Groupement Hospitalier de Territoire
Grand Paris Nord-Est
Aulnay-sous-Bois - Le Raincy-Montfermeil - Montreuil

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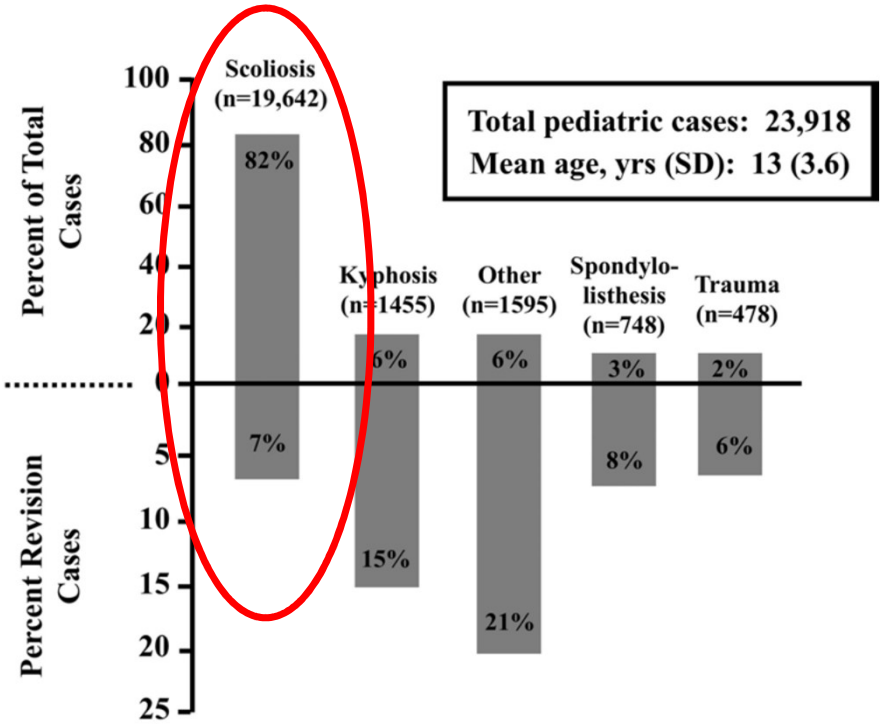
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Implications périopératoires pour les différentes techniques de chirurgie du rachis

Pr Souhayl DAHMANI

DAR Hôpital Robert Debré. Paris & DAR Hôpital Robert Ballanger. Aulnay-Sous-Bois

Morbidity and mortality associated with spinal surgery in children: a review of the Scoliosis Research Society morbidity and mortality database



Complication	No. of Patients (%)
overall	2040 (8.5)
mortality	31 (0.13)
superficial wound infection	248 (1)
deep wound infection	413 (1.7)
pulmonary embolus	8 (0.03)
respiratory	224 (0.9)
hematoma	107 (0.4)
durotomy	115 (0.5)
implant related	371 (1.6)
DVT	9 (0.04)
new neuro deficit	324 (1.4)
other	190 (0.8)

Disease Process	No. of Patients	No. of Complications (%)	No. of Deaths (%)
scoliosis	19,642	1619 (8.2)	26 (0.13)
kyphosis	1,455	214 (14.7)	3 (0.21)
spondylolisthesis	748	72 (9.6)	0 (0)
trauma	478	36 (7.5)	1 (0.21)
other*	1595	99 (6.2)	1 (0.06)

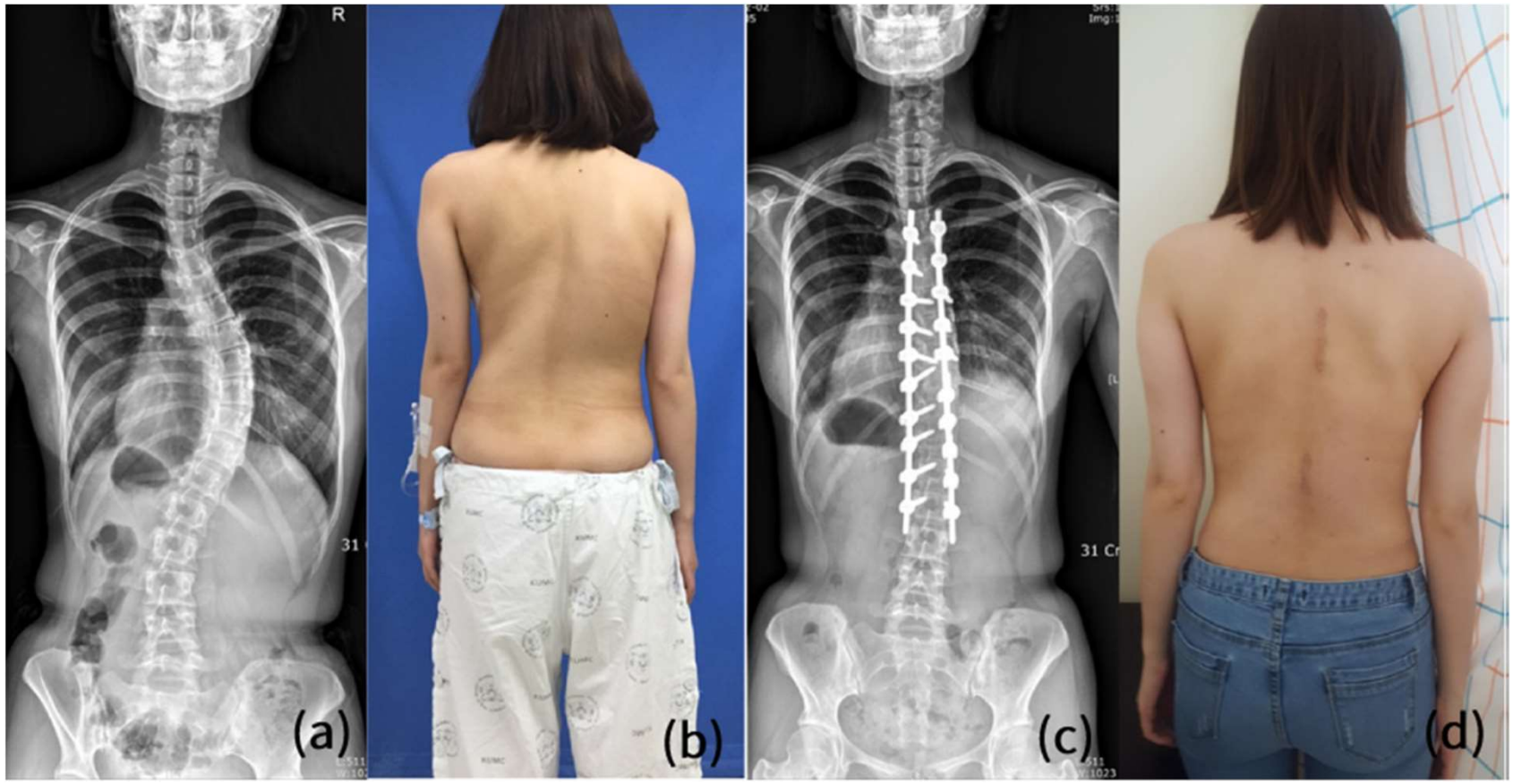
Kai-Ming G et al. J Neurosurg Pediat 2011.





- Chirurgie du rachis dominée par la scoliose : idiopathique, malformative ou neuromusculaire
- Chirurgie lourde avec retentissement général sur des patients potentiellement lourds
- Prise en charge périopératoire
- Equipe pluridisciplinaire

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Park SC et al. J Clinic Med 2022.

Block AMet al. J Clinic Med 2022.







- Le type de scoliose & implications pour la préparation



- Gestion du capital sanguin



- Gestion de la douleur & Réhabilitation accélérée après chirurgie



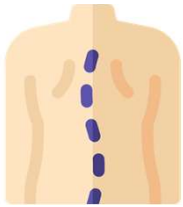
- Prévention des infections



- Anesthésie & monitorage médullaire

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Type de scoliose

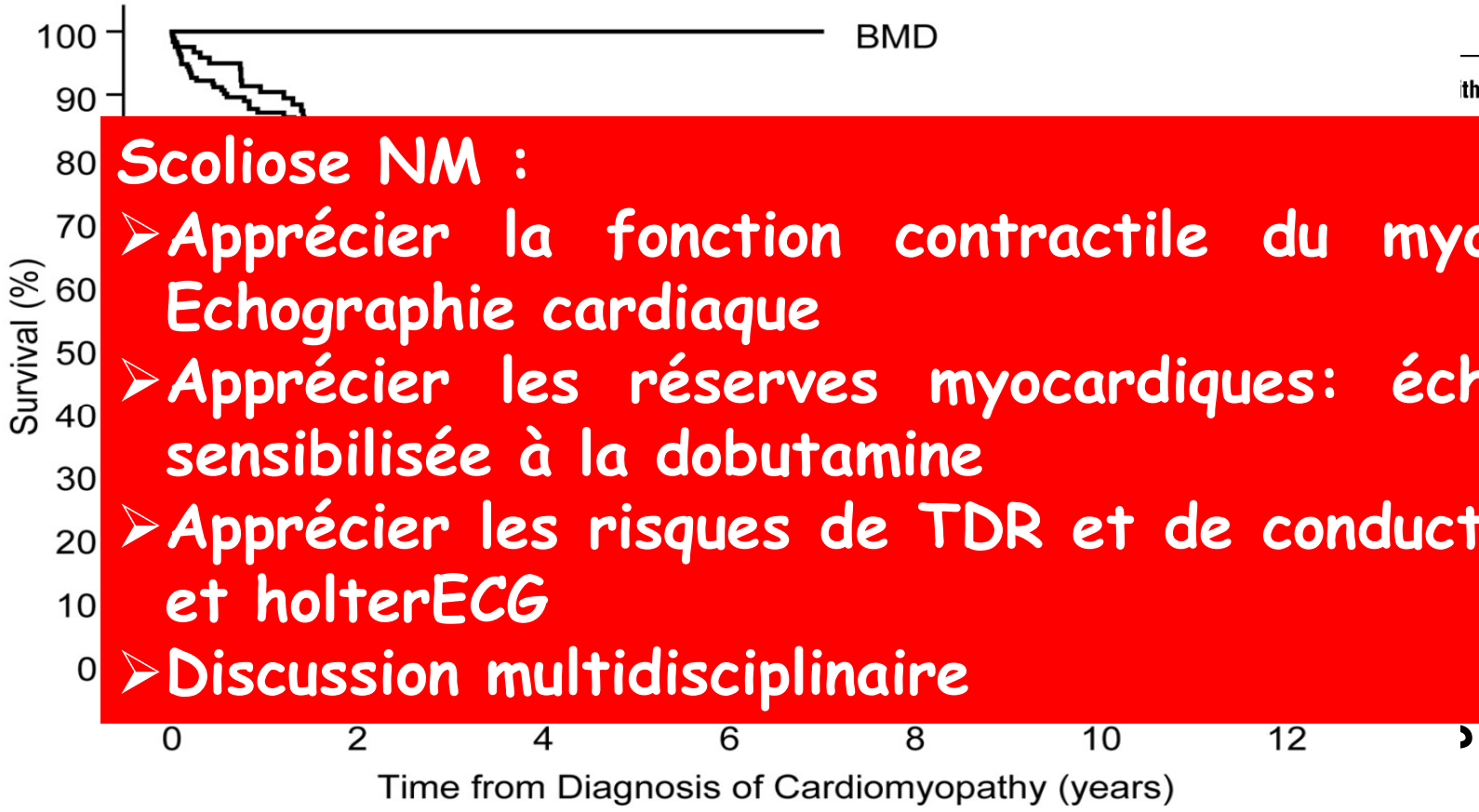


N = 9351

	Toutes complication	Complications cardio-vasculaires	Transfusion sanguine	Admission SI	Durée d'hospitalisation
Neuromusculaire	2.77 [2.12–3.61]	3.06 [2.26–4.14]	1.89 [1.50–2.39]	1.49 [1.15–1.91]	1.30 [1.24–1.36]
Age		15 – 18 ans: 0.55 [0.32–0.94]		19 à 21 ans: 0.58 [0.34–0.98]	15-18 ans: 0.80 [0.74–0.87]
Etendue chirurgie (> 7 étages)			1.80 [1.39–2.34]	1.42 [1.09–1.83]	
Expérience	0.99 [0.99–0.99]	0.99 [0.98–0.99]		1.01 [1.01–1.02]	
Antifibrinolytiques (ATX)				1.52 [1.14–2.03]	0.95 [0.91–1.00]

DelPizzo K et al. Anesth Analg 2020.

