Learning curve for rectal robotic surgery

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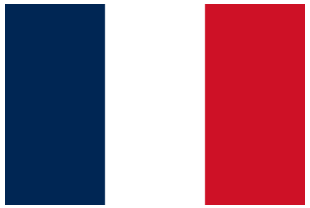
Learning curve for robotic-assisted surgery for rectal cancer: a multicentric, prospective study (ROBOT-CR Study)



E. Cotte [1], A. Dubois [2], E. Rullier [3], P. Rouanet [4], Q. Denost [3], B. Celerier [3], D. Pezet [2], G. Passot [1], A. Aboukassem [2], P.E. Colombo [4], A. Mourregot [4], S. Carrere [4], D. Vaudoyer [1], Y. François [1], S. Gourgou [4], L. Gauthier [4].

[1]Hôpital Lyon-Sud - Pierre-Bénite (France), [2]Chu Estaing - Clermont-Ferrand (France), [3]Hopital Haut-Lévèque - Pessac (France), [4]Institut Du Cancer De Montpellier - Montpellier (France)

Rationnal

- Robotic surgery is booming
- In particular for colorectal surgery
- New technique = learning curve

→ What is the learning curve for rectal robotic surgery?

→ Is there any risk for patients during the learning curve?

Learning curve study

- **4 centers in France :**

  Clermont-Ferrand; Bordeaux; Lyon; Montpellier

- **Prospective robotic colorectal studies : ROBOT-CR studies**

- **1324 patients included from jan 2018 to Feb 2021 (now 1800)**

Learning curve study

Selection of an homogeneous population :

- *Inclusion criteria*:
  - LAR with TME for rectal adenocarcinoma
  - With low colorectal or coloanal anastomosis

- *Exclusion criteria*:
  - Rectal cancer reccurence
  - Any associated resection
  - LAR after local excision
  - Surgeon already expert in robotic surgery

- **3 centres**
- 991 robotic colorectal procedures
- 483 for rectal cancer

► 174 patients selected

Methods

- **2 endpoints for the learning curve**:
  - **Operative time** (skin to skin, min)
  - **Conversion rate**
- **Learning curves estimation → 2 methods**
  - Continuous criteria: **CUSUM**
  - Binary criteria: **RA-CUSUM**

Methods

- **Learning phases were identified according to the changes in trend of the curves obtained**

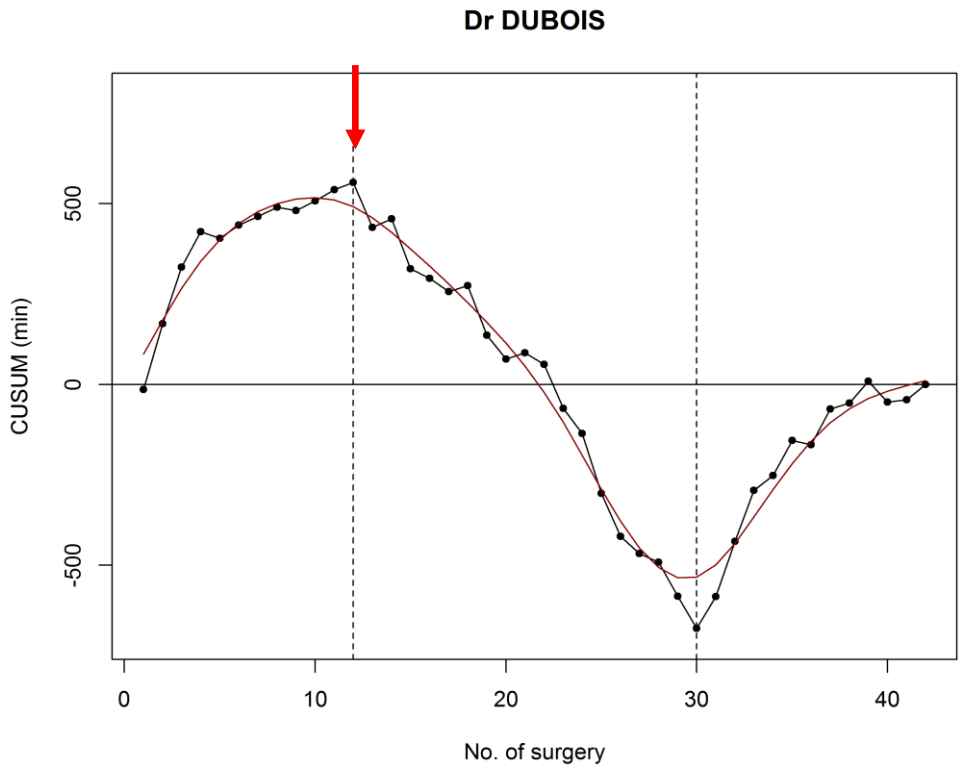
- **Criteria compared according to the learning phases** :
  - Patients features: Age, Sex, Obesity, ECOG, ASA, metastatic status, histology, previous abdominal surgery

