.47295742	D	
511	M	75	a	3	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	18.06916427	C	
513	M	63	2	3	Yes	Primary	Yes	Unknown	Unknown	WT	p.E542K	WT	WT	WT	29.68929804	C	
518	M	66	a	2	No	Primary	No	Unknown	p.K652E	WT	p.E542K	WT	WT	WT	0	A	
519	M	69	1	3	Unknown	Primary	Yes	Unknown	p.R248C	p.E298*	WT	WT	WT	WT	32.53739931	D	
529	M	74	a	2	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	p.E17K	14.52449568	C	
536	M	79	a	2	No	Primary	Unknown	Unknown	p.S249C	WT	p.E545K	WT	WT	WT	0	A	
540	M	64	a	2	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	p.Y185*	WT	15.01440922	C	
554	M	79	1	2	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	9.250720461	B	
561	M	64	1	3	No	Primary	Unknown	Unknown	Unknown	WT	p.H1047R	HRAS p.G13V	WT	WT	11.29682997	C	
567	M	75	1	3	Unknown	Recurrence	Yes	Unknown	Unknown	WT	WT	WT	WT	WT	31.00864553	D	
571	F	88	1	3	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	p.S871*	WT	10.69164265	C	
572	M	61	1	3	Yes	Primary	No	Unknown	p.S249C	p.R249S	WT	WT	p.Y195*	WT	19.0778098	C	
575	F	61	a	2	Yes	Primary	Unknown	Unknown	p.R248C	WT	p.E545K	WT	WT	WT	2.247838617	B	
577	F	91	3	3	No	Primary	Unknown	Unknown	Unknown	p.E180K	WT	WT	WT	WT	24.49567723	C	
578	M	66	a	2	Yes	Primary	No	Unknown	p.Y375C	WT	WT	WT	WT	WT	0.979827089	B	
579	F	74	1	2	No	Primary	No	Unknown	p.S249C	WT	p.E545K	WT	p.Q55*	WT	9.193083573	B	
584	M	77	a	3	Yes	Primary	No	Unknown	p.S249C	WT	WT	WT	WT	WT	0	A	
588	F	89	2	3	No	Recurrence	Yes	Unknown	Unknown	Splicing error (c.375+5 G>A)	WT	WT	WT	WT	43.49827388	D	
589	M	70	1	3	Yes	Primary	No	Unknown	Unknown	WT	WT	WT	WT	WT	16.48414986	C	
593	M	75	1	2	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	WT	WT	12.36311239	C	
594	M	74	2	3	Yes	Primary	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	63.54466859	D	
595	M	73	4	3	Yes	Primary	Yes	At diagnosis	Unknown	WT	p.S90fs	WT	WT	Splicing error (c.1317G>A)	WT	71.05868815	D
606	M	66	a	3	Yes	Primary	Yes	Unknown	p.Y375C	WT	p.E545K	WT	WT	WT	21.03746498	C	
643	F	79	a	2	No	Primary	Unknown	Unknown	p.G372C	WT	p.E542K	WT	WT	WT	0	A	
653	M	76	3	3	Yes	Primary	Yes	Unknown	Unknown	p.M169*	WT	WT	WT	WT	34.17721519	D	
657	F	84	a	2	No	Primary	Unknown	Unknown	Unknown	WT	p.Q643R	WT	WT	WT	14.35158501	C	
658	F	57	a	2	Unknown	Primary	Unknown	Unknown	p.S249C	WT	p.E542K	WT	WT	WT	0.23054755	A	
672	F	40	a	2	Yes	Primary	Unknown	Unknown	Unknown	WT	WT	HRAS p.Q61R	WT	WT	0.172708653	C	
675	M	58	a	3	Yes	Primary	Unknown	Unknown	p.R248C	WT	WT	WT	p.S289*	WT	7.34870317	B	
677	M	68	3	3	Yes	Primary	No	Unknown	Unknown	p.E51*	WT	WT	WT	WT	11.26801153	C	
695	F	80	a	2	No	Primary	No	Unknown	Unknown	WT	WT	WT	WT	WT	7.665706052	B	
701	M	81	3	3	Yes	Primary	Yes	Unknown	Unknown	p.R249S	WT	WT	WT	WT	4.833141542	B	
718	F	81	a	2	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	WT	WT	23.34293948	C	
734	M	75	a	3	No	Primary	Unknown	Unknown	Unknown	WT	WT	WT	WT	WT	36.08069164	D	
736	M	62	a	3	Yes	Primary	Unknown	Unknown	p.Y375C	WT	WT	HRAS p.G12S	WT	WT	6.300345224	B	
741	F	39	3	3	No	Recurrence	No	Unknown	Unknown	p.R273H	WT	WT	WT	WT	58.50144092	D	
778	M	55	3	3	Yes	Primary	No	Unknown	p.S373C	WT	WT	WT	p.Q951*	p.E17K	15.30259366	C	
798	M	69	1	3	Yes	Primary	Yes	Unknown	Unknown	p.Y163C	WT	WT	WT	p.S511fs	WT	50.31706238	D
806	M	43	3	3	Yes	Recurrence	No	Unknown	Unknown	WT	WT	WT	WT	WT	25.67723343	C	
811	F	73	a	2	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	p.H1047R	WT	WT	0.028818444	A	
818	M	81	4	3	Yes	Recurrence	Unknown	At diagnosis	Unknown	WT	WT	WT	WT	WT	27.80979827	C	
826	M	67	3	3	Yes	Primary	Yes	Unknown	Unknown	WT	WT	WT	p.L388L (somatic)	WT	14.75834292	C	
837	M	75	a	1	Yes	Primary	Unknown	Unknown	p.S249C	WT	WT	WT	WT	WT	2.795389049	B	