Table 3. Concurrent Diagnoses of Children Hospitalized for Scoliosis Surgery With and Without NMD



ithout NMD

	P Value[a]
	<.001
	<.001
	<.001
	.63
	<.001

wi

[c] $P < .25$ for negative tail (decreased frequency of association among children with NMD).

Scoliose NM :

- Apprécier la fonction contractile du myocarde : Echographie cardiaque
- Apprécier les réserves myocardiques: échographie sensibilisée à la dobutamine
- Apprécier les risques de TDR et de conduction: ECG et holterECG
- Discussion multidisciplinaire

Barsdorf AI et al. Arch Neurol 2010.

Connuck DM et al. Am Heart J 2008.

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Decision made to undergo posterior spinal fusion

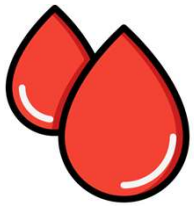


Table 5. Univariable Associations Between Secondary Variables of Interest and Postoperative Intubation and Intensive Care Unit Admission Among Secondary Scoliosis Cohort

	Secondary Scoliosis Cohort (n = 145)			
Outcome	**Postoperative Intubation (n = 29)**		**Intensive Care Unit Admission (n = 77)**	
	Odds Ratio (95% CI)	***P* Value[a]**	**Odds Ratio (95% CI)**	***P* Value[a]**
Age	1.00 (0.90–1.12)	.98	1.02 (0.94–1.11)	.65
Weight	0.97 (0.93–1.00)	.029	0.98 (0.95–1.00)	.031
Cobb Angle	1.03 (1.00–1.05)	.025	1.03 (1.01–1.05)	.005[b]
ASA physical status				
I and II	Ref	.185	Ref	<.001[b]
III and IV	1.99 (0.72–5.50)		4.15 (1.91–9.03)	
Preoperative BiPAP use[c]				
No	Ref	.007[b]	…	…
Yes	4.25 (1.50–12.05)			
Pulmonary function test attempted				
Yes	Ref	<.001[b]	Ref	.001[b]
No	4.91 (1.96–12.29)		3.14 (1.58–6.26)	
Pulmonary function test acceptable[d]				
No	Ref	.48	Ref	.08
Yes	1.98 (0.30–12.89)		2.57 (0.90–7.33)	
Intraoperative blood transfusion				
No	Ref	.11	Ref	.004[b]
Yes	1.97 (0.85–4.52)		2.71 (1.38–5.33)	

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Transfusion sanguine



Variable	Adjusted OR	95% Confidence Interval	p value
Erythropoietin treatment			
No	1.00	—	—
Yes	0.290	(0.135,0.624)	.0015
Type of scoliosis			
Idiopathic	1.00	—	—
Neurogenic	2.020	(1.069,3.819)	.03
Degree of curve*	1.015	(1.005,1.025)	.004
Lumbrosacral fusion			
No	1.00	—	—
Yes	2.174	(0.910,5.192)	.08

*Estimate

Estimation transfusion homologue: 5 à 25 %

Factor	B	SE of B	P	OR	95% confidence interval of OR
Levels fused > 15	1.6	0.9	0.08	5	0.8–29.7
Sacral fusion	0.3	1.4	0.8	0.7	0–10.4
BMI < 3rd percentile	1.6	0.8	0.03	5	1.1–22.6
Neuromuscular scoliosis	2.7	1	0,008	15	2–115
Duration of surgery > 255 min	2.3	0.7	0.001	10	3–38

Optimisation:

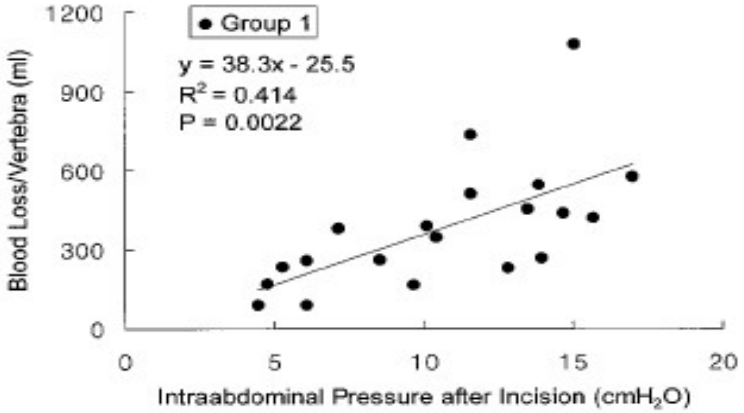
- Hb préopératoire
- Statut nutritionnel

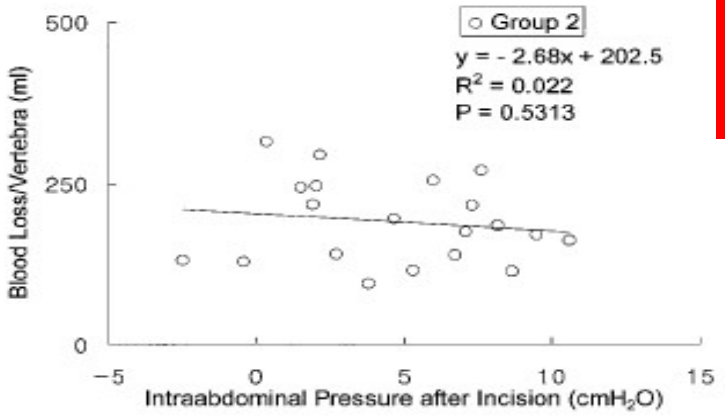
Vitale MG et al. Spine J 2002.

Dupuis C et alet al. ACCPM 2015.

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	Group 1 (n = 20)	Group 2 (n = 20)
Total blood loss (mL)	878 ± 521	436 ± 159*
Blood loss/vertebra (mL)	381 ± 236	190 ± 65*
Number of patients transfused	5	1
Mean units of packed red cells	2.2	2
Fluid replacement (mL)	2175 ± 611	1685 ± 406*
Preoperative Hb (gm/dL)	13.1 ± 1.0	13.1 ± 1.4
Postoperative Hb (gm/dL)	10.6 ± 1.1	11.3 ± 1.1
Operating time (min)	136.8 ± 23.7	134.0 ± 27.8
Hypotensive time (min)	103.0 ± 25.7	101.5 ± 22.0
Anesthetic time (min)	219.3 ± 34.3	203.3 ± 33.6

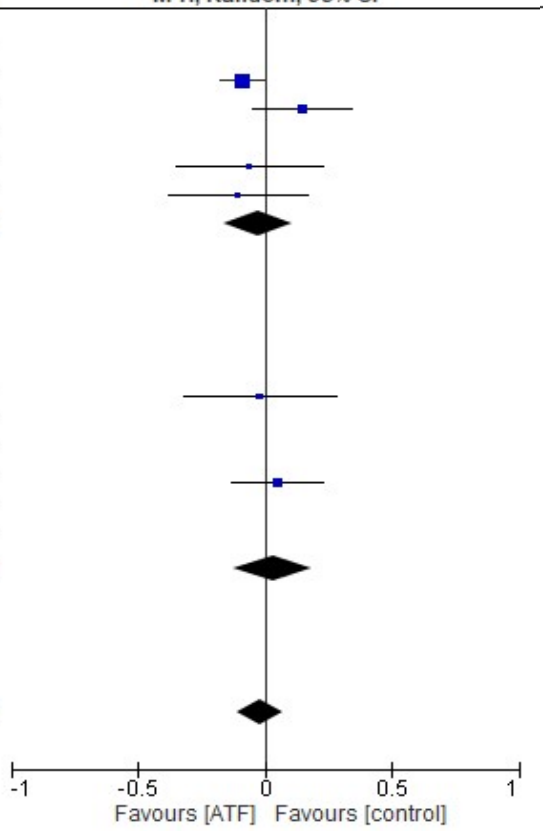




Optimisation de la position ventrale

Park CK. Anesth Analg 2000.

Study or Subgroup	Antifibrinolytic agents Events	Total	Control Events	Total	Weight	Risk Difference M-H, Random, 95% CI
2.1.1 Tranexamic acid						
Florentino-Pinada 2004	13	19	12	17	0.0%	0.97 [0.63, 1.49]
Goobie 2018	1	57	6	56	38.6%	-0.09 [-0.18, -0.00]
Kushagra 2014_1	13	36	10	47	16.2%	0.15 [-0.05, 0.34]
Kushagra 2014_2	11	42	10	47	0.0%	1.23 [0.58, 2.60]
Neilipovitz 2001	6	22	6	18	8.9%	-0.06 [-0.35, 0.23]
Sethna 2005	14	23	15	21	9.4%	-0.11 [-0.38, 0.17]
Subtotal (95% CI)		**138**		**142**	**73.1%**	**-0.03 [-0.16, 0.11]**
Total events	34		37			
Heterogeneity: Tau² = 0.01; Chi² = 5.78, df = 3 (P = 0.12); I² = 48%						
Test for overall effect: Z = 0.41 (P = 0.68)						
2.1.2 Aminocaproic Acid						
Florentino-Pinada 2004	13	19	12	17	8.2%	-0.02 [-0.32, 0.28]
Goobie 2018	1	57	6	56	0.0%	0.16 [0.02, 1.32]
Kushagra 2014_1	13	36	10	47	0.0%	1.70 [0.84, 3.42]
Kushagra 2014_2	11	42	10	47	18.7%	0.05 [-0.13, 0.23]
Neilipovitz 2001	6	22	6	18	0.0%	0.82 [0.32, 2.10]
Sethna 2005	14	23	15	21	0.0%	0.85 [0.56, 1.30]
Subtotal (95% CI)		**61**		**64**	**26.9%**	**0.03 [-0.12, 0.18]**
Total events	24		22			
Heterogeneity: Tau² = 0.00; Chi² = 0.16, df = 1 (P = 0.69); I² = 0%						
Test for overall effect: Z = 0.40 (P = 0.69)						
Total (95% CI)		**199**		**206**	**100.0%**	**-0.02 [-0.11, 0.07]**
Total events	58		59			
Heterogeneity: Tau² = 0.00; Chi² = 7.01, df = 5 (P = 0.22); I² = 29%						
Test for overall effect: Z = 0.39 (P = 0.70)						
Test for subgroup differences: Chi² = 0.33, df = 1 (P = 0.57), I² = 0%						



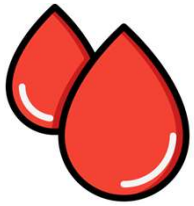
Patients transfusés en intraopératoire

Acide Tranéxamique en intraopératoire

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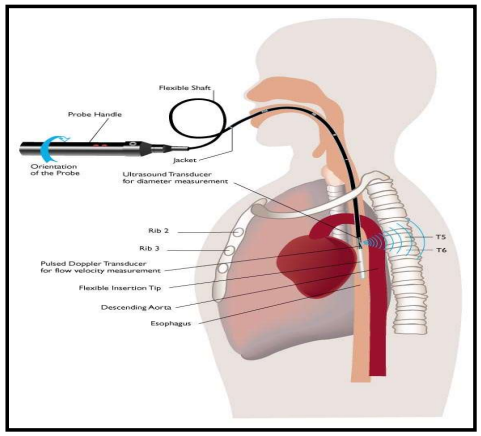