  - Surgical features: Blood loss, Conversion, TME Grade, CRM, DRM, splenic flexure mobilisation, nodes count, LOS, 30 days-Morbidity

Surgeons> 25 TME

	All N=174	
Center		
Clermont-Ferrand	65	(37.4%)
Bordeaux	51	(29.3%)
Lyon	58	(33.3%)
Clermont Ferrand : Investigator's name		
ABOUKASSEM	5	(7.7%)
DUBOIS	45	(69.2%)
GAGNIERE	1	(1.5%)
PEZET	14	(21.5%)
Bordeaux : Investigator's name		
CELERIER	2	(3.9%)
DENOST	16	(31.4%)
RULLIER	33	(64.7%)
Lyon : Investigator's name		
COTTE	57	(98.3%)
TAVERNIER	1	(1.7%)

Operative time – Dr Dubois



1 – 12th procedures longer than mean

13 – 30th procedures faster than mean

31 - 45th procedures longer than mean

Patients features:

	Phase identified			All	Test
	1-12 surgeries N=12	13-30 surgeries N=18	31-45 surgeries N=15	N=45	
Age					P = 0.540
N	12	18	15	45	
Mean (Std)	65.9 (7.3)	62.1 (12.1)	62.9 (10.8)	63.4 (10.5)	
Median (Q1;Q3)	67.0 (63.5; 72.5)	64.5 (55.0; 67.0)	65.0 (60.0; 71.0)	66.0 (60.0; 69.0)	
Gender					P = 0.775
Male	9 (75.0%)	11 (61.1%)	11 (73.3%)	31 (68.9%)	
Female	3 (25.0%)	7 (38.9%)	4 (26.7%)	14 (31.1%)	
Obese					P = 0.552
No	10 (83.3%)	16 (88.9%)	11 (73.3%)	37 (82.2%)	
Yes	2 (16.7%)	2 (11.1%)	4 (26.7%)	8 (17.8%)	

Surgical features:

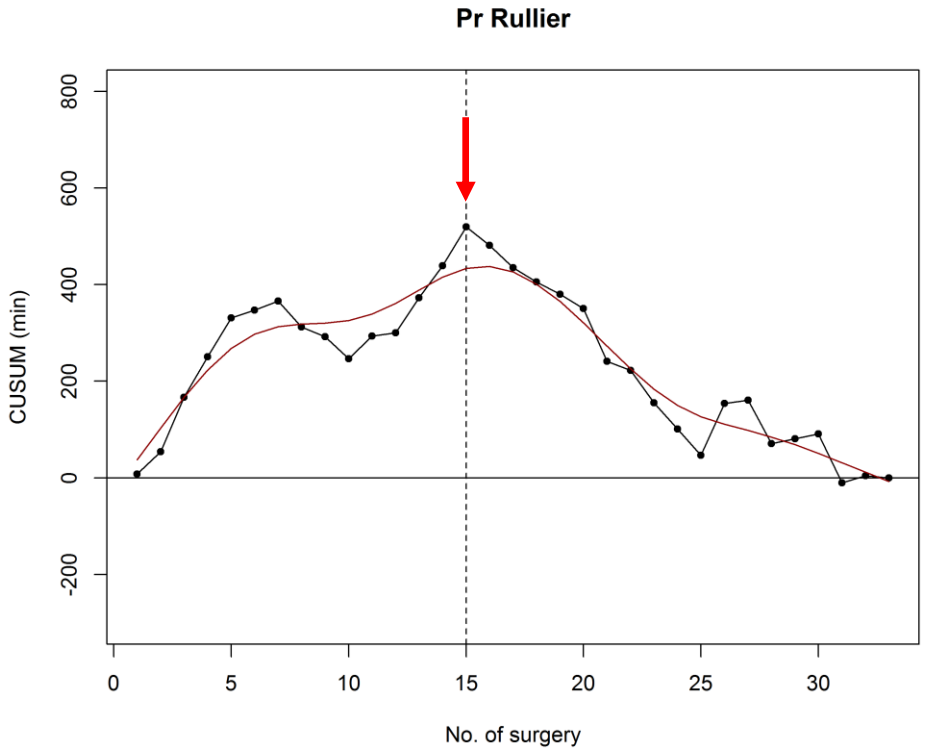
- Operative time (p<0.001)