844	F	72	a	2	No	Recurrence	No	p.S240C	WT	p.E542K	WT	WT	WT	3.948126801	B
848	M	87	2	3	Yes	Recurrence	Unknown	WT	p.E221*	WT	WT	p.R0900*, H015Y	WT	55.17836594	D
860	M	70	a	2	Yes	Primary	Unknown	p.S240C	WT	p.E545K	WT	WT	WT	4.870317003	B
866	M	65	1	3	No	Primary	No	p.K652N	WT	WT	WT	WT	WT	3.832853026	B
868	M	79	a	2	Yes	Primary	No	p.S240C	WT	WT	WT	WT	p.E17K	0.115273775	A
884	M	82	1	3	Unknown	Primary	Yes	WT	p.R273H	WT	WT	WT	WT	24.63976045	C
893	M	70	2	3	No	Primary	Yes	WT	p.C275Y	WT	WT	WT	WT	43.44073648	D
894	F	77	a	1	No	Primary	Unknown	WT	WT	WT	HRAS p.Q61L	WT	WT	0.086455331	A
924	F	91	a	2	No	Primary	Unknown	WT	WT	WT	WT	WT	WT	6.195965418	B
930	M	80	1	3	Yes	Primary	Yes	WT	p.K139E	WT	WT	WT	WT	68.73198847	D
933	F	74	a	2	Yes	Primary	Unknown	p.S240C	WT	p.E542K	WT	WT	WT	1.268011527	B
934	F	54	a	2	Yes	Primary	Unknown	p.Y375C	WT	p.E545K	WT	WT	WT	7.780979827	B
944	M	49	3	3	Yes	Primary	Yes	WT	p.R273C	WT	WT	WT	WT	45.79976985	D
961	M	70	a	2	Yes	Primary	No	p.S373C	WT	WT	WT	WT	WT	0.057636888	A
963	F	68	a	2	No	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	1.52737322	B
966	M	73	a	2	No	Primary	No	WT	WT	WT	WT	p.S370*	WT	21.21037464	C
969	M	62	1	3	Yes	Recurrence	Yes	p.Y375C	WT	WT	WT	WT	WT	8.515535998	B
979	M	76	1	3	Yes	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	21.08745685	C
980	F	44	a	2	No	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	8.242074928	B
983	M	74	1	2	Unknown	Primary	Unknown	p.Y375C	WT	p.H104R	WT	WT	WT	1.121979287	B
989	M	71	a	3	No	Primary	Unknown	WT	WT	WT	WT	WT	WT	7.796317606	B
1006	M	70	a	2	Yes	Primary	No	p.S240C	p.G108R	WT	WT	WT	WT	7.867435159	B
1010	M	66	1	3	Yes	Primary	Unknown	WT	WT	WT	HRAS p.R68P	WT	WT	6.530494822	B
1021	M	73	1	3	Yes	Primary	Unknown	WT	p.Q331*, p.D259V	p.E545K	WT	WT	WT	14.49942463	C
1025	F	86	1	2	No	Primary	No	WT	WT	WT	WT	WT	p.E17K	10.50057537	C
1028	M	65	1	3	No	Primary	Unknown	WT	WT	WT	WT	WT	WT	7.53739931	B
1033	M	74	1	3	Yes	Primary	Unknown	WT	p.H195T	WT	WT	p.R1906	WT	24.33831991	C
