Supplementary material

An injectable, high-tough, biodegradable polyethylene glycol-based hydrogel for rapid sealing after dural breakage

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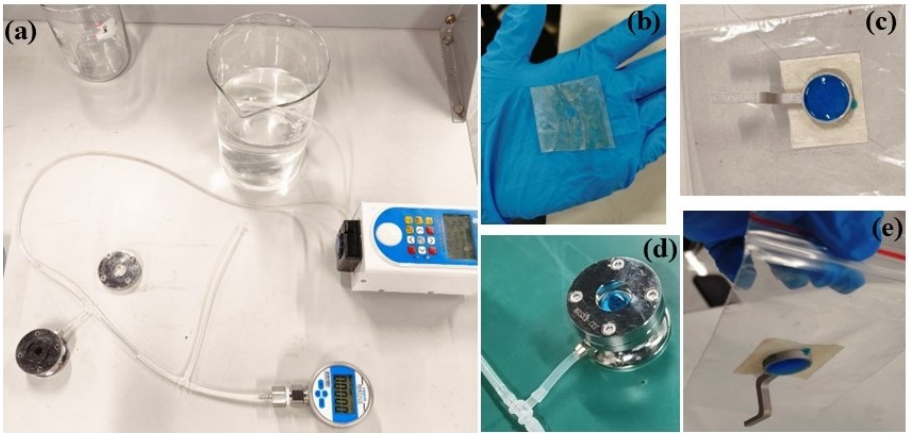

Figure S1. (a) Burst strength instruments; (b) Punching of casings; (c-e) Preparation of test samples

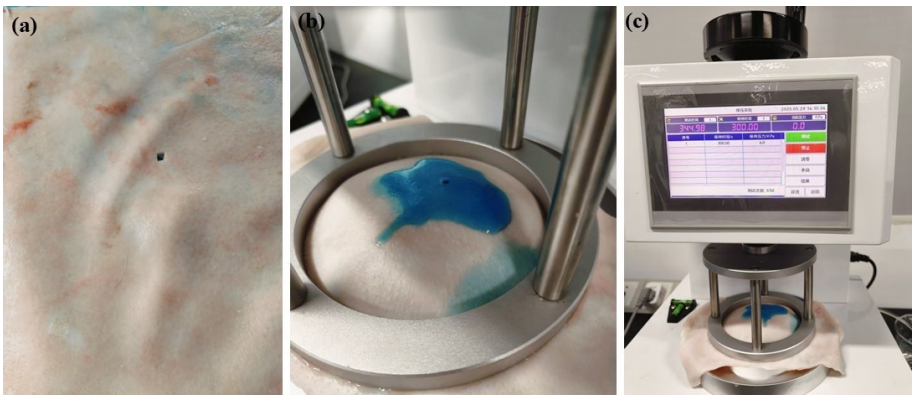

Figure S2. (a) Fresh pig rind holes; (b) Spraying of meningeal sealant on pig skin; (c) Meningeal sealant was exposed to a rapid stream of water (45 mmHg) to test adhesion properties as well as impermeability

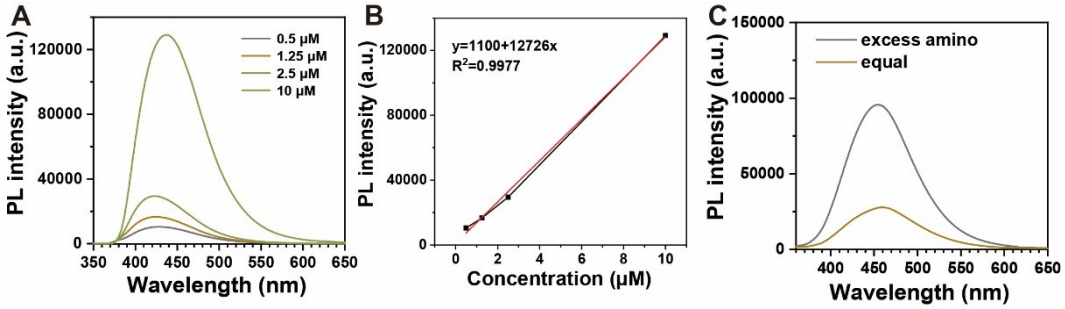

Figure S3. (A) The fluorescent emission curve following reaction with o-phthalaldehyde (OPA) at different tri-lysine concentrations; (B) Standard curve of fluorescence intensity corresponding to amine concentration; (C) Fluorescence emission curves of unreacted amine and OPA-reacted amine in hydrogel extracts at equivalent and excess amine reactant ratios