Operative time	Phase 1	Phase 2	Phase 3
N	12	18	12
Median (Q1-Q3)	404.5 (384; 446)	310.5 (257; 352)	421.0 (385; 478)

- Conversion (p=0.055)

	Phase 1 (N=12)	Phase 2 (N=18)	Phase 3 (N=15)
Yes	25.0%	0.0%	6.7%

Operative time– Pr Rullier



1 – 15th procedures longer than mean

16 – 33th procedures faster than mean

Patients features :

► No difference between phases

Surgical features :

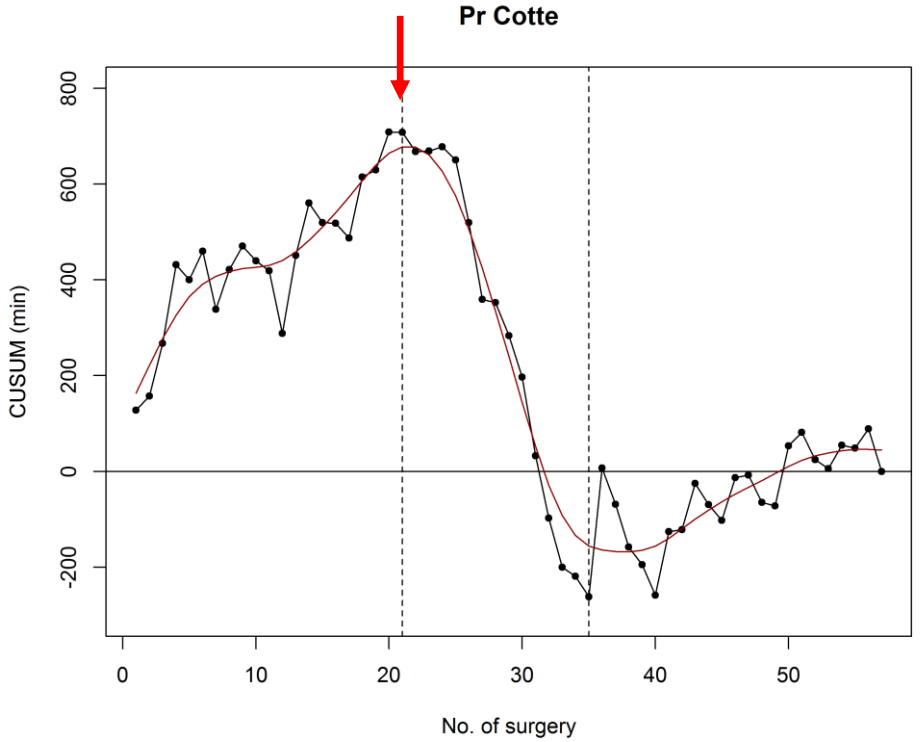
- Operative time (p=0.002)

Operative time	Phase 1	Phase 2
N	15	18
Median (Q1-Q3)	339.0 (299; 373)	263.0 (238; 299)

- Conversion (p=0.013)

	Phase 1 (N=15)	Phase 2 (N=18)
Yes	33.3%	0%

Operative time– Pr Cotte



1 – 21st procedures longer than mean
22 – 35th procedures faster than mean
36 – 57th stabilisation phase

Patients features :