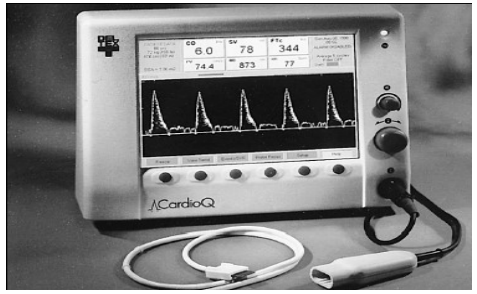
Apports liquidiens

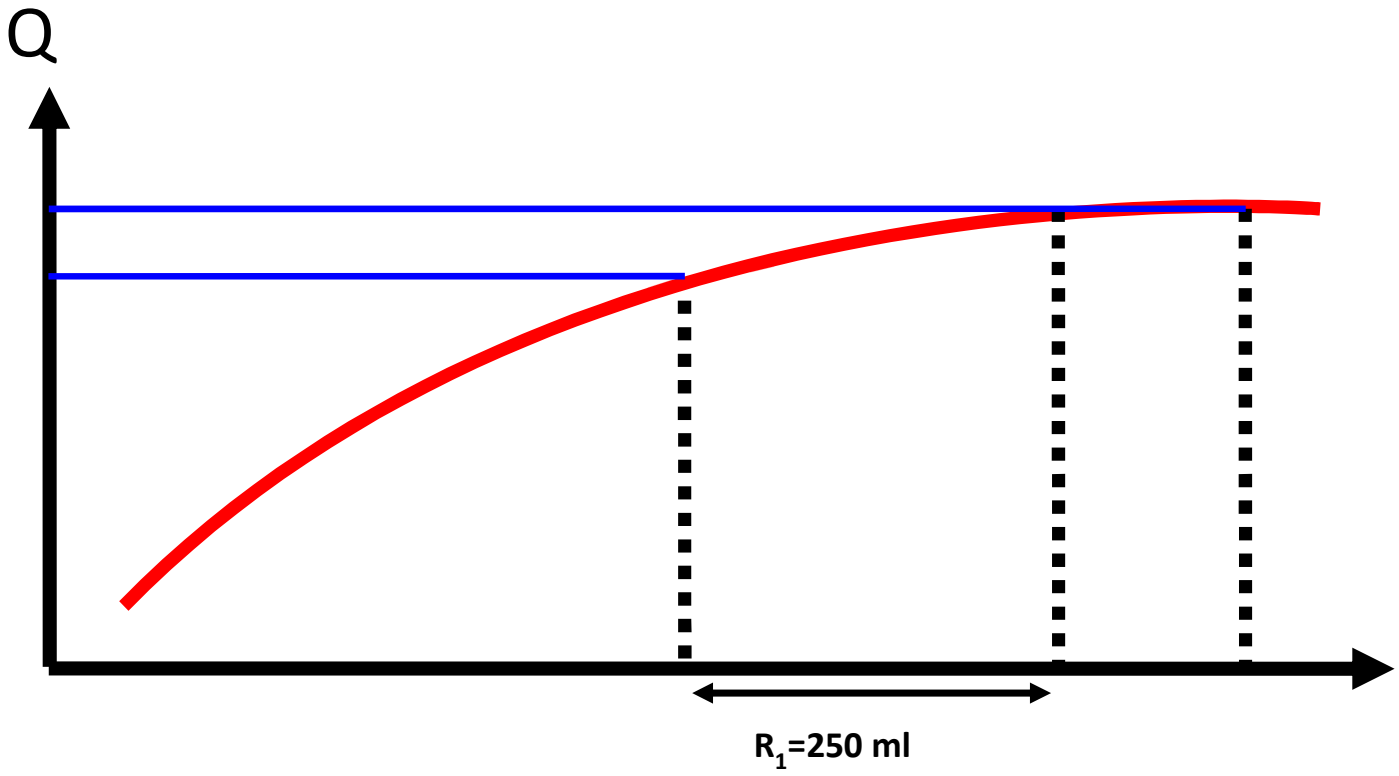


Factor	Transfused (N=12)	Non-transfused (N=188)	P value	Odd ration [95 % confidence interval]
Age (years)	14.5 [11; 18]	16 [10; 18]	0.5	
Weight (kg)	46 [25; 59]	55 [21; 93]	0.001	Not entered in the model
BMI	18 [12; 24]	20 [14; 34]	0.01	Excluded from the model
Preoperative hemoglobin ($g.dl^{-1}$)	14.6 [13; 15]	15 [13, 16]	0.009	0.8 [0.6; 1.031]
Number of levels fused	13 [7; 15]	13 [3; 15]	0.8	
Thoracoplasty	4 (33.3 %)	26 (13.9 %)	0.09	Excluded from the model
Sacral fusion	0 (0 %)	1 (0.5 %)	1	
Preoperative Halo-gravity	3 (27.3 %)	7 (3.7 %)	0.01	Excluded from the model
Intraoperative fluid administration ($ml.kg^{-1}$)	85 [56; 240]	54 [9; 155]	0.001	Not entered in the model
Intraoperative fluid administration ($ml.kg^{-1}.h^{-1}$)	**18 [14; 48]**	**15 [6; 36]**	**0.03**	**1.133 [1.028;1.248]**
Intraoperative stroke volume optimization	1 (8.3 %)	65 (34.6 %)	0.1	Not entered in the model
Intraoperative Dexmedetomidine	7 (58.3 %)	176 (94.1 %)	0.001	Not entered in the model
Duration of surgery (minutes)	**270 [180; 420]**	**240 [120; 420]**	**0.006**	**1.017 [1.008; 1.028]**

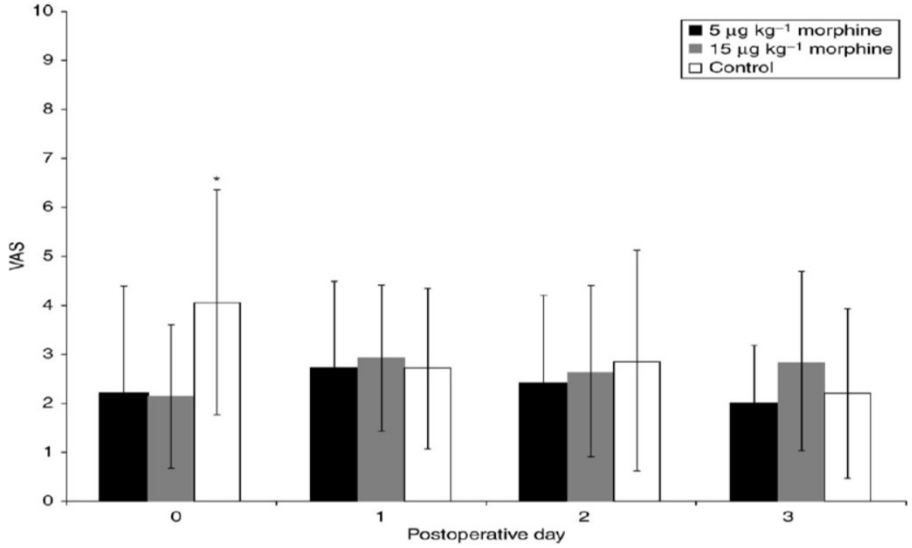
Apports en cristalloides < 14 $ml.kg^{-1}.h^{-1}$:
Risque de transfusion < 10 %







Bennarosch L et al . *Ann Fr Anesth Reanim 2008.*

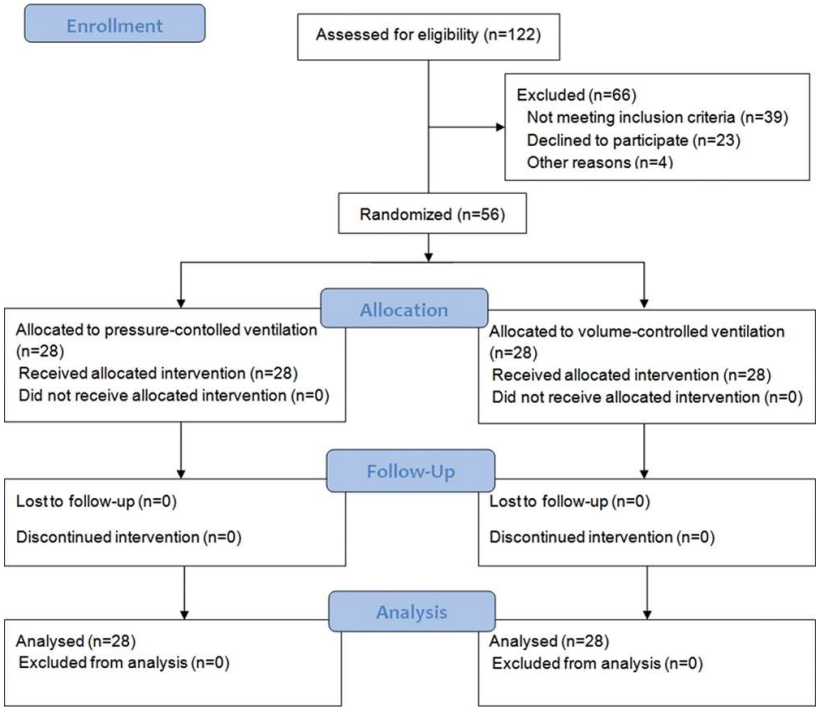


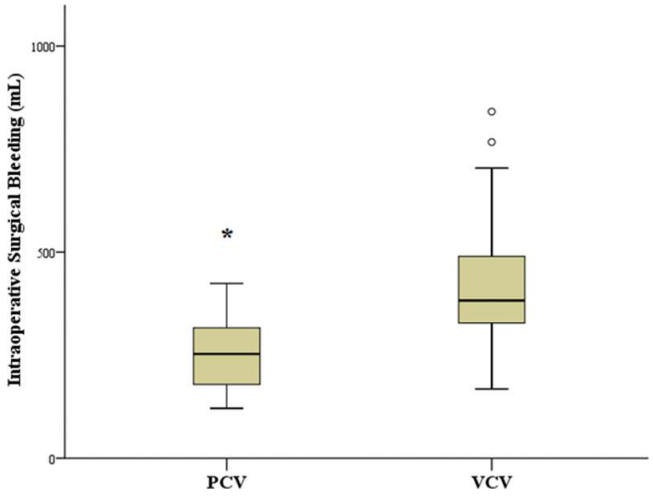
Rachianalgésie Morphine: En début d'intervention

	LITO ($n=14$)	HITO ($n=14$)	Control ($n=14$)
Intrathecal morphine (µg kg^{-1})	5	15	0
Intrathecal sufentanil (µg kg^{-1})	1	1	0
Operation time (h)	4.0 (1.1)	4.1 (1.3)	4.0 (1.2)
End tidal sevoflurane (%)	1.5 (0.1)	1.5 (0.1)	1.6 (0.2)
Remifentanil used (µg kg^{-1})	42.3 (23.5)	32.4 (26.1)	104.2 (57.5)*
Mean arterial blood pressure (mm Hg)	66 (5)	66 (6)	68 (5)
Heart rate (beats min^{-1})	69 (12)	68 (7)	71 (8)
Blood loss (ml kg^{-1})	41.4 (18.8)	37.5 (6.9)	76.9 (15.3)*

Eschertzhuber et al. BJA 2002.

Ventilation mode pression ?



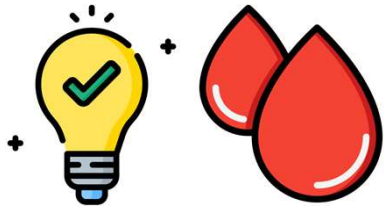


Transfusion (ml)	PCV Group	VCV Group	*P* Value
Intraoperative	0.0 (0.0–0.0)	0.0 (0.0–300.0)	0.66
Postoperative 24 h	0.0 (0.0–0.0)*	0.0 (0.0–500.0)	0.04
Postoperative 72 h	0.0 (0.0–250.0)	0.0 (0.0–500.0)	0.21

Data are expressed as median (25–75% interquartile range).
*$P < 0.05$ compared with the volume-controlled ventilation (VCV) group.
PCV = pressure-controlled ventilation.

Kang WS et al. Anesthesiology 2016.