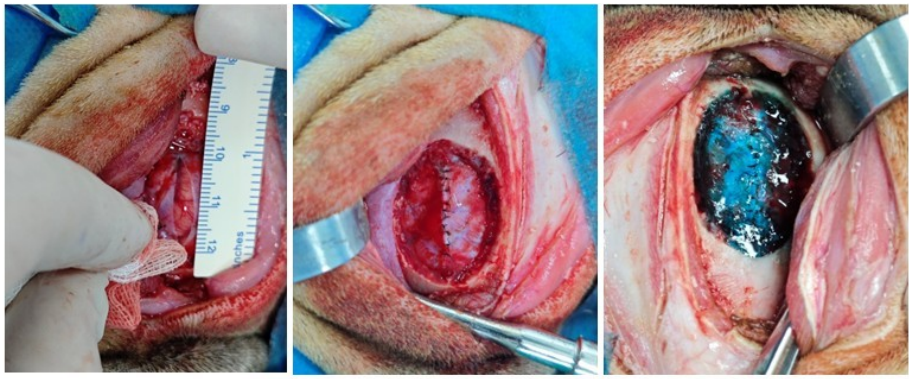

Figure S4 Beagle dog dural rupture model to establish surgical pictures

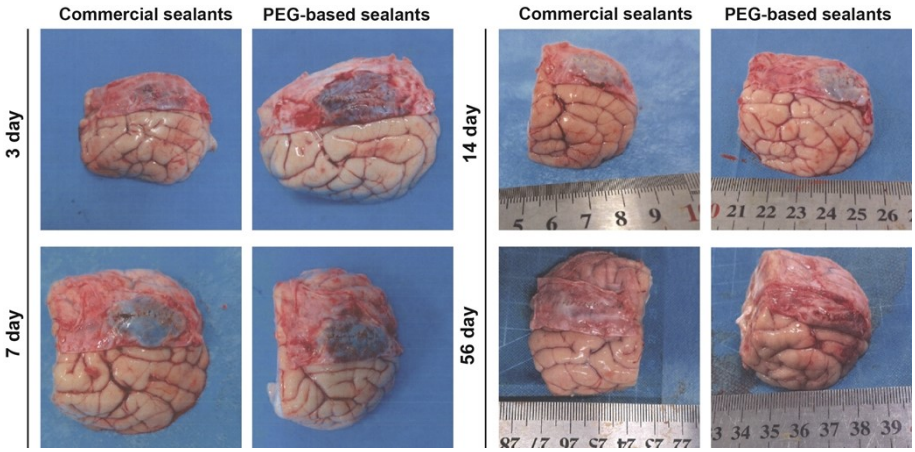

Figure S5. Beagle dog dural rupture model to establish surgical pictures

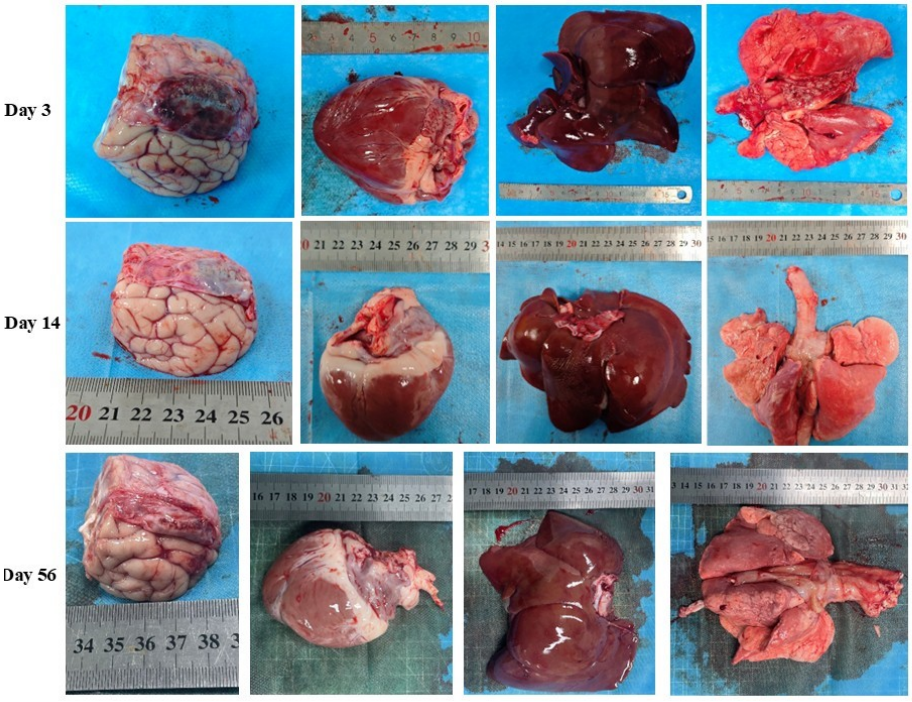

Figure S6. Anatomical pictures of the brain and major organs (heart, liver, lungs)

Table S1. Cerebrospinal fluid analysis results

Experiment	Period	Protein content (mg/mL)	PEG-based sealants	Control group	P value
Cortical Implantation	5 days	Mean (SD)	0.64 (0.10)	0.59 (0.05)	0.281
	15 days	Mean (SD)	0.97 (0.31)	0.97 (0.38)	0.980
Intraventricular Injection	5 days	Mean (SD)	0.56 (0.12)	0.72 (0.21)	0.209
	15 days	Mean (SD)	0.56 (0.14)	0.70 (0.21)	0.247
Cerebellar Medullary Injection	5 days	Mean (SD)	0.57 (0.10)	0.73 (0.23)	0.269
	15 days	Mean (SD)	0.84 (0.22)	0.93 (0.30)	0.656

Table S2 Cell viability in this work with commercial PEG-adhesives and recent reports on bioadhesive materials

Variety	Product name	Components	Cell type	Viability (%)	Ways of preparation	Reported by ref.
PEG-bioadhesive		PEG-SG, tri-lysine	L929 mouse fibroblasts	~75	0.2g mL^{-1} Leaching medium	In this work
Commercial adhesives	Coseal	PEG-SG, PEG-SH	Human intestinal epithelial cell line	~83	50 mg mL^{-1} Leaching medium	[1]
	Histoacryl	N-butyl-cyanoacrylate	Human intestinal epithelial cell line	~80	50 mg mL^{-1} Leaching medium	[1]
	BioGlue	BSA,glutaraldchyde	Human intestinal epithelial cell line	~40	Co-culture	[2]