► No difference between phases

Surgical features

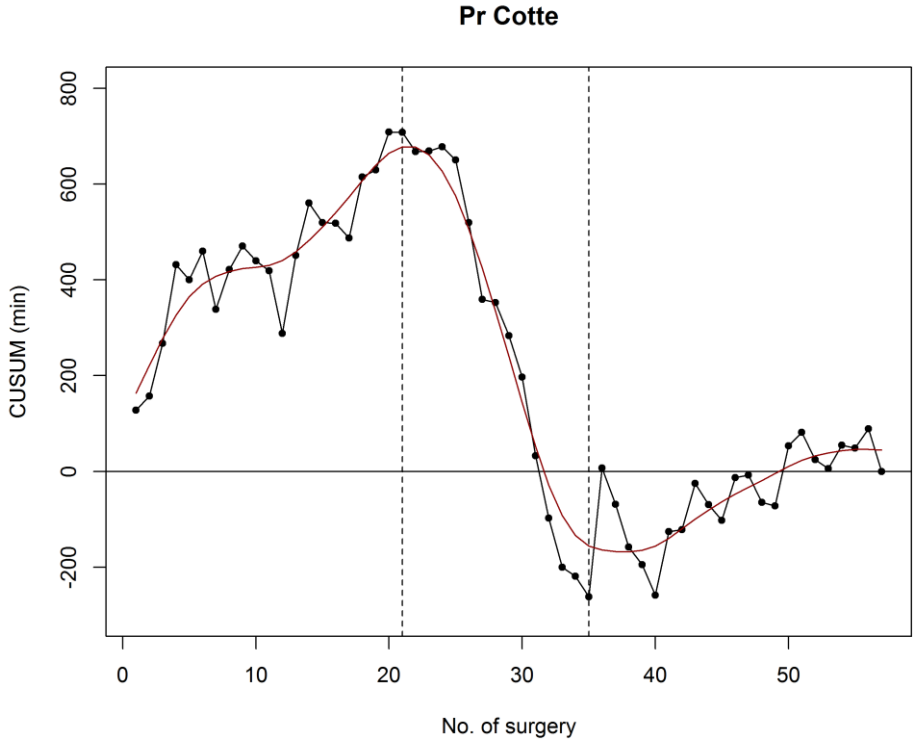
- Operative time (p<0.002)

Operative time	Phase 1	Phase 2	Phase 3
N	21	14	22
Median (Q1-Q3)	360.0 (300; 440)	275.0 (201; 312)	324.5 (274; 380)

- Splenic flexure mobilisation (p=0.008)

Splenic flexure mobilization	Phase 1 (N=21)	Phase 2 (N=14)	Phase 3 (N=22)
Yes	95%	79%	36%

SAFETY



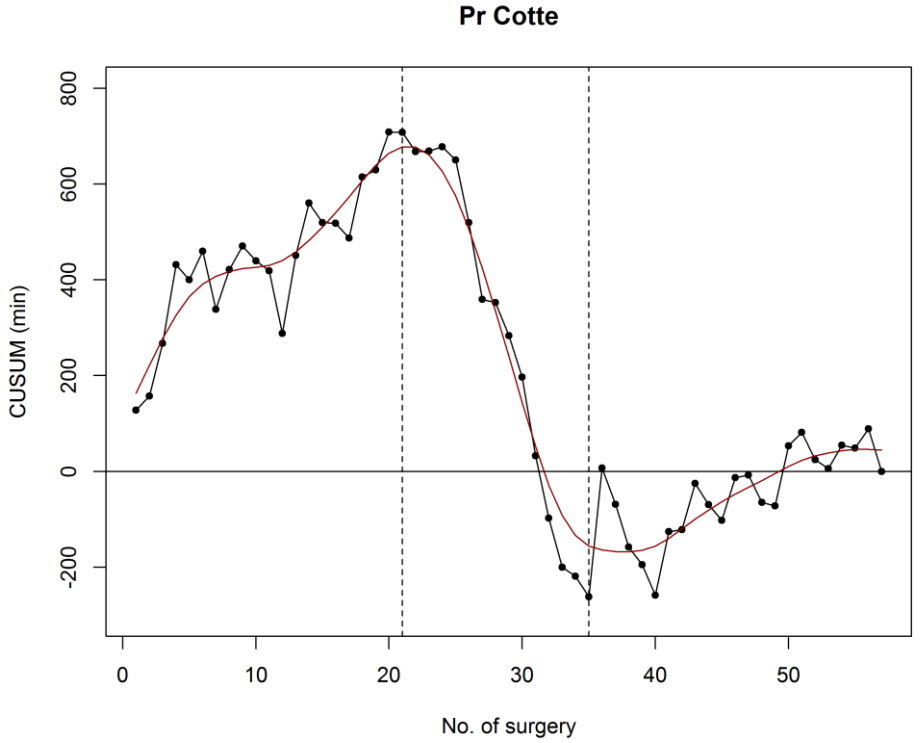
1 – 21st : procedures longer than mean
22 – 35th : procedures faster than mean
36 - 57th : stabilisation phase