- **Erythropoïétine préopératoire & supplémentation martiale**



Dosage Hb 48h avant chaque infection:

Si Hb ≥ 15 g/dl stop d'EPO

- **Optimisation nutritionnelle préopératoire**
- **Antifibrinolytiques: Acide tranéxamique : 10-30 mg.kg^{-1} & 5-10 mg.kg^{-1}.h^{-1}**
- **CellSaver péropératoire**
- **Optimisation apports liquidiens intraopératoires**
- **Rachianalgésie morphine en début d'intervention**
- **Bon positionnement des patients (pas de compression abdominale)**
- **Ventilation pression positive**

Prise en charge de la douleur



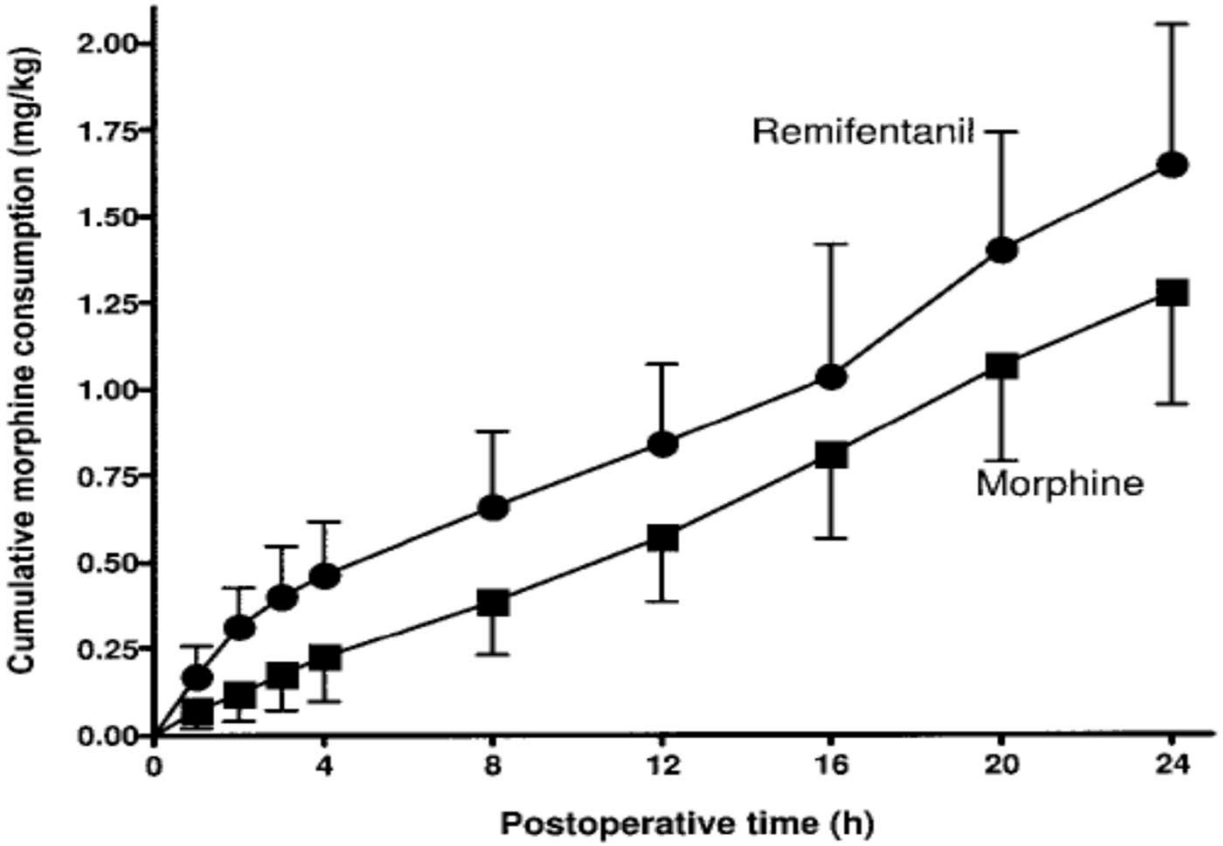
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Diagnosis	Current diagnosis, %*	Past diagnosis, %*	General population, %, range†
Depression	4.7	23.8	8—11 [26]
Generalized anxiety disorder	33	42.8	1.7—5 [27,28]
Acute stress disorder	—	28.7	8—10 [29-31]
Separation anxiety disorder	—	9.5	3—5 [29,30]
Social phobia	4.7	19	4—10 [29,30]
Specific phobia	23.8	33.3	8.7 [27,28]
Oppositional defiant disorder	4.7	9.5	2—10 [32]
Enuresis	—	23.8	1—2 [28]

- **Facteurs psychologiques : terrain anxieux**

Nikilajsen L et al. Curr Opin Anesthesiol 2014.
Asla C et al. Spine Difor 2017



bis: 40 % à 47 %

Odd ratio (OR)	95% confidence interval of OR
13	[1.3, 129]
43	[3.7, 481]

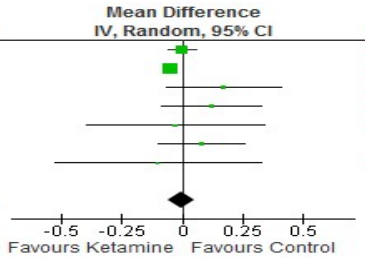
Crowford MW et al. Anesth & Analg 2006.
Julien-Marsollier F et al. Scandin J Pain 2017
Chidanbaran F et al, EJP 2017.

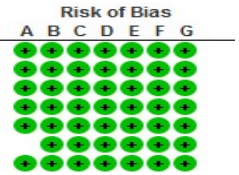




Study or Subgroup	Ketamine Mean	Ketamine SD	Ketamine Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Batra YK, 2007	0.38	0.09	20	0.38	0.1	20	31.2%	0.00 [-0.06, 0.06]
Bazin V, 2010	0.03	0.03	18	0.08	0.03	19	46.7%	-0.05 [-0.07, -0.03]
Dix P**, 2003_2	0.56	0.45	25	0.39	0.28	12	4.7%	0.17 [-0.07, 0.41]
Dix P*, 2003_1	0.51	0.31	25	0.39	0.28	11	6.1%	0.12 [-0.09, 0.33]
Engelhardt T, 2008	1.57	0.56	16	1.6	0.53	18	2.1%	-0.03 [-0.40, 0.34]
Perello M, 2016	0.76	0.3	21	0.68	0.3	23	7.8%	0.08 [-0.10, 0.26]
Pestieau S, 2014	1.7	0.7	29	1.8	0.8	21	1.6%	-0.10 [-0.53, 0.33]
Total (95% CI)			**154**			**124**	**100.0%**	**-0.00 [-0.06, 0.05]**

Heterogeneity: Tau² = 0.00; Chi² = 9.96, df = 6 (P = 0.13); I² = 40%
Test for overall effect: Z = 0.15 (P = 0.88)





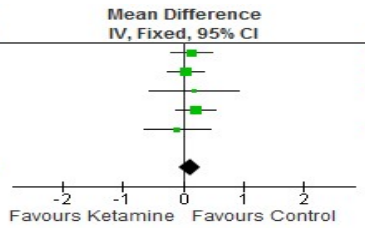
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

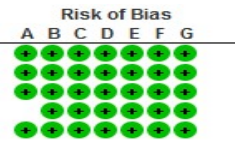
Kétamine

Morphine consumprtion at 24 h

Study or Subgroup	Ketamine Mean	Ketamine SD	Ketamine Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
Dix P**, 2003_2	0.762	0.66	25	0.62	0.423	12	24.4%	0.14 [-0.21, 0.49]
Dix P*, 2003_1	0.668	0.462	25	0.62	0.423	11	31.8%	0.05 [-0.26, 0.36]
Engelhardt T, 2008	3.05	1.14	16	2.87	1.05	18	5.5%	0.18 [-0.56, 0.92]
Perello M, 2016	1.59	0.51	21	1.38	0.59	23	28.7%	0.21 [-0.12, 0.54]
Pestieau S, 2014	3.4	1	29	3.5	1	21	9.6%	-0.10 [-0.66, 0.46]
Total (95% CI)			**116**			**85**	**100.0%**	**0.11 [-0.06, 0.28]**

Heterogeneity: Chi² = 1.12, df = 4 (P = 0.89); I² = 0%
Test for overall effect: Z = 1.24 (P = 0.21)