PEG-adhesives in recent reports	Hybrid	Hyaluronic acid, PEG-SH	Human gastric cpithelial cells	~90	3D cell culture	[3]
	Tetra-PEG	PEG-SS, PEG-NH_2	3T3 mouse fibroblasts	~140	0.15g mL^{-1}	[4]
	OSS	PEG-SS, PEG-NH_2	Schwann Cells	~100	Hydrogel extracts	[5]
	PLGA/PEG	PLGA, PEG	L929 mouse fibroblasts	~90	10 mg mL^{-1} ISO10993-5	[6]

Table S3 Biodegradation comparison in this work with commercial PEG-adhesives and recent reports on bioadhesive materials

Variety	Product name	Components	Biodegradable period(days)	Reported by ref.
PEG-bioadhesive		PEG-SG, tri-lysine	~56	In this work
PEG-adhesives in recent reports	Coseal	PEG-SG, PEG-SH	~6	[2]
	DuraSeal	PEG-SG,tri-lysine	28-42	[7]
	Histoacryl	N-butyl-cyanoacrylate	Not degradable	[8]
	BioGlue	BSA,glutaraldehyde	Not degradable	[8]

Table S4 Adhesion comparison in this work with commercial PEG-adhesives and recent reports on bioadhesive materials

Variety	Product name	Components	Adhesion Strength (kPa)	Interfacial toughness (Jm^{-2})	Burst Strength (kPa)	Reported by ref.
PEG-bioadhesive		PEG-SG, tri-lysine	~15		~15	In this work
Commercial PEG-adhesives	Coseal	PEG-SG, PEG-SH	~25	NR	~2	[9]
PEG-adhesives in recent reports	Hybrid	Hyaluronic acid, PEG-SH	NR	~200	~16	[3]
	Tetra-PEG	PEG-SS, PEG-NH_2	~20	NR	~5	[4]
	OSS	PEG-SS, PEG-NH_2	~16	NR	NR	[10]
	PEG-PDA	PEG-SCM, PEG-NH_2, PDA	~19	NR	NR	[11]
	PLGA/PEG	PLGA, PEG	~4	NR	NR	[6]

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