1043	M	79	a	3	Yes	Primary	No	p.S240C	WT	WT	WT	WT	WT	31.21403913	D
1044	M	68	a	2	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	2.968299712	B
1046	M	72	a	2	Yes	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	24.00576369	C
1049	F	70	4	3	Yes	Primary	No	WT	p.Y205C	WT	WT	Splicing error (c.664-2A>G)	WT	42.92289988	D
1052	F	62	1	3	Yes	Recurrence	Unknown	p.Y375C	WT	p.E545K	WT	WT	WT	12.77330265	C
1072	M	87	a	3	Yes	Primary	No	WT	WT	WT	WT	WT	WT	20.10932106	C
1073	M	69	a	3	No	Primary	Unknown	WT	WT	WT	WT	WT	WT	23.21634062	C
1079	F	96	a	3	No	Primary	Unknown	p.R248C	WT	p.E545K	WT	p.W444*	WT	12.71576525	C
1081	F	79	1	3	Yes	Primary	Yes	p.A393E	p.Y234H	p.H104R	WT	WT	WT	0	A
1082	F	46	a	3	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	17.72151899	C
1094	F	67	1	3	Yes	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	13.72266974	C
1103	M	45	a	3	No	Primary	Unknown	WT	WT	p.E542K, p.E545K	WT	WT	WT	0.230149597	A
1109	M	68	2	3	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	21.31708644	C
1118	M	85	1	3	Yes	Primary	Unknown	p.R248C	WT	p.E545K	WT	KRAS p.G12D	WT	12.31300345	C
1126	M	85	3	3	Yes	Primary	Yes	At diagnosis	WT	WT	WT	WT	WT	42.92289988	D
1129	M	60	1	3	Unknown	Primary	Unknown	WT	p.E68D, p.A76V, p.R337C	WT	WT	NRAS p.Q61L	WT	14.47065593	C
1138	M	73	1	3	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	16.7433832	C
1145	M	67	1	3	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	28.73939396	C
1148	F	81	3	3	Yes	Primary	Unknown	WT	p.E271K, p.N3106	WT	WT	WT	WT	24.6835443	C
1153	M	79	1	3	Yes	Primary	Unknown	p.R248C	Splicing error (c.672-16T>T)	WT	WT	WT	WT	8.745684695	B
1157	M	85	2	3	Yes	Primary	No	p.S240C	WT	WT	WT	WT	WT	10.64441887	C
1161	M	76	1	3	Unknown	Primary	Unknown	p.S240C	WT	p.E545K	WT	WT	WT	11.39240506	C
1210	F	68	1	3	Yes	Primary	Unknown	WT	WT	WT	WT	WT	WT	20.19562716	C
1212	M	48	1	3	Yes	Primary	Yes	WT	p.T140-Q144Del, p.E224K, p.C238Y	WT	WT	WT	WT	29.20020315	C
1220	M	59	1	2	Yes	Recurrence	Unknown	p.S240C	WT	WT	WT	WT	WT	1.00690488	B