No difference during the different phases for :

- **Pathological results : TME grade or CRM**
- **Post-operative outcomes : LOS, morbidity**

TME Grade									P = 0.189
Incomplete	2	(9.5%)	0	(0.0%)	0	(0.0%)	2	(3.5%)	
Complete	19	(90.5%)	14	(100.0%)	22	(100.0%)	55	(96.5%)	
CRM									P = 1.000
<=1mm	1	(4.8%)	1	(7.1%)	1	(4.5%)	3	(5.3%)	
>1mm	20	(95.2%)	13	(92.9%)	21	(95.5%)	54	(94.7%)	
Number of postoperative days prior to discharge									P = 0.905
N	21		14		22		57		
Mean (Std)	10.2 (4.8)		8.6 (3.1)		10.2 (6.9)		9.8 (5.4)		
Median (Q1;Q3)	7.0 (7.0; 13.0)		8.0 (7.0; 8.0)		9.0 (5.0; 12.0)		8.0 (7.0; 13.0)		
Grade 3 + morbidity at 30 days									P = 0.090
No	15	(71.4%)	14	(100.0%)	17	(77.3%)	46	(80.7%)	
Yes	6	(28.6%)	0	(0.0%)	5	(22.7%)	11	(19.3%)	

SAFETY



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Operative time– Conclusion

- **2-3 phases according to the surgeon**
- **1st phase was achieved after 12-21 procedures**
- **No degradation of safety and quality criteria (TME grade, CRM, nodes count, morbidity)**

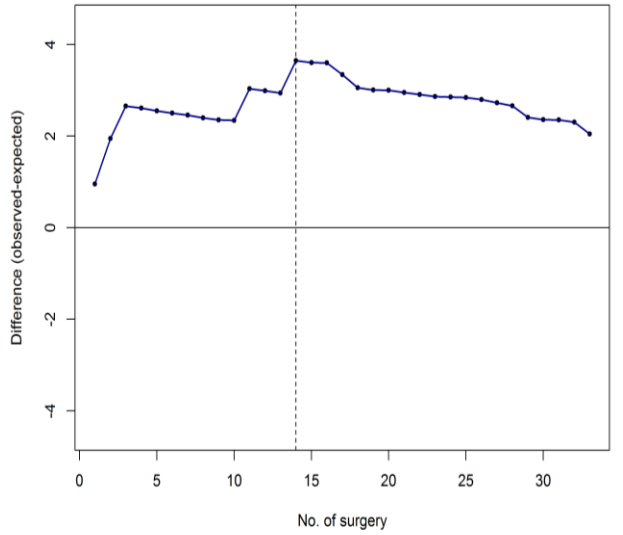
	Nb of other robotic surgeries during phase 1
Dr Dubois	21
Pr Rullier	55
Pr Cotte	55