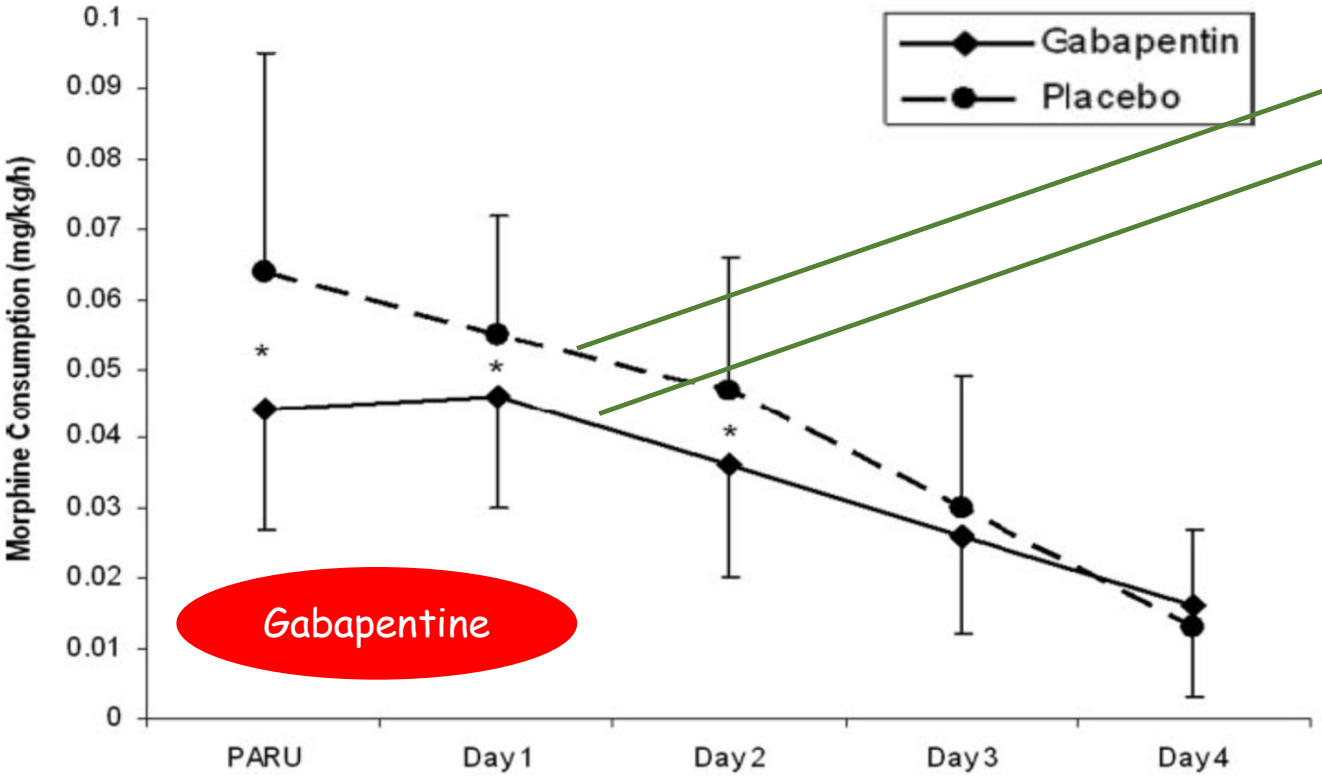




Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

Morphine consumption at 48 h

Michelet D et al. Pediatr Drugs 2016

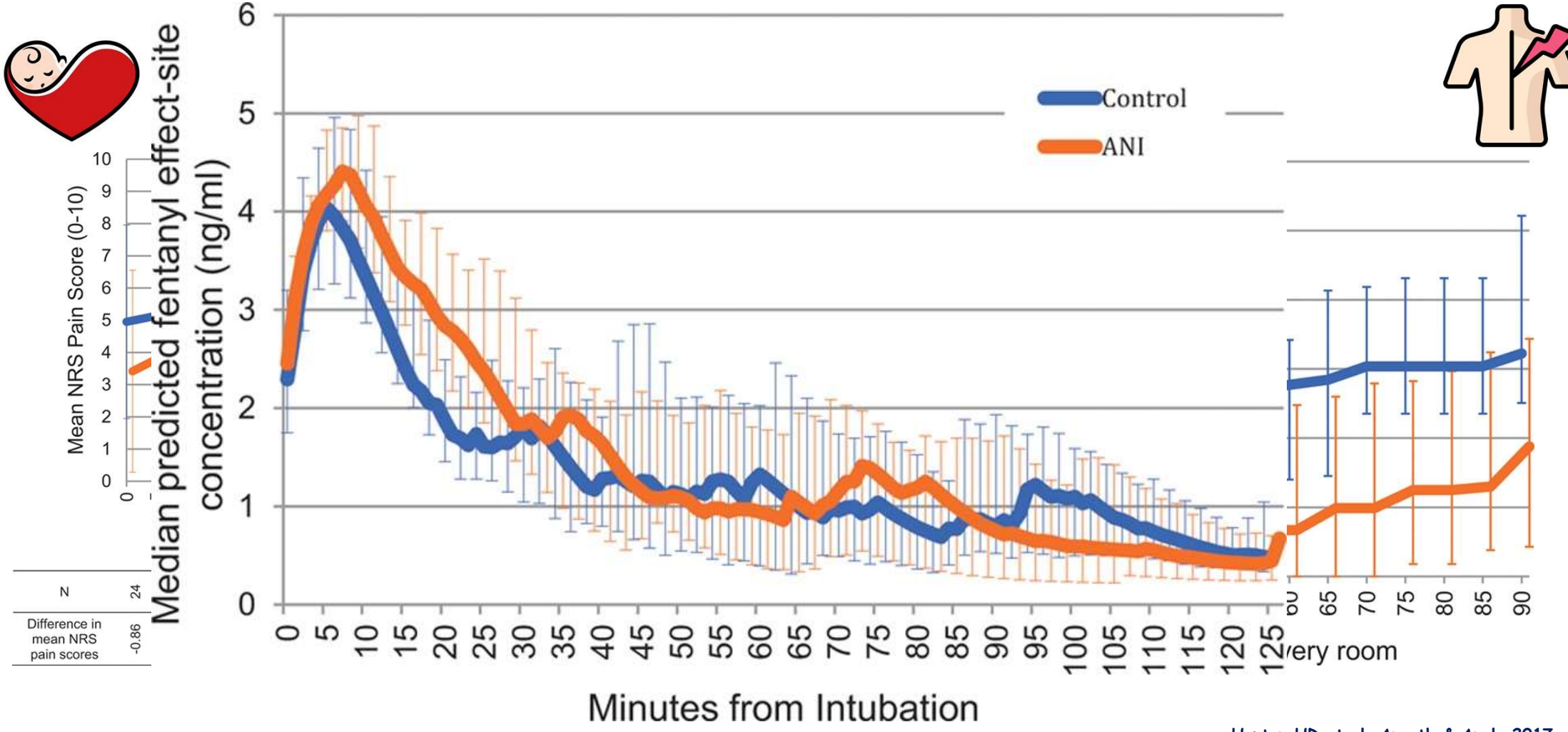


Morphine: 1,3 mg/kg

Morphine: 1 mg/kg

Localement
1 à 0,6 mg/kg

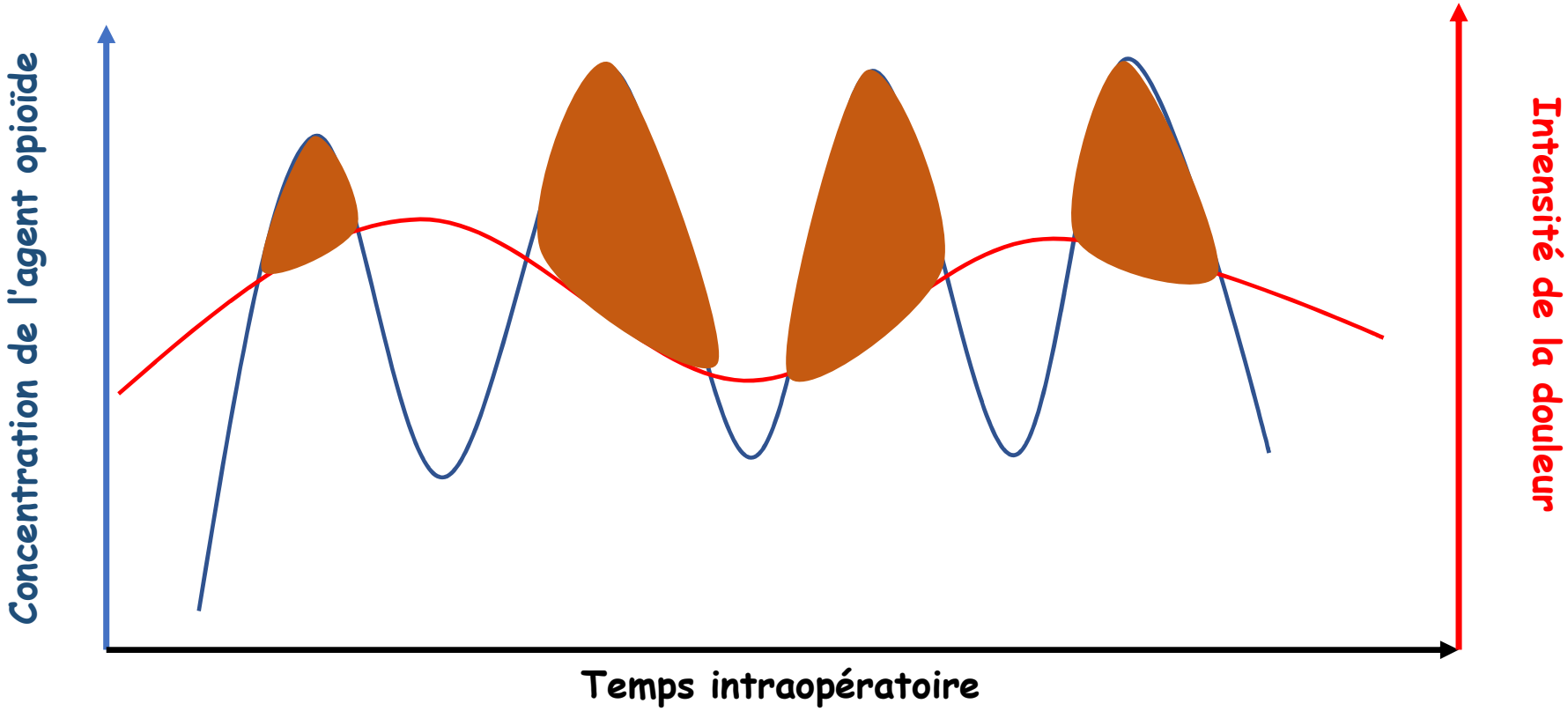
Rusy LM et al. Anesth & Analg 2010.



Hupton HD et al. Anesth & Analg 2017.

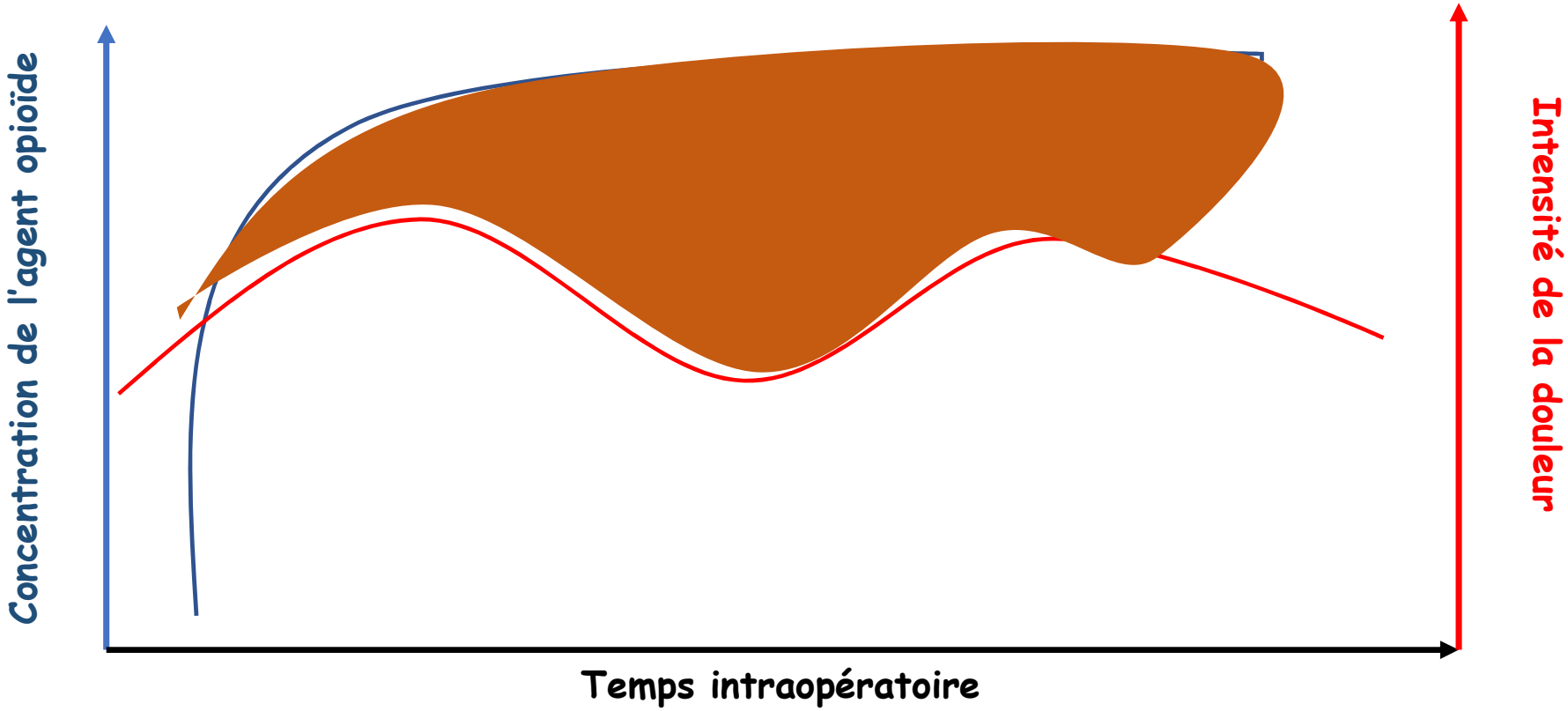





Concentration de l'agent opioïde
Intensité de la douleur
Temps intraopératoire






Concentration de l'agent opioïde
Intensité de la douleur
Temps intraopératoire





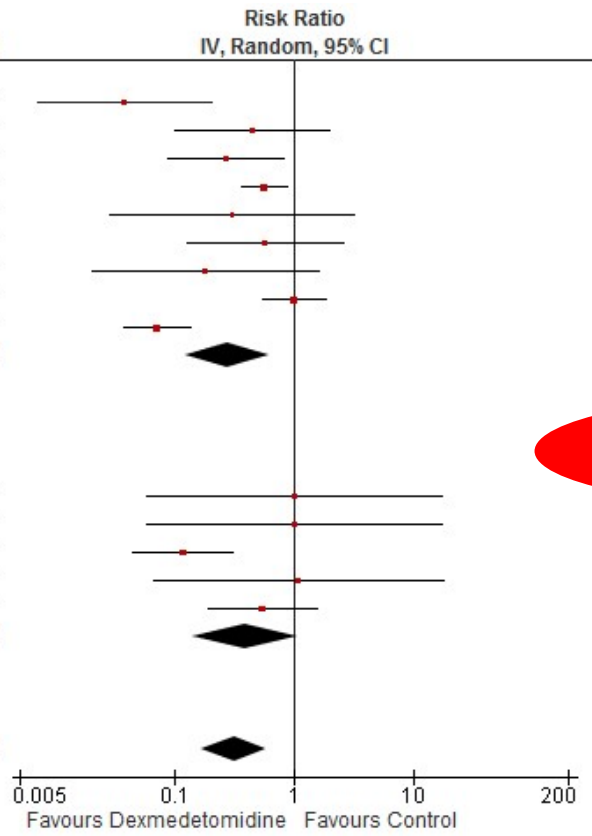
OpisPani : Opioid-Sparing Effect of using ANI during idiopathic scoliosis surgery in children

- PHRC national : 260 inclusions
- Monitorage ANI vs standard
- Anesthésie propofol-rémifentanil à objectif de concentration
- Objectifs primaires : morphine à J1 et incidence des douleurs chroniques
- Objectifs secondaires: morphine postopératoire et effets secondaires





Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV, Random, 95% CI
6.6.1 Bolus Dose ≥ 0.5 µg/kg				
Al-Zaben KR 2010	-3.29	0.86	6.4%	0.04 [0.01, 0.20]
Erdil F 2009	-0.81	0.76	7.2%	0.44 [0.10, 1.97]
Guler G 2005	-1.32	0.57	8.7%	0.27 [0.09, 0.82]
Haubert JA 2015	-0.58	0.22	11.2%	0.56 [0.36, 0.86]
Kim JA 2014	-1.2	1.2	4.5%	0.30 [0.03, 3.16]
Meng QT 2012_1	-0.57	0.77	7.1%	0.57 [0.13, 2.56]
Meng QT 2012_2	-1.72	1.12	4.9%	0.18 [0.02, 1.61]
Patel A 2010	0	0.32	10.6%	1.00 [0.53, 1.87]
Soliman R 2015	-2.65	0.33	10.6%	0.07 [0.04, 0.13]
Subtotal (95% CI)			**71.2%**	**0.28 [0.12, 0.62]**
Heterogeneity: Tau² = 1.07; Chi² = 46.63, df = 8 (P < 0.00001); I² = 83%				
Test for overall effect: Z = 3.12 (P = 0.002)				
6.6.2 Bolus dose < 0.5 µg/kg				
Ghai B 2015_1	0	1.45	3.5%	1.00 [0.06, 17.15]
Ghai B 2015_2	0	1.45	3.5%	1.00 [0.06, 17.15]
Kim J 2014	-2.15	0.49	9.3%	0.12 [0.04, 0.30]
Sato M 2010	0.08	1.43	3.6%	1.08 [0.07, 17.86]
Shukry M 2005	-0.62	0.54	8.9%	0.54 [0.19, 1.55]
Subtotal (95% CI)			**28.8%**	**0.38 [0.14, 1.07]**
Heterogeneity: Tau² = 0.54; Chi² = 7.08, df = 4 (P = 0.13); I² = 43%				
Test for overall effect: Z = 1.83 (P = 0.07)				
Total (95% CI)			**100.0%**	**0.31 [0.17, 0.59]**
Heterogeneity: Tau² = 0.88; Chi² = 54.05, df = 13 (P < 0.00001); I² = 76%				
Test for overall effect: Z = 3.59 (P = 0.0003)				
Test for subgroup differences: Chi² = 0.24, df = 1 (P = 0.62), I² = 0%				



Dexmedetomidine

Administration de morphiniques SSPI

Bellon M et al. Pain Ther 2016.