1229	M	90	1	3	Yes	Primary	Unknown	p.S240C	WT	WT	WT	WT	WT	15.10356732	C
1230	M	62	1	3	Yes	Primary	No	p.S240C	WT	WT	WT	p.E571Q	WT	15.73647871	C
1234	M	78	1	3	Yes	Primary	Unknown	WT	p.M246I	WT	WT	WT	WT	24.5972382	C
1248	F	84	3	3	No	Primary	Yes	WT	p.E258G	WT	WT	WT	WT	70.56962025	D
1264	F	65	1	3	Yes	Primary	Yes	WT	WT	WT	WT	WT	WT	27.35903337	C
1267	M	73	2	3	No	Primary	Yes	p.S240C	WT	p.E545K	WT	WT	WT	16.05293441	C
1298	M	75	a	3	Yes	Primary	Unknown	p.S240C	WT	p.E545K	WT	WT	WT	3.509781358	B
1300	M	53	1	3	Yes	Primary	Unknown	WT	p.L130P, p.D228H	p.E545K	WT	Splicing error (c.693G>A)	WT	35.67318757	D
1301	M	76	4	3	Yes	Primary	No	WT	p.R273C	WT	WT	WT	WT	38.40621404	D
1310	M	89	1	3	Yes	Primary	Unknown	WT	p.E258*	WT	WT	WT	WT	25.51783659	C
1311	M	58	1	3	Yes	Primary	Unknown	p.G372C	WT	p.E545Q	WT	p.E9fs	WT	6.214039125	B
1315	M	64	1	3	Yes	Primary	No	p.S240C	p.R280T	p.E545K	WT	WT	WT	0.143843498	A
1317	M	47	3	3	Yes	Primary	Yes	WT	p.K139N	WT	WT	WT	WT	2.991944764	B
1320	M	68	1	3	Yes	Primary	Yes	WT	p.Y234H	WT	WT	WT	WT	50.80552359	D
1321	F	82	2	3	Yes	Primary	Yes	p.S240C	p.R280K	p.H104R	WT	WT	WT	7.278481013	B
1322	M	59	4	3	Yes	Primary	No	WT	WT	WT	WT	WT	WT	25.0287687	C
1324	M	59	1	3	No	Primary	Yes	p.S240C	p.S90F, p.Q192*, p.G244V, p.E388Q	WT	WT	WT	WT	12.11162255	C
1325	M	42	1	3	Yes	Recurrence	Unknown	Yes	p.S240C	p.Y234H	WT	WT	WT	28.30840046	C
1338	F	68	3	3	Yes	Primary	Yes	WT	p.Y375C	p.E545K	WT	WT	WT	29.37284235	C
1342	M	68	1	2	Yes	Primary	No	WT	p.Q192*	p.S240C	WT	WT	WT	16.11047181	C
1345	M	67	1	2	Yes	Primary	No	p.S240C	WT	WT	WT	WT	WT	12.91714614	C
1349	M	77	1	3	Yes	Primary	Yes	WT	WT	p.E545K	WT	KRAS p.G12V	WT	20.88607595	C
1352	M	78	2	2	Yes	Primary	Unknown	At diagnosis	WT	WT	WT	WT	WT	36.96777906	D
1366	M	68	3	2	No	Primary	Unknown	At diagnosis	WT	p.R248Q	WT	WT	WT	47.12313003	D

¹ If cystectomy was not performed then staging of tumours >T2 was inferred from CT scan.

² Variants c.637 C>T and c.639 A>G were both detected in sample 315

³ FGA group:

A = <1.0%

B = 1.0-10%

C = 10-30%

D = >30%