Conversion – Method

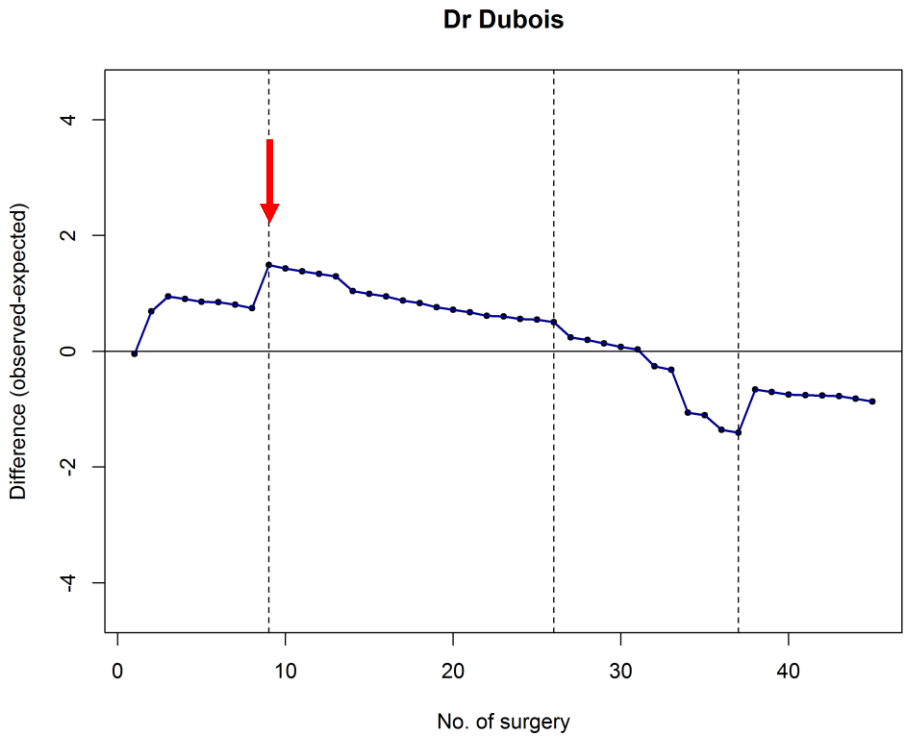
Logistic model for conversion risk estimation :

- Model was estimated on the all cohort (n=174)
- **Risk factors in the final model :** Obesity, male sex, metastasis and previous history of cancer

	Conversion risk	
	Low	**High**
Conversion	Strongly ↗	Faintly ↗
No conversion	Faintly ↘	Strongly ↘



Conversion – Dr Dubois



1 – 9th : Initial phase with conversions
10 – 26th : Phase without conversion
27 – 37th : Optimal performance phase
38 – 45th : Stabilisation phase with 1 conversion

Patients features :

► No difference between phases

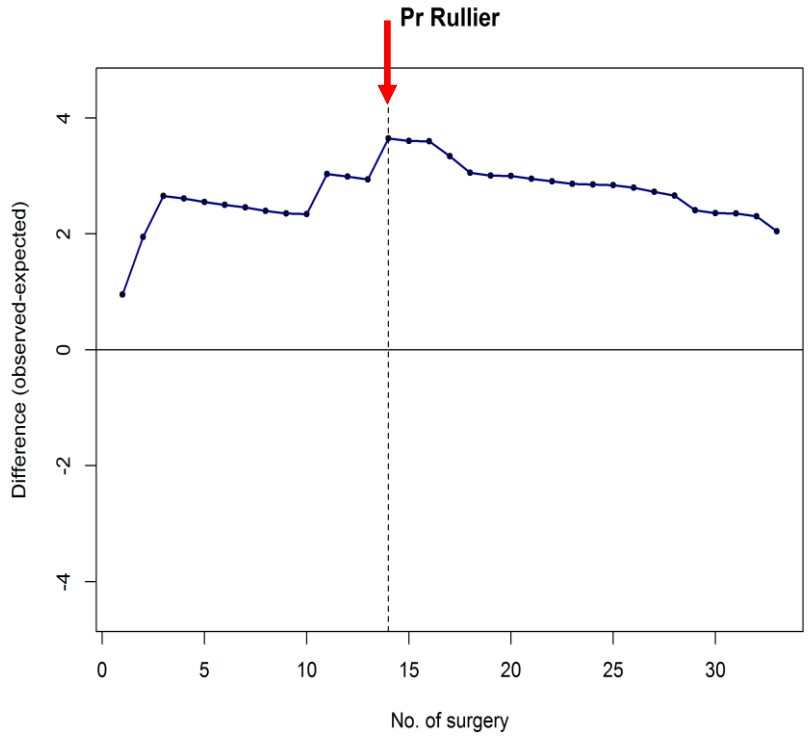
Surgical features :

- Conversion (p=0.016)