- **Dexmedetomidine:**
  - **Bolus : 1 µg/Kg en 10 minutes**
  - **Entretien : 0,4 µg/Kg/h**
  - **Arrêt à la fermeture**
- **Kétamine :**
  - **Bolus : 0,5 mg/Kg à l'induction**
  - **Entretien : 0,15 mg/Kg/h**
  - **Arrêt à la fermeture**

Aucun effet bradycardisant lié à l'utilisation de la dexmedetomidine ou OFA en 3 ans d'utilisations (450 patients)

Julien-Marsollier F et al. Pain Manag 2021.

Techniques	Morphine J1 (mg/kg)	Morphine J3 (mg/kg)	Douleurs neuropathique 1 an
Contrôle (N = 33)	1,1 [0,6 – 1,54]	1,4 [0,5 – 2,3]	17 (47,2 %)
OFA: Dexmédetomindine & kétamine (N = 36)	**0,7 [0,2 – 2]**	**0,9 [0,07 – 1,9]**	**5 (17,9 %)*** **



Patients with significant postoperative pain (%)

60
40
20
0

Factor	Control cohort *N* (%)/ median [range] (*N* = 23)	Cooling cohort *N* (%)/ median [range] (*N* = 22)	*P*
Postoperative day 1			
Total morphine (mg kg^{-1})	1.7 [0.9, 3.3]	1.2 [0.5, 3.2]	0.024
Postoperative day 3			
Total morphine (mg kg^{-1})	2.5 [0.5, 6.7]	1.2 [0.9, 2.5]	0.003

	nce	SE	Weight	Std. Mean Difference IV, Random, 95% CI
	0.86	0.25	6.6%	-0.86 [-1.35, -0.37]
	0.98	0.3	6.1%	-0.98 [-1.57, -0.39]
	3.14	0.33	5.7%	-3.14 [-3.79, -2.49]
	0.95	0.4	5.0%	-0.95 [-1.73, -0.17]
	-0.8	0.37	5.3%	-0.80 [-1.53, -0.07]
	1.55	0.61	3.3%	-1.55 [-2.75, -0.35]
	0.28	0.34	5.6%	-0.28 [-0.95, 0.39]
	0.49	0.23	6.8%	-0.49 [-0.94, -0.04]
	-1.1	0.34	5.6%	-1.10 [-1.77, -0.43]
	0.49	0.09	8.1%	-0.49 [-0.67, -0.31]
	0.47	0.2	7.2%	-0.47 [-0.86, -0.08]
	1.55	0.67	2.9%	-1.55 [-2.86, -0.24]
	0.55	0.28	6.3%	-0.55 [-1.10, -0.00]
	0.37	0.27	6.4%	-0.37 [-0.90, 0.16]
	0.18	0.23	6.8%	-0.18 [-0.63, 0.27]
	0.66	0.23	6.8%	-0.66 [-1.11, -0.21]
	0.86	0.37	5.3%	-0.86 [-1.59, -0.13]
			100.0%	**-0.83 [-1.11, -0.55]**

(P < 0.00001); I² = 79%

Std. Mean Difference
IV, Random, 95% CI

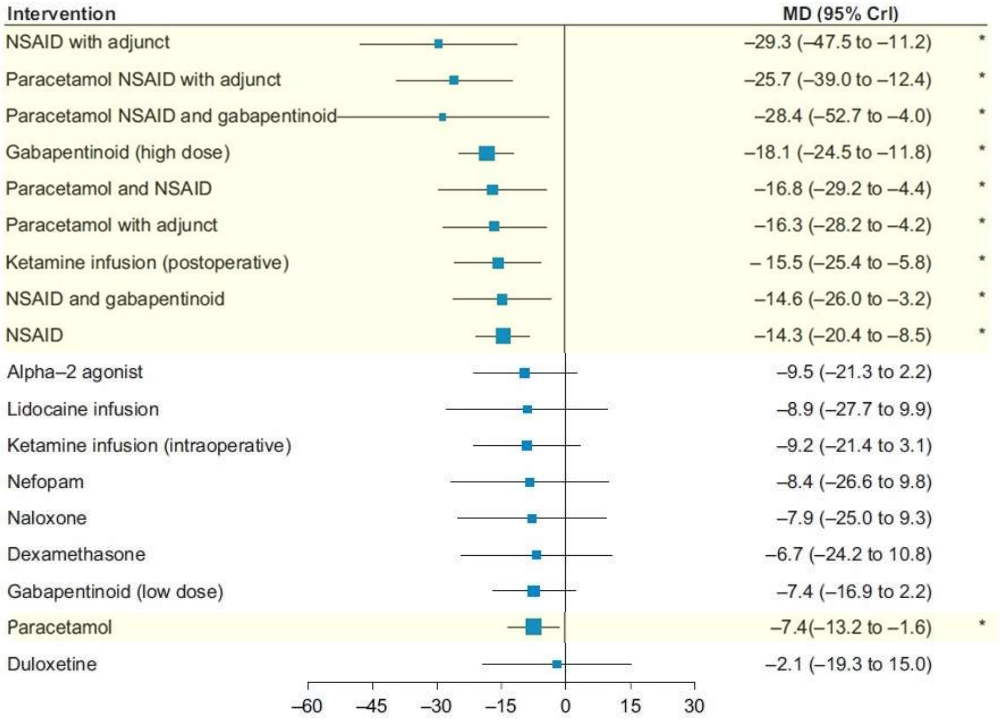
-4 -2 0 2 4
Favours NSAID Favours control

AINS

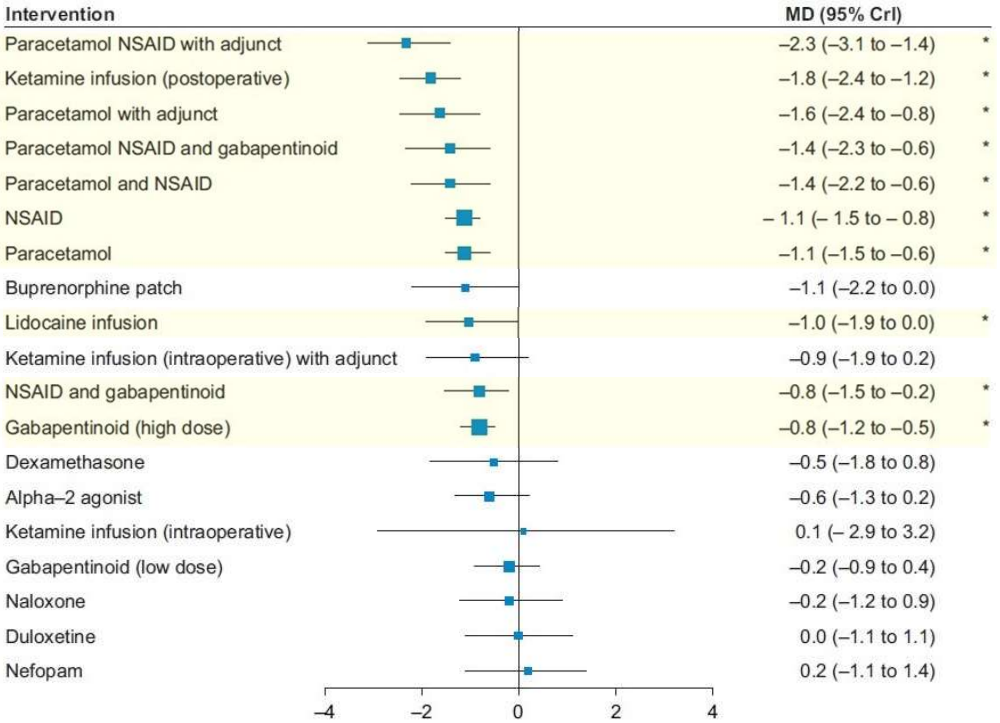
Hermans V et al. Br J Anaesth .
Michelet D et al. Anesth & Analg 2012.
Bellon M et al. Eur Spine J 2019.







Administration de morphiniques 24h



Qualité de l'analgésie24h

Bae S et al. Br J Anaesth 2022.



Analgésie Péridurale

Douleur 24 h

Study or subgroup	Mean (VAS 0-10)	SD (VAS 0-100)	Total	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Weight	Mean difference IV, Random, 95% CI (VAS 0-100)
				Control				
Cassady 2000	33	60	14	30	66	11	5.6%	3.00 [-47.09, 53.09]
O'Hara 2004	36	40	10	42	25	9	15.8%	-6.00 [-35.69, 23.69]
Blumenthal 2006	7	16	15	21	34	15	38.6%	-14.00 [-33.02, 5.02]
Blumenthal 2005	7	20	15	23	31	15	40.0%	-16.00 [-34.67, 2.67]
Total (95% CI)			54			50	100.0%	-12.59 [-24.40, -0.78]

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.71$, df = 3 ($P = 0.87$); $I^2 = 0\%$
Test for overall effect: $Z = 2.09$ ($P = 0.04$)

Mean difference IV, Random, 95% CI (VAS 0-100)

-20 0 10 20
Epidural group Morphine group



Douleur 48 h

Study or subgroup	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Weight	Mean difference IV, Random, 95% CI (VAS 0-100)	Year
	Epidural			Morphine					
Cassady 2000	22	55	14	12	40	15	6.5%	10.00 [-25.21, 45.21]	2000
O'Hara 2004	30	50	10	40	40	9	4.9%	-10.00 [-50.54, 30.54]	2004
Blumenthal 2005	11	20	15	20	10	15	62.9%	-9.00 [-20.32, 2.32]	2005
Blumenthal 2006	3	8	15	21	34	15	25.8%	-18.00 [-35.68, -0.32]	2006
Total (95% CI)			54			54	100.0%	-10.13 [-19.11, -1.16]	

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 2.06$, df = 3 ($P = 0.56$); $I^2 = 0\%$
Test for overall effect: $Z = 2.21$ ($P = 0.03$)

Mean difference IV, Random, 95% CI (VAS 0-100)

-50 -25 0 25 50
Epidural group i.v Morphine group

Douleur 72 h

Study or subgroup	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Weight	Mean difference IV, Random, 95% CI (VAS 0-100)	Year
	Epidural			Morphine					
Cassady 2000	35	28	14	35	40	15	13.9%	0.00 [-25.00, 25.00]	2000
O'Hara 2004	0	0	0	0	0	0		Not estimable	2004
Blumenthal 2005	5	16	15	17	17	15	62.2%	-12.00 [-23.81, -0.19]	2005
Blumenthal 2006	2	7	15	19	37	15	23.9%	-17.00 [-36.06, 2.06]	2006
Total (95% CI)			44			45	100.0%	-11.53 [-20.85, -2.21]	

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 1.14$, df = 2 ($P = 0.57$); $I^2 = 0\%$
Test for overall effect: $Z = 2.42$ ($P = 0.02$)

Mean difference IV, Random, 95% CI (VAS 0-100)

-20 -10 0 10 20
Epidural group i.v Morphine group

1 Cathéter

Study or subgroup	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Weight	Mean difference IV, Random, 95% CI (VAS 0-100)
	Epidural			Control				
O'Hara 2004	36	40	10	42	25	9	74.0%	-6.00 [-35.69, 23.69]
Cassady 2000	33	60	14	30	66	11	26.0%	3.00 [-47.09, 53.09]
Blumenthal 2006	7	16	15	21	34	15	0.0%	-14.00 [-33.02, 5.02]
Blumenthal 2005	7	20	15	23	31	15	0.0%	-16.00 [-34.67, 2.67]
Total (95% CI)			24			20	100.0%	-3.66 [-29.20, 21.88]

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.09$, df = 1 ($P = 0.76$); $I^2 = 0\%$
Test for overall effect: $Z = 0.28$ ($P = 0.78$)

Mean difference IV, Random, 95% CI (VAS 0-100)

-20 0 10 20
Epidural group Morphine group

> 1 Cathéter

Study or subgroup	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Mean (VAS 0-100)	SD (VAS 0-100)	Total	Weight	Mean difference IV, Random, 95% CI (VAS 0-100)
	Epidural			Control				
O'Hara 2004	36	40	10	42	25	9	0.0%	-6.00 [-35.69, 23.69]
Cassady 2000	33	60	14	30	66	11	0.0%	3.00 [-47.09, 53.09]
Blumenthal 2006	7	16	15	21	34	15	49.1%	-14.00 [-33.02, 5.02]
Blumenthal 2005	7	20	15	23	31	15	50.9%	-16.00 [-34.67, 2.67]
Total (95% CI)			30			30	100.0%	-15.02 [-28.34, -1.70]

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.02$, df = 1 ($P = 0.88$); $I^2 = 0\%$
Test for overall effect: $Z = 2.21$ ($P = 0.03$)

Mean difference IV, Random, 95% CI (VAS 0-100)

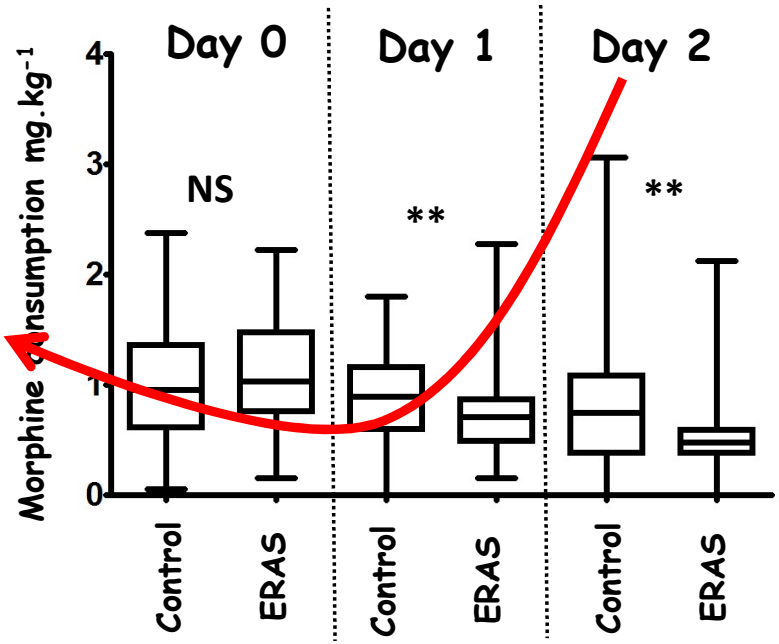
-20 0 10 20
Epidural group Morphine group

Douleur 24 h

Taenzer AH. Ped Anesth 2010.

RAAC

Factor	Control (N = 82)	ERAS (N = 81)
Oral analgesics	53 (64.6 %)	81 (100 %)***
Physiotherapy	68 (82.9 %)	81 (100 %)***
Pain at rest	1 [1; 5]	2 [1; 4]***
Pain at movement	5 [3; 8]	5 [1; 7]**
Wound drainage	59 (72 %)	2 (2,5 %)***
Bladder catheter	31 (37.8 %)	6 (7.4 %)***
Constipation	60 (73.2 %)	46 (56.8 %)*
Duration of hospital stay	7 [5; 19]	4 [3; 16]***



Julien-Marsollier F et al. Pediatr Anesth 2020.

AR-Péd-Obst
Hôpital Robert-Debré AP-HP

Prévention des infections site opératoire

TABLE I Surgical Site Infections by Etiology of Scoliosis and Procedure Type to Correct Scoliosis*

Etiology	No. of Surgical Site Infections per Procedure Type: Primary Arthrodesis	Revision or Converted Arthrodesis	Growing Construct Insertion	Growing Construct Lengthening	Growing Construct Revision	Row Total
Idiopathic	5 of 417 (1.2%)	2 of 38 (5.3%)	0 of 9 (0.0%)	1 of 28 (3.6%)	5 of 17 (29.4%)	13 of 509 (2.6%)
Non-idiopathic						
Neuromuscular	26 of 198 (13.1%)	4 of 38 (10.5%)	3 of 29 (10.3%)	0 of 82 (0.0%)	3 of 44 (6.8%)	36 of 391 (9.2%)
Syndromic	5 of 72 (6.9%)	2 of 26 (7.7%)	2 of 7 (28.6%)	3 of 35 (8.6%)	2 of 19 (10.5%)	14 of 159 (8.8%)
Congenital	4 of 66 (6.1%)	0 of 18 (0.0%)	2 of 28 (7.1%)	2 of 71 (2.8%)	0 of 22 (0.0%)	8 of 205 (3.9%)
Other	3 of 23 (13.0%)	0 of 7 (0.0%)	0 of 10 (0.0%)	2 of 28 (7.1%)	2 of 15 (13.3%)	7 of 83 (8.4%)
Column total	43 of 776 (5.5%)	8 of 127 (6.3%)	7 of 83 (8.4%)	8 of 244 (3.3%)	12 of 117 (10.3%)	78 of 1347 (5.8%)

*The values are given as the number of surgical site infections per the number of procedures, with the percentage in parentheses.

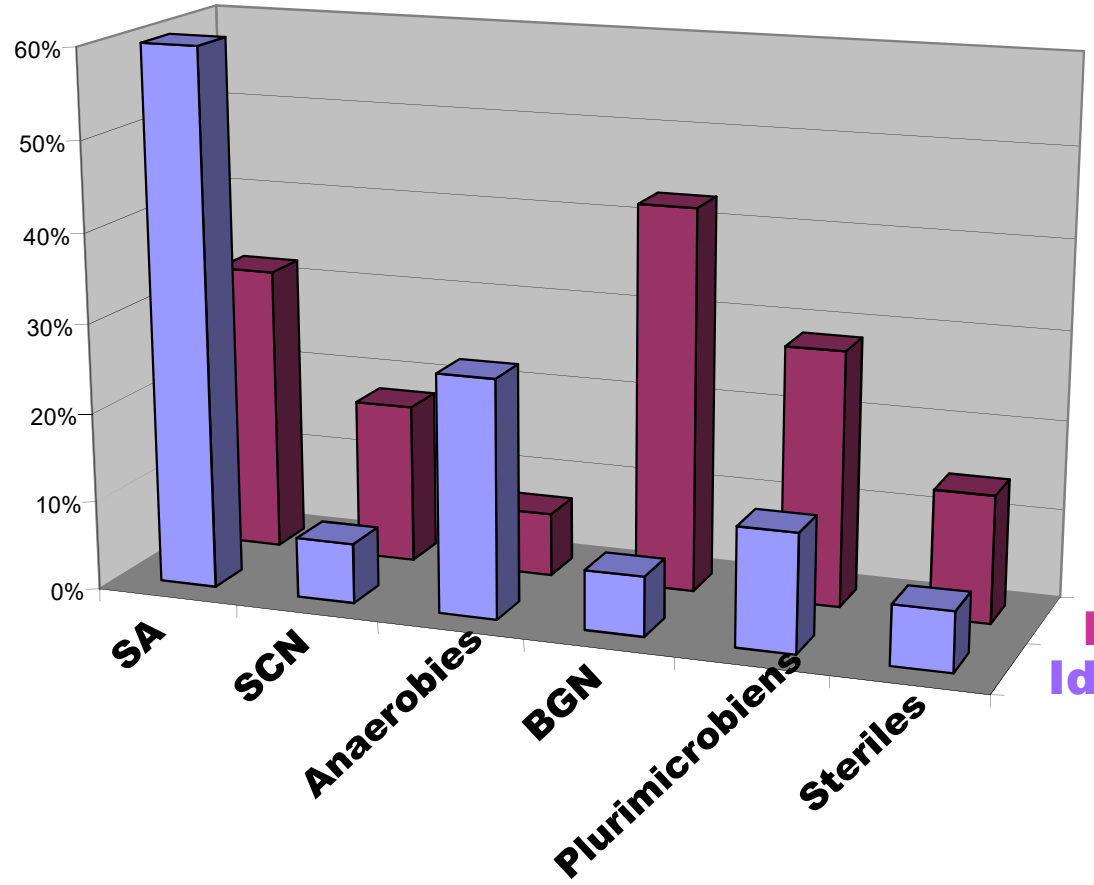
TABLE II Univariate Analysis of Risk Factors for Surgical Site Infection Following Scoliosis Surgery

Risk Factor	No. of Procedures	Surgical Site Infection*	No Surgical Site Infection*	P Value
Sex				0.076
Male	573	7.2% (41)	92.8% (532)	
Female	774	4.8% (37)	95.2% (737)	
Age	1347	11.0 ± 4.9†	11.5 ± 4.7†	0.388
Race				0.514
Black	148	4.1% (6)	95.9% (142)	
White	693	5.2% (36)	94.8% (657)	
Asian	84	8.3% (7)	91.7% (77)	
Hispanic	301	6.6% (20)	93.4% (281)	
Other or not specified	121	7.4% (9)	92.6% (112)	
Etiology				
Idiopathic	509	2.6% (13)	97.4% (496)	—
Non-idiopathic				<0.001
Neuromuscular	391	9.2% (36)	90.8% (355)	<0.001
Syndromic	159	8.8% (14)	91.2% (145)	0.002
Congenital	205	3.9% (8)	96.1% (197)	0.334
Other	83	8.4% (7)	91.6% (76)	0.014
Type of procedure				
Primary arthrodesis	776	5.5% (43)	94.5% (733)	—
Revision or converted arthrodesis	127	6.3% (8)	93.7% (119)	0.681
Growing construct lengthening	244	3.3% (8)	96.7% (236)	—
Growing construct insertion	83	8.4% (7)	91.6% (76)	0.068
Growing construct revision	117	10.3% (12)	89.7% (105)	0.012
Instrumentation extending to the pelvis				<0.001
Yes	271	13.7% (37)	86.3% (234)	
No	1076	3.8% (41)	96.2% (1035)	

*The values are given as the percentage of procedures in each subcategory, with the number of procedures in parentheses. †The values are given as the mean and the standard deviation, in years.

FDR:
- Neuromusculaires
- IMC bas
- Fixation sacrée

Mackenzie WGS et al. *J Bone Joint Surg J 2013.*



Non Idiopathiques
Idiopathique

Maesani M et al. Pediatr Infect Dis 2015.



Does *Staphylococcus aureus* nasal decontamination affect the rate of early surgical site infection in adolescent idiopathic scoliosis surgery?



Cindy Mallet[1] · Marion Caseris[2] · Catherine Doit[3] · Anne-Laure Simon[1] · Daphné Michelet[4] · Chrystel Madre[1] · Keyvan Mazda[1] · Stéphane Bonacorsi[3] · Brice Ilharreborde[1]

Infections SA : 5 % vs 1,6 %

Is *Cutibacterium acnes* early surgical site infection rate related to the duration of antibiotic prophylaxis in adolescent idiopathic scoliosis surgery?