	Phase 1 (N=9)	Phase 2 (N=17)	Phase 3 (N=11)	Phase 4 (N=8)
Yes	33%	0%	0%	12.5%

4/45 conversions (8.9 %)

Conversion – Pr Rullier



1 – 14th : 5 initial conversions

15 – 33th : Phase without conversion

Patients features :

- No difference between phases

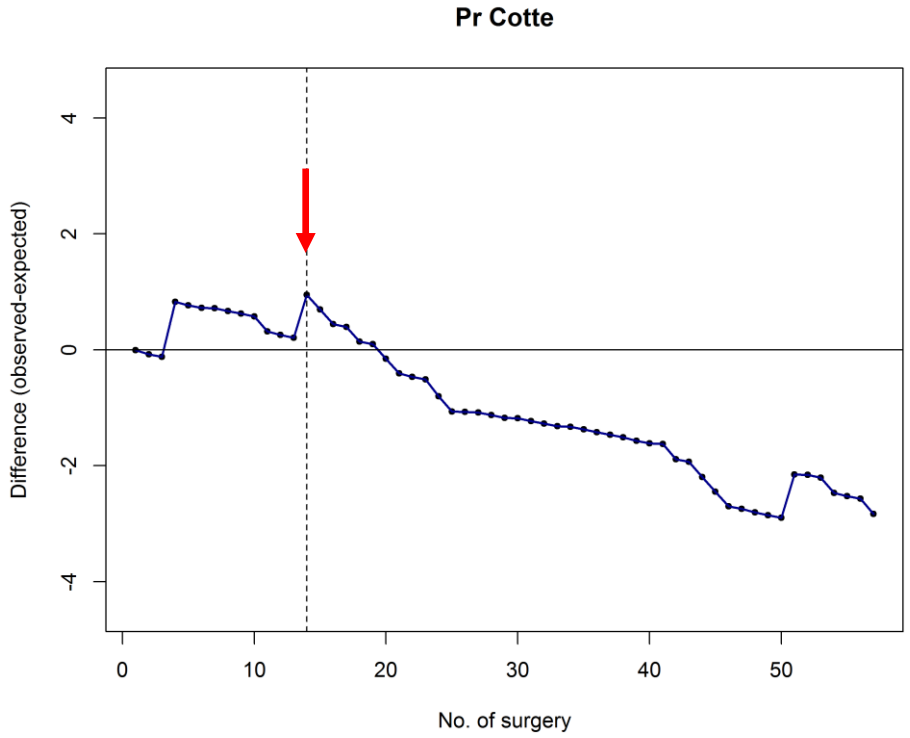
Surgical features :

- Conversion (p=0.046)

	Phase 1 (N=14)	Phase 2 (N=19)
Yes	36%	0%

5/33 conversions (15 %)

Conversion – Pr Cotte



1 – 14ème procedures: Initial phase : 2 conversions

15 - 57ème procedures: Descending phase with low rate of conversion

3/57 conversions (5 %)

Patients features:

- Previous abdominal surgery (p=0.049)

	Phase 1 (N=14)	Phase 2 (N=43)
Yes	14%	49%

- Obesity (p=0.049)

	Phase 1 (N=14)	Phase 2(N=43)
Yes	0%	26%

Surgical features:

- Conversion (p=0.146)

	Phase 1 (N=14)	Phase 2 (N=43)
Yes	14%	2.3%

- Splenic flexure mobilisation(p=0.023)

	Phase 1 (N=14)	Phase 2 (N=43)
Yes	93%	59%

Conversion – Conclusion

- **2-4 phases according to surgeon**
- **Learning curve was achieved after 9-14 procedures**
- **No degradation of safety and quality criteria (TME grade, CRM, nodes count, morbidity)**
- Low number of conversion: learning phases are diffcult to identify
- But conversion became exceptional after the 1st phase

CONCLUSIONS

- **Learning curve** for robotic TME was achieved after **12 à 21 procedures** (operative time and conversion)
- **Conversion became exceptional** after the 1st phase
- **No chance loss for the patient during the learning curve of robotic surgery** (oncological quality criteria and morbidity)
- **But we must take in account the other robotic procedures performed during the same time** (between 21 and 55 according to surgeon)