Marion Caseris[1] · Brice Ilharreborde[2] · Catherine Doit[3] · Anne-Laure Simon[2] · Christine Vitoux[2] · Nora Poey[1] · Stéphane Bonacorsi[3] · Cindy Mallet[2]

ATB protocol	Total AIS	Early SSI	Incidence of early SSI (%)	Early *C. acnes* SSI	Incidence of early *C. acnes* SSI (%)	% of early SSI due to *C. acnes*
Protocol 1	226	15	6.6	0	0	0
Protocol 2	387	33	8.5	19	4.9	57.6
Protocol 3	119	5	4.2	2	1.7	40.0
Total	732	53	7.2	21	2.9	39.6

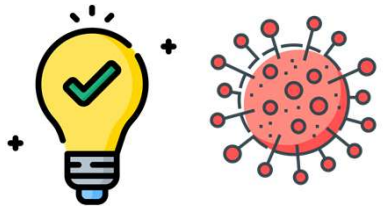
ATB antibioprophylaxys, *SSI* surgical site infection, *C. acnes Cutibacterium acnes*

Protocol 1: 1st long ATB protocol: From January 2007 to February 2012

Protocol 2: Short ATB protocol: From March 2012 to August 2016

Protocol 3: 2nd long ATB protocol: From September 2016 to September 2017





- Eviction du portage nasal SA.
- Toilette antiseptiques.
- Dépistage des infections urinaires et traitement si besoin.
- Eviction des foyers dentaires
- Pas de rasage.
- Nutrition
- Mobilisation rapide dès que possible
- Antibioprophylaxie standard adaptée à l'écologie locale et aux résultats de l'écouvillonage nasal (SARM) mais probablement prolongée pour prévenir les infections à C.Acnes
- Vancomycine en poudre « no comment »



Agents anesthésiques & monitorage médullaire



➢ Monitorage médullaire : aspect médico-légal

Type	Territoire monitoré	Faux négatifs	Effets dépressif	Anesthésique
PE somesthésiques	• Corne postérieure	Atteintes antérieures (vasculaires)	Agents anesthésiques IV et halogénés, HypoTA, Hypothérmie	Agnets IV
PE moteurs : stimulation trans-crânienne & signal médullaire (D-Wave)	• Corne antérieure • Détection signal médullaire	Atteintes postérieures ou lésions limitées	Agents anesthésiques (moins que les PES)	Agents IV & Curare possible
PE moteurs stimulation trans-crânienne & signal musculaire (potentiel d'action)	• Corne antérieure • Détection signal musculaire	Atteintes postérieures ou lésions limitées	Agents anesthésiques (moins que les PES) & curares	Agents IV & Curare inhibe la detection
PE moteurs neurogéniques : stimulation épidurale ou cutanée	• Corne postérieure • Détection médullaire ou musculaire	Atteinte antérieure	• Peu sensible aux agents anesthésiques • Curarisation souhaitable si détection médullaire	• Agents halogénés possibles • Curare si détection médullaire

Malhotra NR et al. Spine 2010.



Technique anesthésique



- Dépends du monitorage mais classiquement association : PES et PEM
- Agents intraveineux préférables
- Au mieux administrés par AIVOC
  - Propofol : modèle March adulte (> 30 kg/10 ans) ou modèle pédiatriques si < 30 kg
  - Rémifentanil modèles de Minto ou administration massique
- Risques de surdosages si pathologies neuromusculaires

Table 2. Target-Controlled Infusion Performance Measures

	All children (n = 20)
MDPE %	39.8 (−20.9 to 103.3)
MDAPE %	39.8 (20 to 103.3)
Wobble %	13.6 (4.0 to 42.3)
Divergence	−2.2 (−1.03 to 0.13)

Table 3. Target-Controlled Infusion Performance Measures

	Paedfusor <61 kg (n = 13)	Mixed (n = 7)
MDPE %	46.3 (−20.9 to 103.3)	27.4 (23.9 to 33.1)
MDAPE %	46.3 (20.9 to 103.3)	27.4 (23.9 to 33.1)
Wobble %	14.4 (5.1 to 42.3)	11.5 (4.0 to 17.6)
Divergence	−0.24 (−1.03 to −0.04)	−0.06 (−0.17 to 0.13)

Panchatsharam S et al . *Anesth & Analg 2014.*

- Peformance Error= PE = (Cm-Cp/Cp)*100 : (< 20 %)
- Absolute Peformance Error= APE = I PE I : (< 30 %)
- Mediane Peformance Error= MDPE = Median PE
- Mediane Adsolute Peformance Error= MDAPE = Median APE
- Divergence= Régression PE : (-4%.h^{-1} à 4%.h^{-1})



Predictive performance of eleven pharmacokinetic models for propofol infusion in children for long-duration anaesthesia

M. Hara[1], K. Masui[2,*], D. J. Eleveld[3], M. M. R. F. Struys[3,4] and O. Uchida[1]



rmance metrics. PK, pharmacokinetic; PE, prediction error; APE, absolute predic-
ian absolute prediction error; Data are expressed as mean ± SD (range) for PE
om that in the Murat models (P<0.001). ** One sample t test was used to examine
whether a mean value of divergence PE was different from zero

PK model	PE derivatives					Predictive performance metrics,%		
	MDPE, %	MDAPE, %	Divergence APE, % h^{-1}	Divergence PE, % h^{-1} [P value *vs* 0**]	Wobble, %	All sampling time (n = 85)	Earlier sampling time ≤180 min (n = 49)	Later sampling time >180 min (n = 36)
Paedfusor	−27.3 (12.5) (−44.2 to 4.0)	27.9 (11.3) (0.8 to 44.2)	6.3 (10.5) (−10.6 to 35.6)	−6.1 (10.8) (−35.6 to 13.8) [P = 0.018]	5.7 (4.5) (0.2 to 17.1)	29.4%	32.7%	25.0%
Kataria	−8.3 (18.0) (−30.6 to 43.0)	17.9 (9.2) (5.0 to 43.0)	3.5 (10.4) (−12.9 to 38.8)	−5.8 (12.9) (−41.1 to 18.2) [P = 0.055]	6.5 (5.3) (0.2 to 21.6)	61.2%	75.5%	41.7%
Marsh	−28.6 (13.6) (−46.1 to 12.4)	29.9 (10.5) (4.0 to 46.1)	2.9 (8.6) (−8.6 to 25.4)	−2.0 (9.9) (−25.4 to 20.6) [P = 0.378]	4.2 (3.5) (0.2 to 9.7)	24.7%	24.5%	25.0%
Short	−10.5 (16.5) (−31.9 to 37.9)	17.5 (8.8) (3.9 to 37.9)	4.5 (8.4) (−10.6 to 31.2)	−1.9 (11.7) (−31.2 to 26.6) [P = 0.454]	5.8 (4.5) (0.2 to 15.5)	63.5%	75.5%	47.2%
Rigby-Jones	−20.4 (14.7) (−39.7 to 21.4)	23.5 (9.1) (6.1 to 39.7)	4.2 (8.3) (−9.0 to 31.2)	−2.5 (10.5) (−31.2 to 22.9) [P = 0.283]	4.9 (3.9) (0.6 to 13.3)	35.3%	40.8%	27.8%
Coppens	−27.7 (14.3) (−44.8 to 17.8)	29.5 (10.1) (4.4 to 44.8)	2.6 (8.2) (−9.0 to 22.9)	−1.2 (9.8) (−22.9 to 20.7) [P = 0.575]	4.0 (3.3) (0.0 to 9.6)	25.9%	24.5%	27.8%
Saint-Maurice	−10.6 (17.5) (−33.3 to 36.5)	19.2 (7.9) (8.6 to 36.5)	4.3 (12.9) (−19.3 to 49.9)	−9.1 (14.9) (−49.9 to 13.5) [P = 0.011]	8.0 (5.2) (1.0 to 19.2)	54.1%	67.3%	36.1%
Shangguan	−49.1 (11.7) (−71.2 to − 26.4)	49.1 (11.7) (26.4 to 71.2)	11.1* (9.7) (1.1 to 39.4)	−11.1 (9.7) (−39.4 to − 1.1) [P < 0.001]	7.6 (4.3) (0.2 to 17.8)	−22.4%	0.0%	−52.8%
Murat	10.7 (20.9) (−15.0 to 71.7)	17.9 (16.9) (2.6 to 71.7)	−3.1 (12.3) (−38.7 to 24.5)	−7.1 (16.5) (−55.2 to 24.5) [P = 0.062]	8.5 (6.2) (0.4 to 22.4)	58.8%	65.3%	50.0%
Schüttler	−19.9 (12.4) (−40.1 to 3.9)	21.3 (10.3) (3.9 to 40.1)	4.1 (7.8) (−9.9 to 23.9)	−2.8 (10.6) (−23.9 to 23.2) [P = 0.233]	5.2 (4.5) (0.1 to 15.0)	47.1%	55.1%	36.1%
Eleveld	−21.6 (13.3) (−38.8 to 13.5)	23.4 (9.6) (5.3 to 38.8)	5.0 (9.4) (−3.8 to 34.7)	−4.0 (10.9) (−34.7 to 19.0) [P = 0.107]	5.6 (4.5) (0.2 to 17.5)	40.0%	44.9%	33.3%

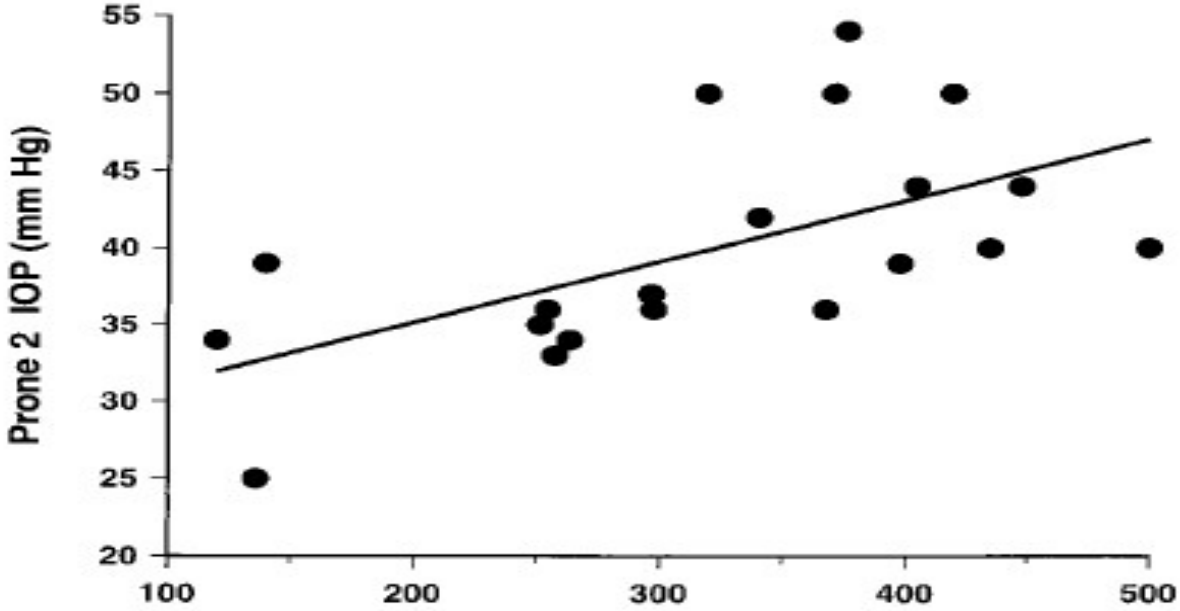
- **Peformance Error < 20 %**
- **Absolute Peformance Error: < 30 %**
- **Divergence= Régression PE avec le temps: -4%.h^{-1} à 4%.h^{-1}**

Hara M et al . Brit J Anaesth 2017.





- **Cécité postopératoires**
  - **FDR : hypotension artérielle, saignement et durée d'intervention & compression oculaire**



ɔn sur les vaisseaux

:tournement)

Chang et al. Anesthesiology 2001.

	Groupe ST N= 48	Groupe contrôle N=58	p
Age (ans)	14 [12-21]	15 [12-22]	0,214
Poids (kg)	50 [11-120]	51 [37-83]	0,204
Taille (cm)	160 [80-184)	162,5 (141-189]	0,203
Nombre d'étages libérés	12 [7-21]	13 [7-15]	0,103
Durée de chirurgie (minutes)	260 (243-292)	297,5 (260-344,5)	<0,001
Durée induction (minutes)	25 [20-28,3]	30,6[24-35]	0,004
Durée anesthésie (minutes)	334,5 (308,8-361,5)	371 (341-430)	<0,001
Transfusion	0 (0)	5 (8,8%)	0,05
Durée de séjour	5 (4-7)	7,1 (5-10)	0,03

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Spine Team

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	Groupe ST N=38	Groupe contrôle N=13	p
Age (ans)	12 [7-19]	13 [8-17]	0,214
IMC	14,3 [11,1-18,5]	17,3 [15,6-19,2]	0,15
Nombre d'étages libérés	18 [15-21]	19 [7-22]	0,103
Durée de chirurgie (minutes)	338 [260-344,5]	416,3 [300-627]	0,002
Durée induction (minutes)	45 [37-54,8]	62,4 [44,5-73,5]	<0,001
Durée anesthésie (minutes)	443 (350-520)	530,4 (361-770)	<0,001
Transfusion	10 (28%)	7 (58%)	<0,01
Durée de séjour	6,9 (5-10)	9 (6-23)	0,07

Linear Association of the
Adjusted[a]Shaded areas re

